Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Fiscal Year 2020 Annual Administrative Record

Prepared for:
U.S. Bureau of Reclamation
Albuquerque Area Office
555 Broadway Blvd. NE, #100
Albuquerque, New Mexico 87102

Prepared by:
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Acronyms and Abbreviations

AAR	Annual Administrative Record
AMWG	Adaptive Management Work Group
AM	adaptive management
BDD	Buckman Direct Diversion
BEMP	Bosque Ecosystem Monitoring Program
BO	biological opinion
CoA	City of Albuquerque
CEM	Conceptual Ecological Model
CPUE	Catch per unit effort
EC	Executive Committee
ESA	Endangered Species Act
FPC	Fiscal Planning Committee
FY	fiscal year
LTP	Long-Term Plan
MAT	Minnow Action Team
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MRG	Middle Rio Grande
MRGCD	Middle Rio Grande Conservancy District
MRGESCP/Collaborative Program/Program	Middle Rio Grande Endangered Species Collaborative Program
NMAGO	New Mexico Attorney General's Office
NMDGF	New Mexico Department of Game and Fish
NMISC	New Mexico Interstate Stream Commission
NMMJM	New Mexico meadow jumping mouse (*Zapus hudsonius luteus*)
PESU	Pecos sunflower (*Helianthus paradoxus*)
PMWG	Population Monitoring Work Group
PoI	Pueblo of Isleta
PoS	Pueblo of Sandia
PoSA	Pueblo of Santa Ana
PST	Program Support Team
Reclamation	U.S. Bureau of Reclamation
RGSM	Rio Grande silvery minnow (*Hybognathus amarus*)
S&AM Plan	Science and Adaptive Management Plan
SAMC	Science and Adaptive Management Committee
ScW/HR	Science and Habitat Restoration Work Group
SOW	scope of work
SWFL	southwestern willow flycatcher (*Empidonax traillii extimus*)
UNM	University of New Mexico
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WEST, Inc.	Western Ecosystems Technology, Inc.
YBCU	Yellow-billed cuckoo (*Coccyzus americanus*)

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PREPARING THE FY20 ANNUAL ADMINISTRATIVE RECORD

The Fiscal Year 2020 (FY20) Annual Administrative Record (AAR) is a compilation of materials from the public meetings of the Middle Rio Grande Endangered Species Collaborative Program (MRGESCP/Collaborative Program/Program). The FY20 AAR includes materials from public meetings that took place between October 1, 2019 and September 30, 2020.

The FY20 AAR includes the following types of documents generated for public meetings of the Collaborative Program Executive Committee (EC), Fiscal Planning Committee (FPC), Population Monitoring Work Group (PMWG), and Science and Habitat Restoration Work Group (ScW/HR):

1. Approved meeting agendas
2. Approved summary meeting minutes
3. Meeting read-aheads
4. Meeting presentations

This record includes all draft documents associated with public Program meetings in order to track the development of Program work products. Final documents are available on the Program Portal. This record does not include correspondences between Collaborative Program members or scopes of work (SOWs).

EXECUTIVE COMMITTEE MEETINGS

February 10, 2020

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

- *Middle Rio Grande Endangered Species Collaborative Program Draft 2020 Work Plan [draft, spreadsheet]*
- *Draft Middle Rio Grande Endangered Species Collaborative Program Population Monitoring Work Group 2020 Work Plan [draft]*
- *Draft Science and Habitat Restoration Work Group 2020 Work Plan [draft]*
- *Draft Middle Rio Grande Endangered Species Collaborative Program Structure [draft]*
- *Middle Rio Grande Endangered Species Collaborative Program Newsletter February 2020*
- *Charter for Fiscal Planning Committee of the Middle Rio Grande Endangered Species Collaborative Program*
- *Middle Rio Grande Endangered Species Collaborative Program Adaptive Management Work Group Update [presentation]*
- *Middle Rio Grande Endangered Species Collaborative Program Cost Share Report*
- *Draft Middle Rio Grande Endangered Species Collaborative Program Letter of Support for U.S. Army Corps of Engineers [draft]*
- *Science and Habitat Restoration Work Group Project Descriptions*

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

EXECUTIVE COMMITTEE MEETING
February 10, 2020 1:30 PM – 4:30 PM

Location: U.S. Army Corps of Engineers Albuquerque District
4101 Jefferson Plaza NE, Albuquerque, NM 87109

Call-in Information:
800-369-1174; passcode 26034

MEETING AGENDA

1:20 – 1:30 **Arrival**

1:30 – 1:40 **Welcome and Introductions** *Co-Chairs*

- Agenda review

➢ **Decision**: Approval of February 10, 2020 meeting agenda

1:40 – 1:50 **Past Meeting Minutes** *Co-Chairs*

- Action items from the September 2019 meeting

Read-ahead:

☐ September 2019 Meeting Summary

➢ **Decision**: Approval of September 2019 Meeting Summary

1:50 – 2:00 **Program Manager Update** *Program Support Team (PST)*

- Staffing update
- Newsletter
- Cost share report

Read-aheads:

☐ February 2020 MRGESCP Newsletter
☐ FY19 Cost Share Report

2:00 – 2:15 **2020 MRGESCP Work Plan Review** *PST*

Read-aheads:

☐ Draft 2020 MRGESCP Work Plan

➢ **Decision**: Approval of the 2020 Work Plan

2:15 – 2:30 **Fiscal Planning Committee (FPC) Update** *PST*

- Letter of support for U.S. Army Corps of Engineers' (USACE) MRGESCP budget
- FPC charter amendment requests

Read-aheads:

☐ Letter of Support to USACE
☐ FPC Charter

➢ **Action Item**: Next steps on the Letter of Support
➢ **Decision**: FPC charter amendments

2:30 – 2:55 **Adaptive Management Work Group (AMWG) Update** *PST*

- Presentation: AMWG Update
- Conversation on program structure
- Next steps on AM process

Read-aheads:

- ☐ Program structure

➢ **Decision**: Approval of Long-term Programmatic Goals

2:55 – 3:05 **Break**

3:05 – 3:25 **Science/Habitat Restoration Work Group (ScW/HR) Update** *ScW/HR Co-chairs*

- 2020 Work Plan
- Project descriptions
  - Soil Moisture Holding Capacity Study
  - Evaluation of Yellow-billed Cuckoo Prey and Associated Host Plants
  - An Analysis of Overbank Flow and Its Relationship with Southwestern Willow Flycatcher and Yellow-billed Cuckoo Territory Selection
  - An Evaluation of Aerial Imagery and Southwestern Willow Flycatcher and Yellow-billed Cuckoo Habitat

Read-aheads:

- ☐ Draft 2020 ScW/HR Work Plan
- ☐ Project descriptions

➢ **Decision**: Approval of the ScW/HR project descriptions for submittal to signatories with funding by the April 2020 deadline

➢ **Decision**: Approval of the 2020 ScW/HR Work Plan

3:25 – 3:40 **Population Monitoring Work Group (PMWG) Update** *Debbie Lee, PST*

- 2020 Work Plan

Read-ahead:

- ☐ Draft 2020 PMWG Work Plan

➢ **Decision**: Approval of the 2020 PMWG Work Plan

3:40 – 4:00 **Buckman Direct Diversion (BDD) Membership Request** *Rick Carpenter, BDD*

- Presentation from BDD
- Questions from Executive Committee

4:00 – 4:10 **Hydrology Update**

4:10 – 4:15 **Announcements**

4:15 – 4:25 **Public Comment**

4:25 – 4:30 **Action Items and Next Steps** *Co-Chairs*

- Action Item Review

➢ Next EC meeting date: May 2020

4:30 **Adjourn**

A closed door session of only Executive Committee members will follow to discuss and vote on the BDD membership request.

Middle Rio Grande Endangered Species Collaborative Program

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Executive Committee (EC)
Meeting Minutes

February 10, 2019; 1:30 PM–4:30 PM
Location: U.S. Army Corps of Engineers Albuquerque District
4101 Jefferson Plaza NE, Albuquerque, NM 87109

Decisions:

- ➢ Approval of February 10, 2020 EC meeting agenda with the following amendments:
  - o Move the hydrology update to earlier in the meeting
  - o Add a decision point for approval of the long-term Program goals
- ✓ Approval of September 16, 2019 EC meeting summary
- ✓ Approval of 2020 Middle Rio Grande Endangered Species Collaborative Program (MRGESCP or Program) Work Plan with the caveat that it will be accelerated whenever possible and is open for amendments as the Program structure evolves
- ✓ Approval of Letter of Support for U.S. Army Corps of Engineers' (USACE) MRGESCP budget being signed by the nonfederal co-chair and sent to the New Mexico Congressional Delegation pending the announcement of USACE's FY21 budget
- ✓ Approval of amending the Fiscal Planning Committee (FPC) charter to include the addition of non-federal and federal co-chairs
- ✓ Approval of the long-term Program goals with the following amendments:
  - o Include the listing status for each species
  - o Spell out all of the acronyms
  - o Revise goal statement B to read "recovery unit goals"
- ✓ Approval of Science/Habitat Restoration Work Group (ScW/HR) project descriptions for submittal to signatories with funding by the April 2020 deadline
- ✓ Approval of the 2020 ScW/HR Work Plan with addition of a plan for sunsetting the work group and moving towards the Science and Technical Network (STN)
- ✓ Approval of the 2020 Population Monitoring Work Group (PMWG) Work Plan
- ✓ Approval of the Buckman Direct Diversion (BDD) membership request

Action Items:

WHO	ACTION ITEM	BY WHEN
EC Co-chairs and PST	Discuss a communication process between the co-chairs and the rest of the EC members	02/20/2020
PST	Revise the letter of support for USACE, and send it to the non-federal co-chair to sign	02/12/2020
John Stomp	Send to letter of support to the New Mexico Congressional Delegation pending the announcement of USACE's FY21 budget	TBD

PST	Amend the composition of the FPC's charter to include federal and non-federal co-chairs, and put appointment of co-chairs on the agenda for the next FPC meeting	TBD
AMWG	Review the lower half of the proposed Program structure and add detail where necessary for EC review and approval	May 2020
PST	Suggest that the Soil Moisture Holding Capacity Study Scope of Work (SOW) writing group consider including an option for lowering the surface aggregation to be closer to the water table	TBD
ScW/HR	Provide a short document explaining how the ScW/HR's functions and tasks will exist within the 2020 MRGESCP Work Plan	March 2020
PMWG	Provide a short document explaining how the PMWG's functions and tasks will exist within the 2020 MRGESCP Work Plan	02/26/2020
BDD	Presentation from BDD explaining its Biological Opinion	May 18, 2020

Next Meeting: May 18, 2020, 1:30—4:30; location TBD

Meeting Summary

Welcome and Introductions

Ground rules
Agenda Review

The EC co-chairs, John Stomp, Albuquerque Bernalillo County Water Utility Authority (ABCWUA), and Brent Esplin, U.S. Bureau of Reclamation, called the meeting to order, covered ground rules, and initiated introductions. The agenda was reviewed and amendments were requested. The Hydrology Update was moved up in the schedule. A decision on Long-Term Programmatic Goals was added to the meeting agenda. The agenda was approved with amendments.

- **Decision**: Approval of February 10, 2020 meeting agenda by the EC

Past Meeting Minutes

Action items from the September 2019 meeting

September 2019 meeting minutes, decisions, and action items were approved with no comments by EC members.

- **Decision**: Approval of September 2019 meeting minutes by the EC

Program Manager Update

Staffing update
Newsletter
Cost share report

Debbie Lee, Program Manager, Program Support Team (PST), presented the February Newsletter. There were no species updates for the birds or the New Mexico Meadow Jumping Mouse. She noted that Fiscal Year 2019 (FY19) Annual Report write-ups are due to the PST by February 27, 2020, and that the new Program Portal launched in December.

Clayton Derby, PST, gave a staffing update:

- Michelle Tuineau, Project Assistant, joined the team
- Ashley Tanner will be leaving
- Dr. Catherine Murphy begins February 24, 2020 as the new Senior Science Coordinator
- Shay Howlin will continue working with the PMWG
- Kevin McDonnel will continue working with the PMWG and AMWG

An EC representative questioned why the EC was not consulted on the Science Coordinator hiring process. The PST stated that in the past, the hiring process for the Program Manager included EC input, and the hiring process for the Science Coordinator did not. As part of the hiring process for the Science

Coordinator, the PST reached out to both EC co-chairs prior to making an offer, and neither raised any concerns. The co-chairs agreed to discuss a communication process between the EC co-chairs and the rest of the EC.

- **Action item:** The PST and the EC will discuss a communication process between the co-chairs and the rest of the EC members

Julie Dickey, PST, presented the Program's cost share report for FY19. She stated that the non-federal cost share was met at 74.7%, and has been met at 40% over the entire life of the Program. An EC representative asked if the cost share report goes any higher within federal or non-federal signatories. In response, the EC was informed that the report does not go higher than the region.

Hydrology Update

Page Pegram, NMISC, and David Gensler, Middle Rio Grande Conservancy District (MRGCD), gave the hydrology update. They stated that New Mexico is in a debit situation of about 38,000 ac-ft. That water is required to be maintained upstream, primarily in El Vado Reservoir, under restrictions set forth by the Rio Grande Compact. New Mexico expects that a request will occur for to be water be released, beginning in November. The Elephant Butte Reservoir is low despite 2019 being a high water year. New Mexico had a compact debit in 2019 because the year had a high snowpack runoff; that means the State has a larger water obligation for Compact deliveries.

2020 MRGESCP Work Plan Review

Debbie L. presented the 2020 MRGESCP work plan and the EC members discussed the proposed implementation of the Long-Term Science and Adaptive Management Plan by January 2021. The EC agreed that the plan should be sped up wherever possible. The members also agreed that the work plan should be open to amendments as the structure of the Program evolves.

- **Decision:** EC approval of 2020 Middle Rio Grande Endangered Species Collaborative Program (MRGESCP or Program) Work Plan with the caveat that it will be accelerated whenever possible and is open for amendments as the Program structure evolves

Fiscal Planning Committee (FPC) Update

Letter of support for U.S. Army Corps of Engineers' (USACE) MRGESCP budget

Julie D. informed the EC that the FPC met and agreed on presenting a letter of support for the U.S. Army Corps of Engineers' (USACE) to the EC. The intent of the letter is to request reinstatement of the previous funding amount for the Program. During the conversation, a few members observed that sending a letter would bring attention to USACE's participation in the Program, which could be either positive or negative. One EC representative said the letter should appropriately be addressed to the New Mexico Congressional Delegation. It was noted that USACE is finalizing its 2021 budget, which may lead to reinstatement of Program funding, in which case the letter would not be necessary. The EC members agreed to approve the letter being signed by the non-federal co-chair and sent to the New Mexico Congressional Delegation pending announcement of USACE's 2021 budget.

- **Decision:** EC approval of Letter of Support for U.S. Army Corps of Engineers' (USACE) MRGESCP budget being signed by the nonfederal co-chair and sent to the New Mexico Congressional Delegation pending the announcement of USACE's FY21 budget
- **Action item:** The PST will revise the letter of support for USACE, and send it to the non-federal co-chair, John Stomp, to sign
- **Action item:** John Stomp will send the letter of support to the New Mexico Congressional Delegation pending the announcement of USACE's FY21 budget

FPC charter amendment requests

The PST requested an amendment to the FPC charter that would add a federal and non-federal co-chair. The EC approved the amendment. The PST will amend the composition of the charter and take it to the next FPC meeting.

- **Decision**: EC approval of amending the Fiscal Planning Committee (FPC) charter to include the addition of non-federal and federal co-chairs
- **Action item**: The PST will amend the composition of the FPC's charter to include federal and non-federal co-chairs, and put appointment of co-chairs on the agenda for the next FPC meeting

Work Group Updates

Adaptive Management Work Group

Presentation: AMWG Update

Ashley Tanner, Deputy Science Coordinator, PST, presented a PowerPoint on the long-term goals developed by the AMWG and walked the EC through an example of how the goals would inform the direction of the work being done in the Program down to the project-development level.

During the conversation that followed, one member questioned the attainability of the goals given that the Rio Grande silvery Minnow is unlikely to ever be delisted from the endangered species list, and requested that this be discussed at a future meeting. Other representatives believe the goals are lofty but meant to be strived for. One member noted that not having approved goals would slow down the Program's work plan. In response to some confusion around Goal B, a participant suggested revising the language to read "recovery unit goals" in place of "recovery unit." Another participant suggested the acronyms be spelled out for clarity and species status be included.

- **Decision:** EC approval of the long-term Program goals with the following amendments:
    - Include the listing status for each species
    - Spell out all of the acronyms
    - Revise goal statement B to read "recovery unit goals"

Conversation on program structure

The EC members discussed the new Program structure. Although the top half of the proposed cycle was agreed upon, the lower half was meant to be further developed by the AMWG. One representative asked

for revisions to the Program structure graphic and narrative to include more details. The EC agreed that the AMWG should revise the lower half of the structure and add detail where necessary.

- **Action:** The AMWG will review the lower half of the proposed Program structure and add detail where necessary for EC review and approval

Science/Habitat Restoration Work Group

2020 ScW/HR Work Plan

Kate Mendoza, ABCWUA and ScW/HR co-chair, presented the 2020 ScW/HR Work Plan to the EC. The representatives asked that the work plan include a plan to move towards the Science and Technical Network.

- **Decision:** EC approval of the 2020 ScW/HR Work Plan with addition of a plan for sunsetting the work group and moving towards the Science and Technical Network (STN)
- **Action:** The ScW/HR will provide a short document explaining how the ScW/HR's functions and tasks will exist within the 2020 MRGESCP Work Plan

Project Descriptions

Vicky Ryan (U.S. Fish and Wildlife Service, USFWS) presented four projects descriptions:

1. Soil Moisture Holding Capacity Study
2. Evaluation of Yellow-billed Cuckoo Prey and Associated Host Plants
3. An Analysis of Overbank Flow and Its Relationship with Southwestern Willow Flycatcher and Yellow-billed Cuckoo Territory Selection
4. An Evaluation of Aerial Imagery and Southwestern Willow Flycatcher and Yellow-billed Cuckoo Habitat

One representative suggested that the Soil Moisture Holding Capacity Study include an option for lowering the surface aggregation to be closer to the water table. In response to a question from a meeting participant, the PST confirmed that the project descriptions specified linkages to the USACE contract to develop critical uncertainties.

- **Decision:** EC approval of the ScW/HR project descriptions for submittal to signatories with funding by the April 2020 deadline
- **Action:** The PST will suggest that the Soil Moisture Holding Capacity Study Scope of Work (SOW) writing group consider including an option for lowering the surface aggregation to be closer to the water table

Population Monitoring Work Group

2020 PMWG Work Plan

Debbie L. presented the 2020 PMWG Work Plan to the EC. The EC requested that the work group prepare a document that explains how it will transition to the new Program structure and operate under adaptive management.

- **Decision:** EC approval of the 2020 PMWG Work Plan

- **Action:** The PWMG will provide a short document explaining how the PMWG's functions and tasks will exist within the 2020 MRGESCP Work Plan

Buckman Direct Diversion (BDD) Membership Request

Questions from Executive Committee (EC)

Presentation from BDD

Kyle Harwood, representing BDD, explained that the BDD board approved requesting full membership to the Program. BDD has been attending Program meetings since 2011 as a wing of the New Mexico Interstate Stream Commission (NMISC).

Questions from Executive Committee (EC)

An EC representative asked why the BDD would want to be involved in the Program when it does not see any of the endangered species of interest.

- Kyle stated that BDD is a diverter on the main stem and must account for effects on species in accordance with diversion permits

An EC representative asked if BDD would prepare a presentation for the EC on their Biological Opinion (BO).

- Kyle agreed to develop a presentation on BDD's BO.

Following the end of the meeting, the EC met in a closed-door executive session to vote on the BDD membership request.

- **Decision:** EC approval of BDD Membership Request
- **Action:** Presentation from BDD explaining its Biological Opinion

Announcements

- It is likely co-chair Brent Esplin's last meeting, and Wayne Pullan, the new Deputy Regional Director for the U.S. Bureau of Reclamation, will be taking over as federal co-chair
- Susan Millsap left the U.S. Fish and Wildlife Service (USFWS) , and Seth Willey, the acting Ecological Services Field Office Supervisor, will take her place on the EC
- David Campbell is retiring from USFWS in April and will be leaving the EC
- Matthew Peterson is leaving the City of Albuquerque Open Space and Colleen Langan-McRoberts will take over as the City's EC representative until an appropriate replacement is chosen
- Trevor Birt is a new employee at NMISC and he will be working with Grace Haggerty
- The 2020 BEMP Crawford Symposium will be March 11
- Kim Eichhorst announced that BEMP has hired an interim director, Greg Dyson
- Jennifer Faler stated that she researched the level of effort to determine administrative costs related to the Program and the 2016 BO, and it will be relatively easy to acquire the costs

Public Comment

There was no public comment.

Action Items and Next Steps

Action Item Review

- **Next EC meeting date:** May 18 2020, 1:30 - 4:30
- **Action item:** The PST will distribute follow-up meeting materials and presentations.

Adjourn

Meeting Participants

Participant	Organization
Debbie Lee	Western EcoSystems Technology, Inc.
Brent Esplin	U.S. Bureau of Reclamation
John Stomp	Albuquerque Bernalillo County Water Utility Authority
Clayton Derby	Western EcoSystems Technology, Inc.
David Campbell	U.S. Fish and Wildlife Service
Matthew Wunder	New Mexico Department of Game & Fish
Janet Jarratt	Assessment Payers Association of the Middle Rio Grande Conservancy District
Cody Walker	Pueblo of Isleta
Kim Eichhorst	Bosque Ecosystem Monitoring Program
Jennifer Faler	U.S. Bureau of Reclamation
Ashley Tanner	Western EcoSystems Technology, Inc.
Page Pegram	New Mexico Interstate Stream Commission
Nathan Schroeder	Pueblo of Santa Ana
LTC Dale Caswell	U.S. Army Corps of Engineers
Anne Marken	Middle Rio Grande Conservancy District
Paul Tashjian	Audubon New Mexico
Bill Grantham	New Mexico Attorney General Environmental Protection Division
Lynette Giesen	U.S. Army Corps of Engineers
Trevor Stevens	U.S. Army Corps of Engineers
Chris Shaw	New Mexico Interstate Stream Commission
Kate Mendoza	Albuquerque Bernalillo County Water Utility Authority
Trevor Birt	New Mexico Interstate Stream Commission

Brenda McKenna	U.S. House of Representatives, Debra Haaland's Office
Grace Haggerty	New Mexico Interstate Stream Commission
Mike Marcus	Assessment Payers Association of the Middle Rio Grande Conservancy District
Kyle Harwood	Buckman Direct Diversion Board
Derek Jarner	Pueblo of Isleta
Jim Wilber	U.S. Bureau of Reclamation
Wayne Pullan	U.S. Bureau of Reclamation
Michael Porter	U.S. Army Corps of Engineers
Danielle Galloway	U.S. Army Corps of Engineers
Vicky Ryan	U.S. Fish and Wildlife Service
Julie Dickey	Western EcoSystems Technology, Inc.
Ryan Gronewold	U.S. Army Corps of Engineers
Tom Turner	University of New Mexico
Johana Estrada	Middle Rio Grande Conservancy District
David Gensler	Middle Rio Grande Conservancy District
Jim Wilber	U.S. Bureau of Reclamation
Megan Osborne	University of New Mexico
Michelle Tuineau	Western EcoSystems Technology, Inc.

Middle Rio Grande Endangered Species Collaborative Program (MRGESCP)
DRAFT 2020 Work Plan Overview

Task	Program Group	Deadline	Deliverable	Status	Notes	Completed Date
STRATEGIC PLANNING						
Complete the Program's Long-Term Plan (LTP)	EC & PST	September 2020	LTP	Pending	The LTP and the Adaptive Management (AM) Plan will be a combined document	
Finalize development of the MRGESCP's AM Process	AMWG & PST	November 2020	Integration of the MRGESCP's AM Process	Ongoing		
Implement the new MRGESCP structure as approved in 2018	EC & PST	September 2020	Revised and implemented MRGESCP structure	Ongoing		
Continue discussions related to the MRGESCP's goals and strategies	EC, AMWG & PST	June 2020	Program goals	Ongoing	Draft goals were developed by AMWG	
Revise by-laws as needed	By-laws & PST	December 2020	Updated By-Laws	Ongoing	Updates related to the new structure	
ANNUAL PLANNING						
Implement the MRGESCP 2020 Work Plan	MRGESCP & PST	Ongoing through 2020	Completed 2020 Annual Work Plan tasks	Ongoing		
Develop the MRGESCP 2021 Work Plan	MRGESCP & PST	November - December 2020	Finalized 2021 Annual Work Plan for implementation	Pending		
Implement the Science/Habitat Restoration Work Group (ScW/HR) 2020 Work Plan	ScW/HR & PST	Ongoing through 2020	Completed 2020 Annual Work Plan tasks	Ongoing		

Develop the ScW/HR 2021 Work Plan	ScW/HR & PST	November - December 2020	Finalized 2021 Annual Work Plan for implementation	Pending		
Implement the Population Monitoring Work Group (PMWG) 2020 Work Plan	PMWG & PST	Ongoing through 2020	Completed 2020 Annual Work Plan tasks	Ongoing		
Develop the PMWG 2021 Work Plan	PMWG & PST	November 2020	Finalized 2021 Annual Work Plan for implementation	Pending		
ADMINISTRATION & REPORTING						
Annual Report						
Prepare first draft FY19 Annual Report for Program review	MRGESCP & PST	May 2020	Draft FY19 Annual Report for review	Ongoing	Signatories send FY19 write-ups to the PST	
Finalize and approve FY19 Annual Report	EC & PST	August 2020	Finalized FY19 Annual Report	Pending		
Begin preparing for the first draft FY20 Annual Report	MRGESCP & PST	October 2020	Signatory coordination	Pending	Signatory's send FY20 write-ups to WEST	
Cost-Share						
Report FY19 Non-Federal Signatory Cost-Share	Non-Feds & PST	February 2020	Cost Share Report	Ongoing	Report to EC at February 2020 meeting	
Report FY20 Non-Federal Signatory Cost-Share	Non-Feds & PST	August 2020	Cost Share Report	Pending	Signatories report to PST by November 2020	
Program Portal (Formerly DBMS)						
Maintain and Update Program Portal	MRGESCP & PST	December 2020	Operational Program Portal for MRGESCP use	Ongoing	Site was launched December 2019. PST will work with Program signatories and USGS to develop additional content, and update as needed	
ENGAGEMENT & OUTREACH						

Science Symposium						
Hold targeted science workshop(s) on specific topics relevant to MRGESCP activities and planning	MRGESCP & PST	December 2020	Science Workshops	Ongoing	Topics TBD	

Middle Rio Grande Endangered Species Collaborative Program
Draft 2020 Work Plan

X Meetings
X Potential Meetings
X Deadlines

	Program Group	January	February	March	April	May	June	July	August	September	October	November	December
Meetings													
Executive Committee (EC) meetings	EC		X			X				X			X
Adaptive Management Work Group (AMWG)	AMWG		X	X	X	X	X	X	X	X	X	X	
Science and Habitat Restoration Work Group (ScW/HR)/Science and Technical Network (STN)	ScW/HR & STN	X	X	X	X	X	X	X	X	X	X	X	
Population Monitoring Work Group (PMWG)	PMWG		X			X			X			X	
River Action Team (RAT)	RAT		X	X	X	X							
Fiscal Planning Committee (FPC) meetings	FPC					X	X			X			
By-laws ad hoc group (By-laws) meetings	By-laws			X	X	X	X	X	X	X			
Science and Adaptive Management Committee	SAMC								X		X		X
Long-Term Plan (LTP)													
Develop a conceptual outline of the LTP	PST & AMWG	2019											
Complete incorportation of material from former	PST	X											
Approve Program goals	EC		X										
Complete Program activity tracking project (tie into	PST				X								
Complete development of Program strategies to	AMWG				X								
Update the EC on strategies to achieve Program goals	AMWG					X							
Complete Operational Space section	PST & AMWG						X						
Provide progress report to the EC	PST & AMWG									X			
Complete Introduction and Executive Summary	PST & AMWG										X		
Complete Reach Plans	AMWG										X		
LTP to EC for review and approval at December 2020	AMWG/EC											X	
Present on the full at the EC	PST & AMWG												X
Implementation of the LTP	EC												2021
MRGESCP's Science & Adaptive Management Process													
Complete conceptual ecological models (CEMs) for southwestern willow flycatcher (SWFL) and yellow-	ScW/HR		X										
Complete Draft Science and Adaptive Management	PST & AMWG				X								

	Program Group	January	February	March	April	May	June	July	August	September	October	November	Dece
Complete development of prioritization process for	ScW/HR					X							
Finish CEM for RGSM	ScW/HR					X							
Complete development of CEMs for New Mexico meadow jumping mouse (NMMJM) and Pecos	PST						X						
Develop list of uncertainties for SWFL, YBCU, and Rio	ScW/HR						X						
Develop a system-wide CEM	PST &							X					
Develop list of uncertainties for NMMJM and PESU	PST &							X					
Implement the prioritization process for the identified uncertainties; identify the first round of uncertainties	ScW/HR								X				
Plan for Independent Science Panel (ISP) and Peer Review													
Complete development of a peer review process	ScW/HR &				X								
EC approval to convene an ISP to review key Program documents (e.g. CEMs, critical uncertainties, LTP,	EC					X							
By-laws													
Finalize Work Groups section	By-laws			X									
Finalize Executive Committee section	By-laws					X							
Finalize Program Support Team section	By-laws					X							
Finalize Science and Adaptive Management	By-laws							X					
Finalize Organization section	By-laws								X				
Finalize Definitions	By-laws								X				
Revised MRGESCP By-laws to EC for approval and	By-laws									X			
Program Structure													
EC approval to transition ScW/HR to STN	EC/PST			X									
Approve charter for SAMC	EC							X					
EC decision on the composition of the SAMC	EC							X					
Convene the SAMC	SAMC								X				
Sunset AMWG	EC												X
RGSM Population Monitoring Work Group (Integrated Stock Assessment Model)													
Completion of RGSM Integrated Stock Asssessment	PMWG												X
Completion of data and methods documentation	PMWG												X
Begin drafting U.S. Geological Survey Open File Report	PMWG												X

	Program Group	January	February	March	April	May	June	July	August	September	October	November	Dece
Project Development													
Draft project descriptions to submit for signatory budget planning	ScW/HR		X										
Submit scopes of work (SOWs) to U.S. Bureau of Reclamation	PST				X								
Submit SOWs to U.S. Army Corps of Engineers	PST				X								
Submit SOWs to New Mexico Interstate Stream Commission	PST				X								
Submit SOWs to Middle Rio Grande Conservancy District	PST				X								
Submit SOWs to Albuquerque Bernalillo County Water Utility Authority	PST				X								
Complete full SOWs from EC approved project descriptions	ScW/HR								X				
EC approval of SOWs to FPC to identify funding opportunities (if needed)	ScW/HR									X			
Ongoing Program Administration													
Cost Share													
Report FY19 cost-share to the EC	PST		X										
Provide FY20 cost-share to PST	All signatories										X		
Report FY20 cost-share to Reclamation	PST											X	
Program Portal													
Incorporate RGSM population monitoring dataset onto Program Portal	PST					X							
Complete uploading of historic Program documents to the Portal	PST									X			
Annual Report													
FY19 Project write-ups to PST	All signatories		X										
Draft FY19 Annual Report out for Program review	PST				X								

	Program Group	January	February	March	April	May	June	July	August	September	October	November	Dece
Draft FY19 Annual Report comments to PST	All signatories						X						
Draft FY19 Annual Report to EC	PST								X				
EC approval of FY19 Annual Report	EC									X			
Project write-ups to PST for FY20	All											X	
Work Plans													
Approve and implement all 2020 Work Plans	EC		X										
Draft all work group and committee 2021 Work Plans	PST				X								
Approve and implement all 2021 Work Plans	EC												X

Middle Rio Grande Endangered Species Collaborative Program
Population Monitoring Work Group
2020 Work Plan

The Population Monitoring Work Group (PMWG) was tasked with providing technical review, focused assessment, and recommendations related to monitoring of fish populations in the Middle Rio Grande (MRG), as impacted by water management and river dynamics.

The PMWG plans to complete the following tasks in 2020:

Task	Subtasks	Target Completion Date
1. Integrate and prioritize recommendations from the science panels	a) Evaluate recent modifications to RGSM population monitoring program	Currently on hold with development of the RGSM Integrated Stock Assessment model
	b) Gear selectivity study	December 2020
	c) Track progress in addressing panel recommendations	Ongoing in 2020
2. Analyze RGSM data to support modeling efforts	a) Survival, age composition, recruitment, and other analyses as identified	December 2020
3. Develop and review a RGSM Integrated Stock Assessment Model		December 2020
4. Development of PMWG report(s)	a) Scientific report documenting the data and methods of the RGSM Integrated Stock Assessment Model	December 2020
	b) USGS Open File Report	Ongoing in 2020
5. Give a progress update to EC		December 2020/January 2021

These tasks support the completion of Task 2 under the original PMWG charge approved by the EC in May 2016.

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Science and Habitat Restoration Work Group
2020 Work Plan

PURPOSE:
Complete the Middle Rio Grande Endangered Species Collaborative Program (Program) Science and Habitat Restoration Work Group (ScW/HR) 2020 Work Plan as approved at the 1/9/2019 ScW/HR meeting.

TASKS AND MANAGEMENT/SCIENCE IMPLICATIONS:
The following tasks are not listed in any specific order. The numbering is intended for conversational reference.

1) **Develop Conceptual Ecological Models for the New Mexico Meadow Jumping Mouse (NMMJM), Pecos Sunflower (PESU), Rio Grande Silvery Minnow (RGSM), Southwest Willow Flycatcher (SWFL), and Yellow-billed Cuckoo (YBCU).**

In the fall of 2019, the Adaptive Management Work Group (AMWG) tasked the ScW/HR with developing conceptual ecological models for the five species encompassed within the Program. These models are intended to assist in the identification of knowledge gaps and subsequent formation of "critical uncertainties." By reducing critical uncertainties and filling knowledge gaps, the Program will be able to support managers in making more informed management decisions in the Middle Rio Grande (MRG). Utilizing subject matter experts, the ScW/HR will develop conceptual ecological models for the RGSM, SWFL, and YBCU by February 2020. Development of models for the NMMJM and PESU will begin by July 2020. All models will be presented to the AMWG.

2) **Identify and Prioritize Uncertainties Developed during the Conceptual Ecological Model Building Process**

The ScW/HR will identify uncertainties during the conceptual ecological model building process, prioritize those uncertainties, and identify overlap in uncertainties between species. By reducing critical uncertainties and filling knowledge gaps, the Program will be able to support managers in making more informed management decisions in the Middle Rio Grande (MRG). These uncertainties will drive project/scope of work (SOW) development each year. The ScW/HR will identify, asses, and prioritize uncertainties for the RGSM, SWFL, and YBCU starting in March 2020. The process by which uncertainties are developed and prioritized will be presented to the AMWG.

3) **Develop Fiscal Year (FY) 2021 Project/SOW Descriptions and Full SOWs for Executive Committee (EC) Consideration**

The ScW/HR will utilize uncertainties identified in the conceptual ecological model building process to develop project/SOW descriptions for EC review by April 2020. The ScW/HR will solicit and incorporate feedback as needed during the SOW writing process. Full SOWs will be presented to the EC for consideration by August 2020.

4) **Determine Priorities for 2021**

The ScW/HR will discuss and identify which uncertainties will be a focus of project/SOW development for 2021 starting in September 2020. Project/SOW development for 2021 will begin immediately after this task is complete.

5) **Consult as Needed with the AMWG**

The ScW/HR will continue to consult with the AMWG as needed to assist with Program planning and adaptive management (AM) moving forward.

6) **Continue Data Inventory and Consolidation Efforts**

The Program signatories have collected a large amount of data, including, but not limited to, endangered species population numbers, hydrology, water quality, and habitat restoration.

There is a need to inventory these data, and to consolidate datasets where possible. This will inform the Program's science and AM activities, and minimize duplicate efforts. Data inventory and consolidation will be a targeted and objective-driven effort, concentrating on specific datasets of interest to better meet the needs of the end data users. The ScW/HR will work with the U.S. Geological Survey (USGS) and those working to develop the Program Portal (formerly the Program's database management system [DBMS]) to ensure that all data consolidation efforts result in a dataset that can be uploaded onto the Program Portal.

7) **Continue Participation in Program Portal Maintenance and Updates**

The USGS developed and launched a new Program Portal in December 2019 to replace the Program's prior database management system (DBMS). This Program Portal will need to be responsive to the needs of the Program, including its scientists and technical experts. The ScW/HR will provide input to the USGS as needed. Overall, a Program Portal will help the Program organize, store, share, and ultimately better utilize data collected and reports written by its multiple stakeholders. These services may inspire scientific studies, provide data for scientific research, and allow managers to interact with resources needed to inform decisions.

The ScW/HR will assist the PST in developing future content for the Program Portal; ensuring relevant reports, papers, and other documents are included in the document library; and supporting the development of other digital resources.

7) **Participate in the Planning of the Science Symposium**

The Program's Science Symposium aims to improve science communication, inform SOW development, and assist in long-term planning. The ScW/HR will assist as needed in the planning process.

8) **Plan and Participate in Program Field Trips**

Field trips will provide members of the ScW/HR with experience-based learning opportunities, such as field visits to restoration sites, float trips down the river, lab tours, hatchery tours, and more. These trips will provide members with the opportunity to learn more about the breadth of work underway in the Middle Rio Grande.

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TASKS SCHEDULE:

Task	By Date
Complete CEMs for the RGSM, SWFL, and YBCU for presentation to the AMWG at the following meeting	February 2020
Begin to develop a process by which critical uncertainties can be prioritized, and present this process to the AMWG	March 2020
Begin to assess and prioritize critical uncertainties for the RGSM, SWFL, and YBCU	April 2020
Submit project/SOWs descriptions to the EC for review	March 2020
Begin developing conceptual ecological models for the NMMJM and PESU	July 2020
Submit finalized projects/SOWs to the EC for approval to move forward	August 2020
Discuss 2021 priorities and projects/SOW	September 2020
Plan field trip(s)	Duration of 2020
Consult with the AMWG to inform development of the Program's AM plan	As needed

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MEMBER ROSTER:

First Name	Last Name	Affiliation
Thomas	Archdeacon	U.S. Fish & Wildlife Service
Jonathan	AuBuchon	U.S. Army Corps of Engineers
Jennifer	Bachus	U.S. Bureau of Reclamation
Trevor	Birt	N.M. Interstate Stream Commission
Holly	Casman	City of Albuquerque, ABQ BioPark
Meaghan	Conway	New Mexico Department of Game and Fish
Katherine	Cordova	Bosque Ecosystem Monitoring Program
Clayton	Derby	Western Ecosystems Technology, Inc.
Julie	Dickey	Western Ecosystems Technology, Inc.
Kim	Eichhorst	Bosque Ecosystem Monitoring Program
Amy	Erickson	Audubon New Mexico
Kim	Fike	Bosque Ecosystem Monitoring Program
Danielle	Galloway	U.S. Army Corps of Engineers
Lynette	Giesen	U.S. Army Corps of Engineers
Eric	Gonzales	U.S. Bureau of Reclamation
Grace	Haggerty	New Mexico Interstate Stream Commission
Aubrey	Harris	U.S. Army Corps of Engineers
Chuck	Hayes	New Mexico Department of Game and Fish
Brian	Hobbs	U.S. Bureau of Reclamation
Monika (Mo)	Hobbs	Albuquerque Bernalillo County Water Utility Authority
Alison	Hutson	New Mexico Interstate Stream Commission
Kathy	Lang	City of Albuquerque
Debbie	Lee	Western Ecosystems Technology, Inc.
Joel	Lusk	U.S. Bureau of Reclamation
Shannon	Mann	Pueblo of Sandia
Mike	Marcus	Assessment Payers Association of the MRGCD
Anne	Marken	Middle Rio Grande Conservancy District
Yvette	McKenna	U.S. Bureau of Reclamation
Kate	Mendoza	Albuquerque Bernalillo County Water Utility Authority
Yasmeen	Najmi	Middle Rio Grande Conservancy District
Megan	Osborne	University of New Mexico
Robert	Padilla	U.S. Bureau of Reclamation

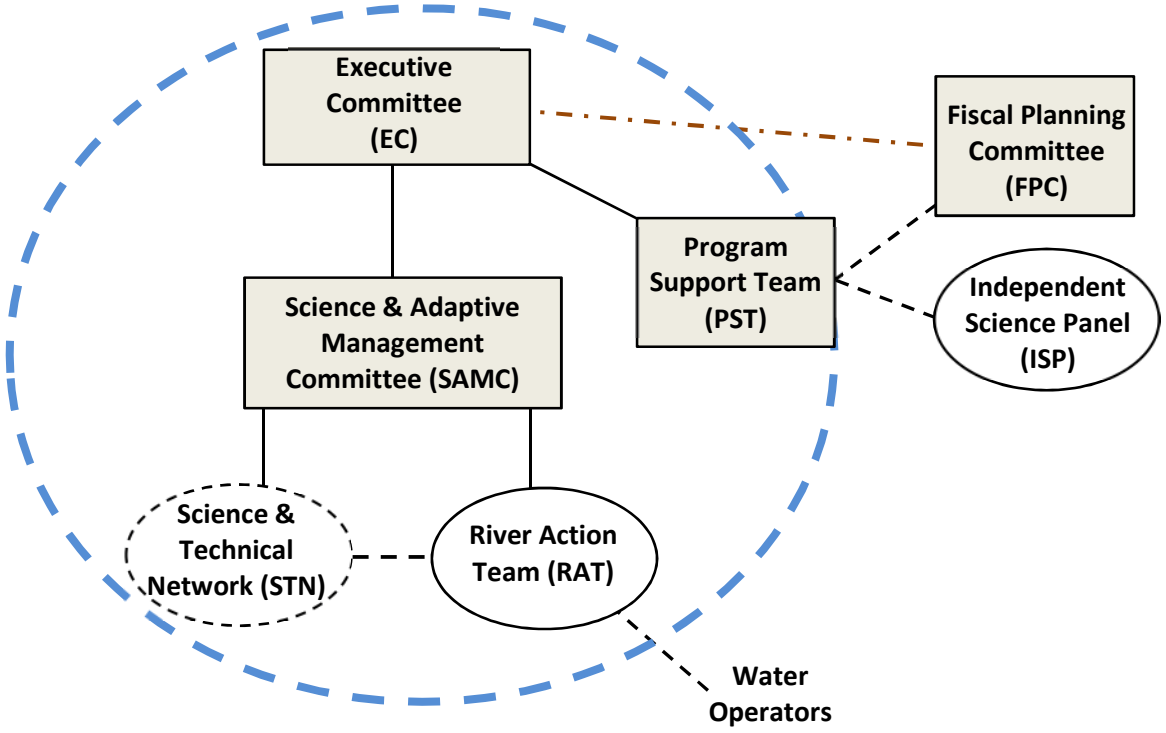
DRAFT

Kirk	Patten	NM Department of Game & Fish
Page	Pegram	NM Interstate Stream Commission
Matthew	Peterson	City of Albuquerque Open Space
Michael (Mick)	Porter	U.S. Army Corps of Engineers
Dana	Price	U.S. Army Corps of Engineers
Justin	Reale	U.S. Army Corps of Engineers, CESPA-DE
Ashlee	Rudolph	U.S. Bureau of Reclamation
Stephen	Ryan	U.S. Army Corps of Engineers
Vicky	Ryan	U.S. Fish & Wildlife Service
Jeff	Sanchez	U.S. Fish & Wildlife Service
Nathan	Schroeder	Pueblo of Santa Ana, DNR
Summer	Schulz	U.S. Army Corps of Engineers
Michael (Scial)	Scialdone	Pueblo of Sandia
Lauren	Sherson	U.S. Geological Survey
Clint	Smith	U.S. Fish & Wildlife Service
Dale	Strickland	Western Ecosystems Technology, Inc.
Kiara	Tackas	Western Ecosystems Technology, Inc.
Ashley	Tanner	Western Ecosystems Technology, Inc.
Douglas	Tave	Los Lunas Silvery Minnow Refugium
Cody	Walker	Pueblo of Isleta - Natural Resources Department, Water Resources Div.
Lori	Walton	U.S. Bureau of Reclamation
Kim	Ward	City of Albuquerque
Wade	Wilson	U.S Fish & Wildlife Service, Southwestern Native Aquatic Resources and Recovery Center
Ara	Winter	Bosque Ecosystem Monitoring Program
Leann	Woodruff	U.S. Bureau of Reclamation
Brooke	Wyman	Pueblo of Sandia

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MRGESCP Program Structure

The Middle Rio Grande Endangered Species Collaborative Program (MRGESCP) Executive Committee (EC) approved the following structure at the April 12, 2018 meeting. The By-laws ad hoc group was tasked with identifying the functions of and relationships between the Executive Committee (EC), Program Support Team (PST), Fiscal Planning Committee (FPC), and the Independent Science Panel (ISP). The Adaptive Management Workgroup (AMWG) was tasked with identifying the functions of and relationships between the Adaptive Management Committee (AMC), Science and Technical Network (STN), and the River Action Team (RAT).



PST Coordination

Group Communication

Program Recommendations

Direct Coordination

- Direction/Requests (top-down)
- Recommendations (bottom-up)

Meet at regular intervals

Convene as needed for specialized work

Subgroups meet with limited charge and timeline

MRGESCP Program Structure

Executive Committee (EC)

- ***Function***: Decision-making body of the MRGESCP
- ***Composition***:
    - One Federal Co-Chair, and one Non-Federal Co-Chair
    - Executive level signatory representatives
    - Each signatory appoints a primary and an alternate representative
- ***Meeting Frequency***: Quarterly meetings
- ***Roles***:
    - Provide direction/requests to Program committees, work groups, and the Program Support Team (PST)
    - Approve the Program's Long Term Plan and other documents (i.e. Annual Reports, Work Plans, Adaptive Management)
    - Makes recommendations to individual signatories or outside entities on behalf of the MRGESCP

Science & Adaptive Management Committee (SAMC)

- ***Function***: Coordinate Program science in support of related efforts in the Middle Rio Grande (MRG)
- ***Composition***:
    - Non-voting Chair: Senior Science Coordinator (PST)
    - Program Co-chairs: Federal & Non-federal
    - Membership TBD
- ***Meeting Frequency***: TBD
- ***Roles***:
    - Develop and maintain Long Term Plan and Triennial Work Plans
    - Provide direction to the Science and Technical Network to complete specific tasks (e.g. Scope of Work [SOW] development; specific task analysis; etc.)
    - Recommend topics to the EC for independent peer review panels
    - Coordinate with the Fiscal Planning Committee (FPC) on funding
    - Help coordinate presentation of results from Program activities

River Action Team (RAT)

- ***Function***: Provide short- and long-term forecasts and projections on the MRG to inform management decisions, water operations, and priority research areas
- ***Composition***:
    - Co-chairs
    - Signatory managers and technical experts based on topic
    - External experts as needed based on topic
- ***Meeting Frequency***: TBD
- ***Roles***:
    - Provide a specialized management-centric and technical review of MRGESCP work as needed with direction from the SAMC
    - Coordinate with the SAMC and the STN on answering questions regarding the future of the MRG ecosystem and watershed. For example:
        - Climate change
        - Vegetative cover
        - Water availability and projected needs

- Build on current hydrological and research programs in the MRG to better inform Program recommendations
- Coordinate to provide recommendations to the SAMC on annual water management and operations, and scientific and research studies
- Identify and provide research and monitoring priority recommendations to the SAMC
- Provide support for the adaptive management process
- Provide hydrology updates and forecasts to the EC

Program Support Team

- ***Function***: Coordinate and provide support for day-to-day and long-term MRGESCP needs
- ***Composition***:
  - Program Manager
  - Science Coordinator
  - Support staff
- ***Roles***:
  - Coordinate Program meetings and activities
  - Staff public outreach events on behalf of the Program
  - Maintain Program records and data on the Program Portal
  - Coordinate and provide support for Program initiatives including the Long Term Plan, Triennial Study Plan, Annual Work Plans and reports, developing and coordinating processes, facilitating and chairing meetings as requested, and other tasks as requested by the EC

Fiscal Planning Committee

- ***Function(s)***: Build a diverse financial support system for priority MRGESCP activities as set forth in the Long Term Plan
- ***Composition***:
  - Co-chairs: Federal and Non-federal
  - Signatory representatives appointed by EC representatives
  - PST coordination and point of contact

Meeting Frequency: Meets as needed to coordinate for various timelines

- ***Roles***:
  - Coordinate on Signatory funding capabilities (i.e. authorities, budget restraints, interests, deadlines) to support priority Program work
  - Identify and pursue additional funding sources (i.e. grants, appropriations) in support of funding Program-related activities, including coordinating messaging for these efforts
  - Identify other potential resources (i.e. partnerships, grants) to support Program-related project implementation
  - Coordinate with other Program committees and workgroups to achieve the FPC's purpose
  - Report and communicate requests to the EC on the pursuit of external funding and other resources to support Program activities

Science and Technical Network

- ***Function***: Provide task-specific scientific and technical expertise
- ***Composition***:
  - Selected based on expertise and interest
  - PST coordination

- ***Meeting Frequency***: Task groups meet at the direction of the EC and when a specific task, timeline, deliverables, and group composition have been identified
- ***Roles***: Roles are defined by the SAMC

MIDDLE RIO GRANDE ENDANGERED SPECIES COLLABORATIVE PROGRAM

Newsletter— February 2020

In This Issue

- 2016 Middle Rio Grande Biological Opinion Implementation Update
- Listed Species Updates
- Hydrology Update
- BDANWR Sediment Plug Circumvention Update

2019 Science Symposium

Provided by Debbie Lee, Program Support Team

Greetings and happy 2020!

The Program ended 2019 with a Science Symposium on December 3-4, 2019 at the Bosque Conference and Retreat Center in Albuquerque, NM. The symposium was a huge success! Over the two-day event, more than 85 attendees heard 36 presentations related to the Middle Rio Grande (MRG) ecosystem and its listed species. Representatives from each of the Program signatories opened the meeting with a lighting round of introductions, during which they gave brief descriptions of their organizations and their roles in the MRG and the Program.

Over lunch on the second day, Symposium attendees participated in one of three bosque walks. These walks were led by Chuck Hayes, NM Department of Game and Fish; Jon Hayes and Amy Erickson, Audubon New Mexico; and Bill Pentler, City of Albuquerque Open Space Division.

The feedback has been overwhelmingly positive, with many people noting that they enjoyed hearing about work that was outside their own field of expertise and discovering how that work might connect to their own. The conversations we had over those two days were rich and interesting. One of the Program's greatest strengths has always been its people, who are an incredible resource for developing partnerships and sharing information. The Symposium highlighted this attribute, and we are hopeful that the event will lead to more dialogue and partnerships that contribute to the exchange of information and ideas within the MRG. We look forward to seeing what comes in 2020!

Available presentations are posted on the Program Portal at https://webapps.usgs.gov/MRGESCP/symposium/detailed-agenda-and-abstracts.

Implementation of the Final Biological and Conference Opinion of Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico (2016 MRG BO)

Update provided by Brian Hobbs, U.S. Bureau of Reclamation

The U.S. Bureau of Reclamation (Reclamation), the U.S. Bureau of Indian Affairs, the Middle Rio Grande Conservancy District (MRGCD), and the New Mexico Interstate Stream Commission (NMISC) continue to implement requirements under the 2016 MRG BO. The following is a status update on some of the ongoing and completed projects.

Progress toward fish passage at the San Acacia Diversion Dam (SADD) and the Isleta Diversion Dam continues. For the long-term fish passage project at SADD, alternatives have been evaluated and a request for proposals to conduct the NEPA process has been issued. Isleta Pueblo's contractor is incorporating sediment analysis into an alternatives report which will consider fish passage in conjunction with improvements to sediment management at the dam. Fish movement using PIT-tagged Rio Grande silvery minnow (RGSM) is currently being studied by NMISC and Reclamation. Reclamation released nearly 10,000 PIT-tagged RGSM in November 2019 above and below the SADD. Antennas were placed above SADD, and Utah State University researchers have been floating the river to get tag returns.

In the spring of 2019, Reclamation and NMISC collaborated to develop and use a standardized monitoring protocol at eight habitat restoration sites below SADD. Reclamation and NMISC intend to use the results to inform site-specific adaptive management decisions in 2020. One goal of standardizing protocols is to eventually allow for comparison across sites and between reaches of the MRG.

During the summer of 2019, a plug formed in the river at the same location on Bosque del Apache National Wildlife Refuge (NWR) as in 2008 and 2017. Reclamation received the 404 permit from the U.S. Army Corps of Engineers (USACE) for the pilot realignment project and began work to open the inlet and outlet of the realignment so that water could be delivered as effectively as possible. Work continues within the 300-foot realignment corridor to widen the excavated areas and move spoiled sediment to the old river channel.

Rio Grande Silvery Minnow

Update provided by Eric Gonzales, U.S. Bureau of Reclamation

The Rio Grande silvery minnow (RGSM; *Hybognathus amarus*) was formerly one of the most widespread and abundant species in the Rio Grande Basin of New Mexico, Texas, and Mexico but is now listed as endangered (USFWS, 1994). Currently, the RGSM occupies less than 10 percent of its historic range and is restricted to the reach of the Rio Grande in central New Mexico from Cochiti Dam to the headwaters of Elephant Butte Reservoir.

Studies of long-term trends of RGSM abundance have generally used October catch per unit effort (CPUE) data from the species population monitoring project. Monitoring has occurred annually since 1993, with the exception of 1998 when no monitoring for the species occurred. Survey methods are standardized and the same sites have been consistently monitored since the project began.

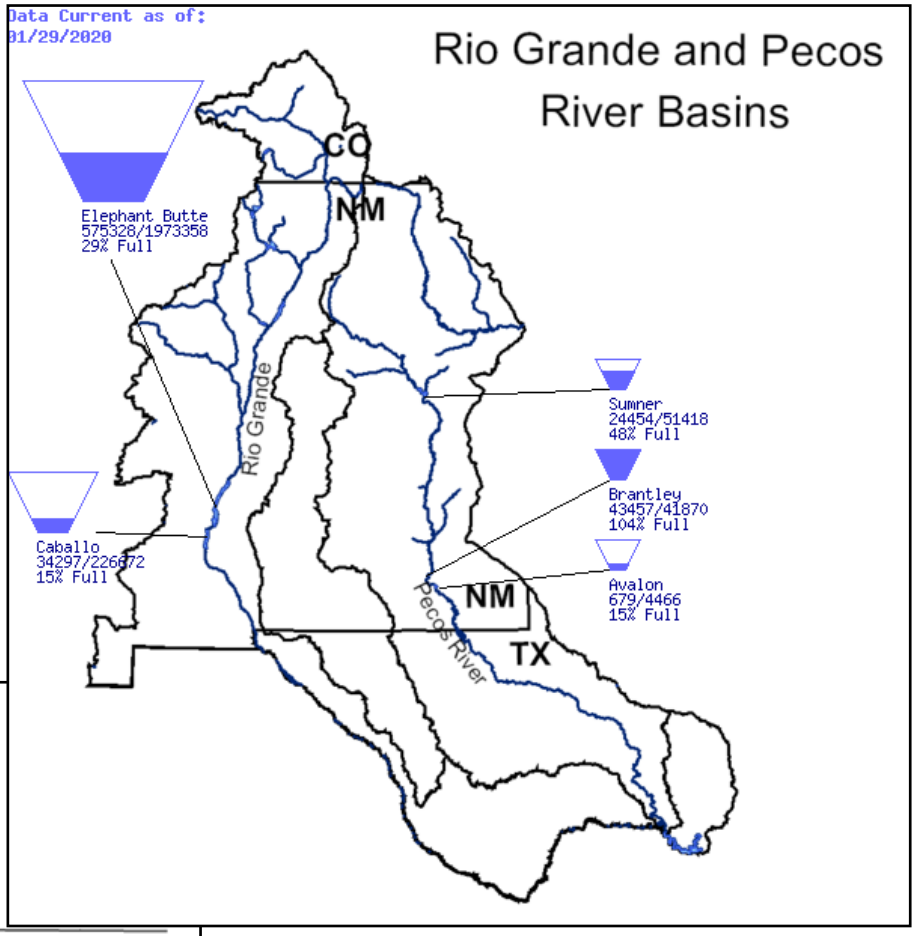
CPUE of RGSM during October 2019 (2.11 fish/100m2) was higher than the October 2018 estimate (0.09 fish/100m2;Dudley et al., 2019). During October 2019, a total of 209 RGSM were collected from the 20 standard long-term monitoring sites. The species was present at 19 of 20 monitoring sites and was collected in 92 of 333 seine hauls that yielded fish (Dudley et al., 2019). All RGSM collected in October 2019 were unmarked and are presumed to be naturally spawned fish. In addition, two age classes of RGSM were present, with the majority being young-of-year fish. The results from October 2019 monitoring indicate that spring runoff flows in 2019 resulted in successful RGSM spawning and recruitment.

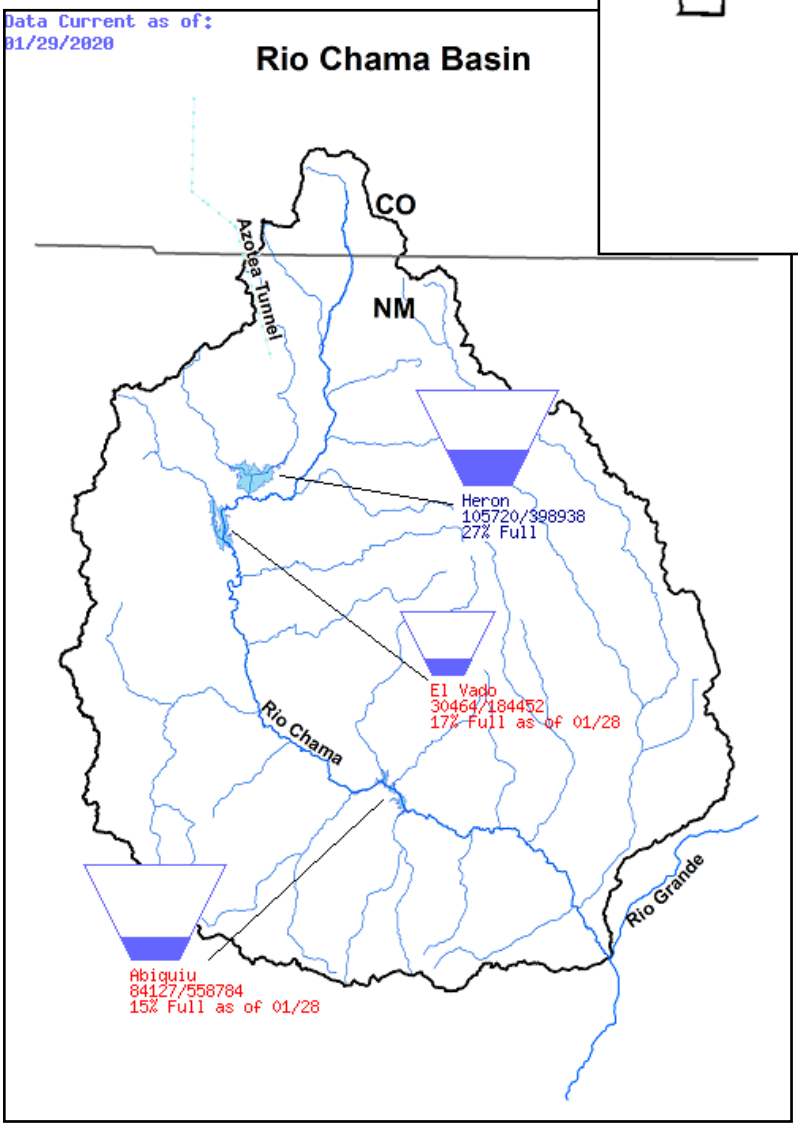


RGSM Photo credit: Joel Lusk, USFWS

Literature Cited

Dudley, R.K., S.P. Platania and G.C. White. 2019. Summary of the Rio Grande Silvery Minnow Population Monitoring Program Results from October 2019. Report to the Middle Rio Grande Endangered Species Collaborative Program and the U.S. Bureau of Reclamation, Albuquerque, N.M. 43 pp.





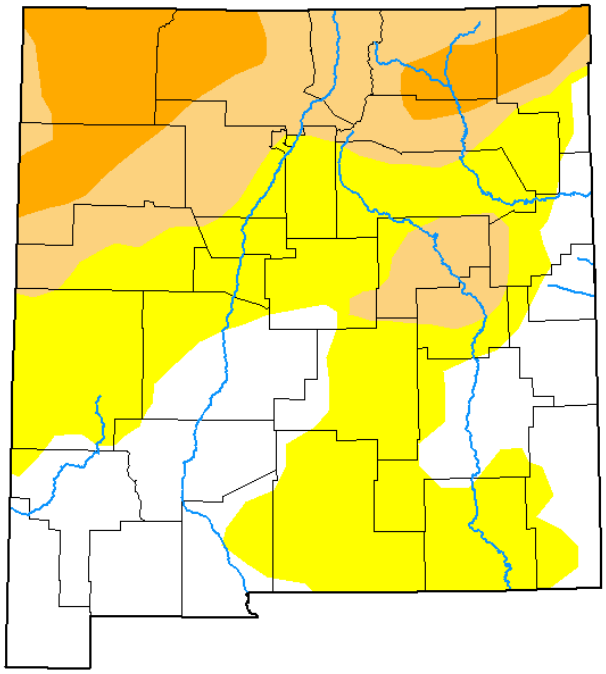
Basin "Bucket" diagrams are available at:
https://www.usbr.gov/uc/water/basin/

(Hydrology Update continued on page 5)

(Hydrology Update continued from page 4)

U.S. Drought Monitor
New Mexico

January 28, 2020
(Released Thursday, Jan. 30, 2020)
Valid 7 a.m. EST



Intensity:
- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

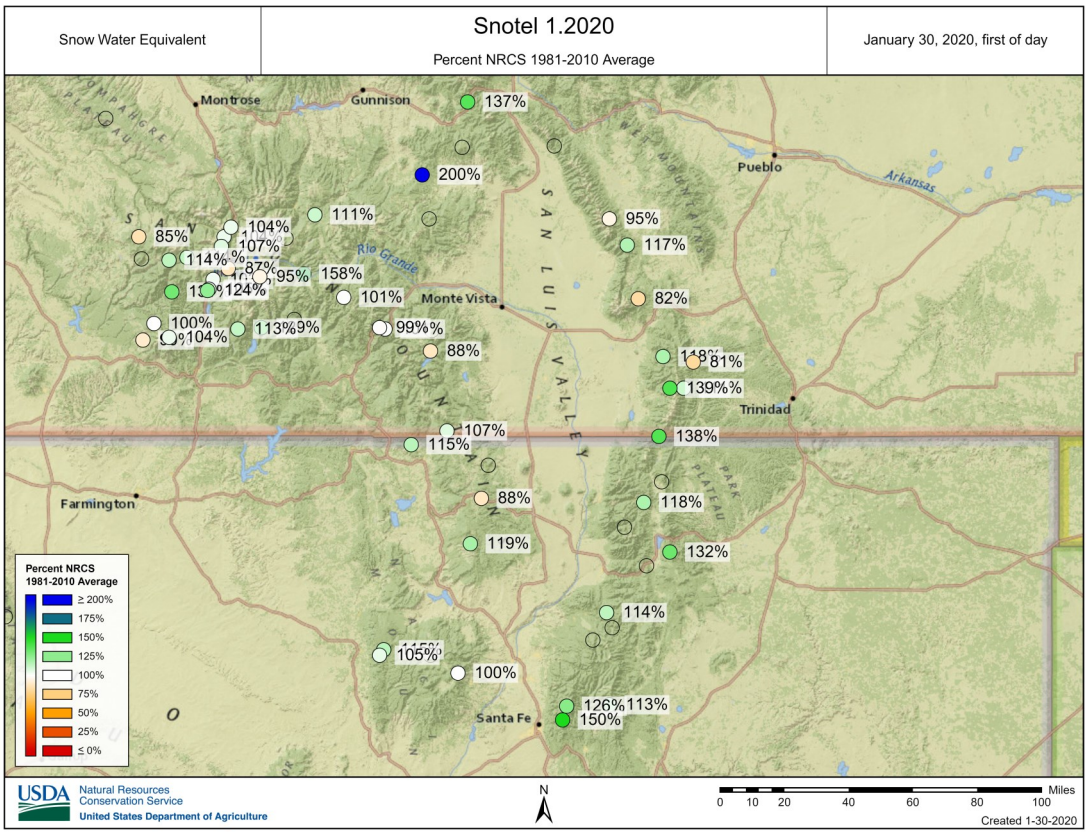
Author:
Richard Heim
NCEI/NOAA

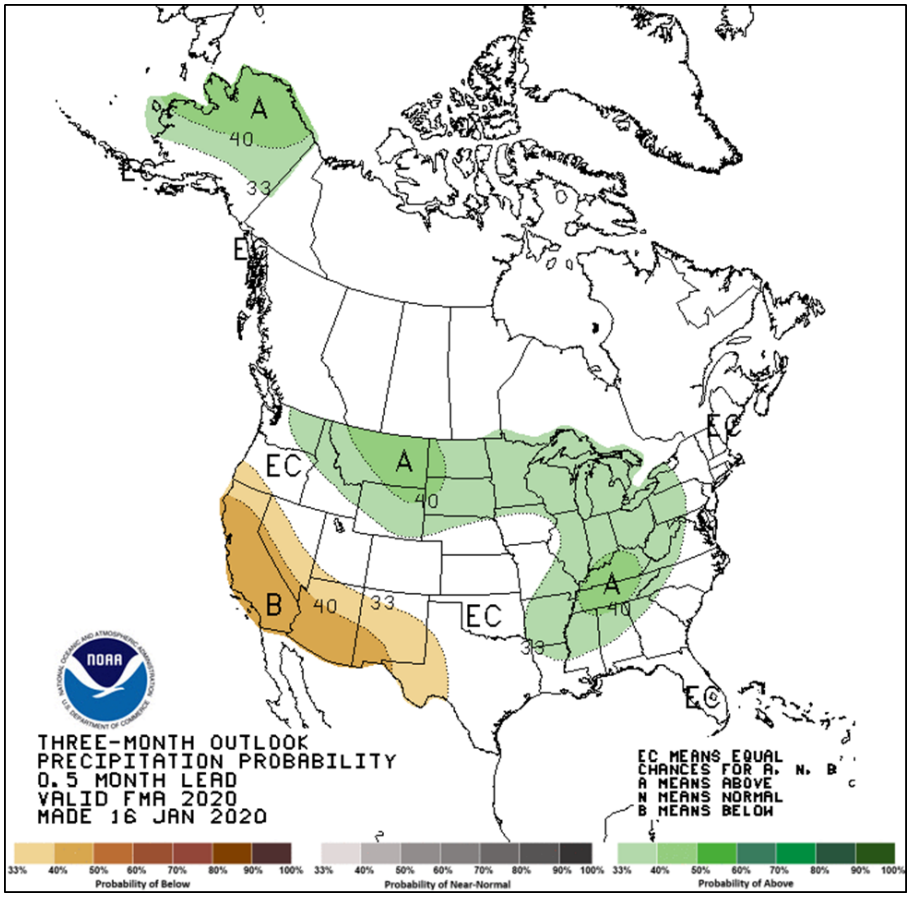
droughtmonitor.unl.edu

U.S. Drought Monitor information is available at: https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?NM

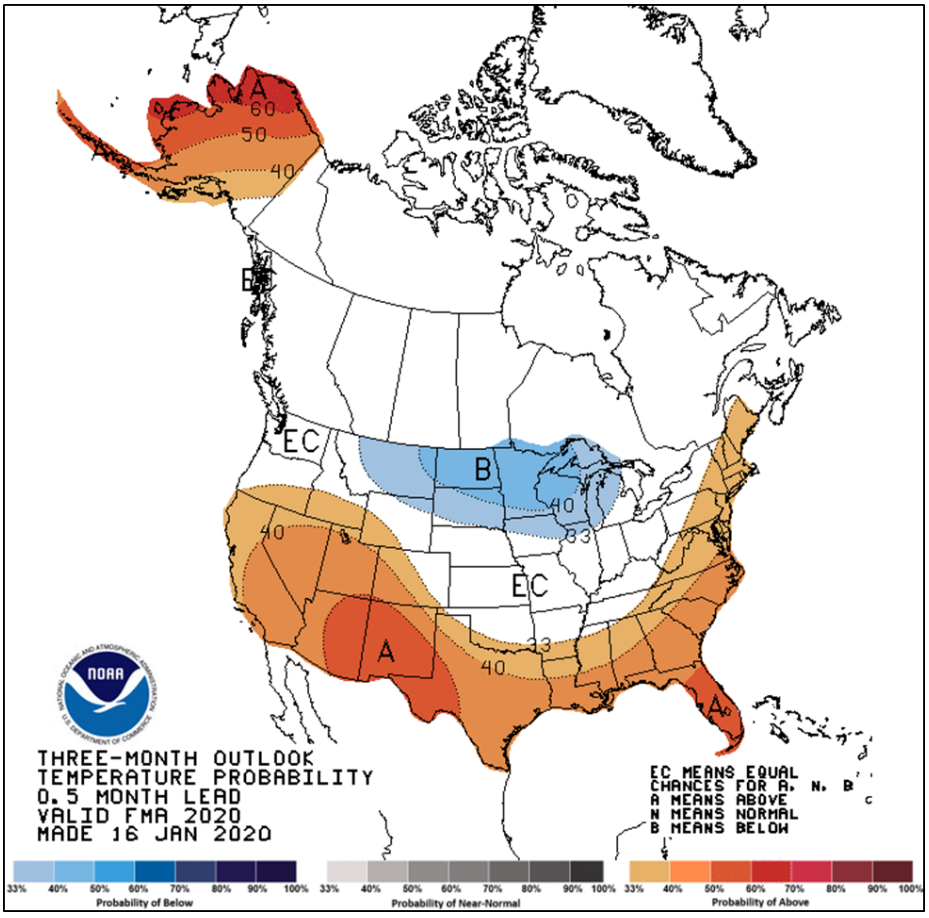
Snow Telemetry (SNOTEL) data, including Snow Water Equivalent data, are available at: https://www.wcc.nrcs.usda.gov/snow/snow_map.html.

This figure depicts snow water equivalent data for January 30, 2020 as a percentage of the 1981-2010 average of snow water equivalent data. Many locations are at or above average snow depths, with nearly 4 feet of snow at locations near Santa Fe.





3-month temperature and precipitation outlooks are available at: https://www.cpc.ncep.noaa.gov/. Other time intervals are available as well, including weekly and monthly.



Bosque del Apache National Wildlife Refuge Sediment Plug Circumvention Update

Update provide by Brian Hobbs, U.S. Bureau of Reclamation

As a result of the sediment plug that formed in 2019, work began on excavation of the inlet and outlet of the Pilot Realignment on Bosque del Apache NWR (Figure 1). In years past, Reclamation would have excavated a channel through the sediment plug to allow water to flow down to Elephant Butte Reservoir. In 2019, however, compliance was already in the works for a Pilot Realignment that was meant to move the Rio Grande to the east to circumvent the part of the river that had also plugged in 2008 and 2017.

Work began in late August 2019 and is expected to continue until at least April 2020. So far, about 1.5 miles has been excavated to a width of at least 100 feet, and all the water in the river was diverted into the new channel in September 2019. Current work includes widening the excavation footprint within the 300-foot corridor and moving excavated spoils into the old channel. An assessment of the condition of the new channel is planned for spring and summer 2020 to determine the next steps for the project.

For more information, please contact Brian Hobbs at bhobbs@usbr.gov; 505-462-3564; or 505-219-5392.

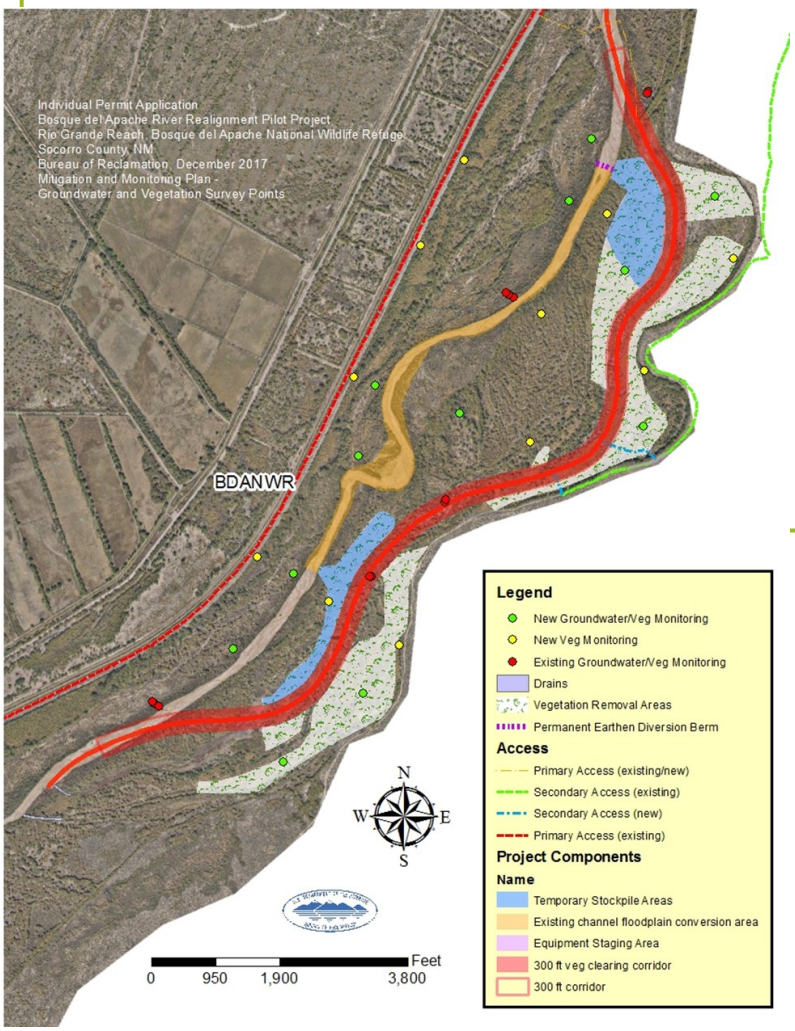


Figure 1. Map of project area. Orange shading in old channel is where excavated materials will be placed and is also the approximate location of the 2019 sediment plug

(Project Update continued on page 8)



Figure 2. Picture of old Rio Grande channel (bottom) and realignment channel (upper right corner) from July 24, 2019 drone footage, courtesy of NMISC. Water is flowing from left to right. This picture was taken approximately one month prior to the start of excavation but after most of the vegetation in the realignment corridor had already been removed.



Figure 3. Photo of amphibious excavator. Workers continue to widen the excavated portion of the channel (left to right) within the 300-foot corridor and remove the spoils piles (right). Photo taken on October 3, 2019.

Figure 4. Photo looking downriver of partially excavated realigned channel (bottom left corner to center) and old channel (right side of photo to center) from October 31, 2019 drone footage, courtesy of the NMISC.



Administrative Updates

Update provide by Julie Dickey, Program Support Team

FY19 Annual Report

FY19 activity write-ups are due by February 27, 2020, if you have not already submitted them. Please email them to Julie Dickey at jdickey@west-inc.com or Michelle Tuineau at mtuineau@west-inc.com.

Program Portal

The Program Portal (https://webapps.usgs. gov/mrgescp/) launched in November 2019! The following features are operational:

- Access to the Home page, where you can find information about each species, Upcoming Events, and Recent Publications, including the most current population monitoring data and more
- Stay informed on upcoming Events by checking the MRGESCP's calendar to find scheduled meetings and their associated documents
- Read About the MRGESCP's Background, Organization, Signatories, and Governance
- Search Resources → Documents to find past MRGESCP reports, meeting materials, publications, and more
- Learn more about the 2019 Science Symposium and access presentation slides and abstracts

Upcoming Program Portal Features!

- Links to listen to and watch 2019 Symposium presentations
- A map function (spatial and tabular interface) that allows you to view and interact with spatial data

Note: The Program Support Team (PST) will continue to upload past documents to the library. Please send document requests to the PST for items you cannot find on the Portal at this time.

UPCOMING DATES

PROGRAM MEETINGS:

Brown Bag—Habitat Restoration in Los Lunas
February 11, 2020
12-1 pm

Science and Habitat Restoration Work Group
February 11, 2020
1:15-4:30 pm

Population Monitoring Work Group
February 26, 2020
8:30 am-4 pm

Science and Habitat Restoration Work Group
March 12, 2020
9 am-12 pm

Adaptive Management Work Group
Time and Date TBD

PROGRAM DEADLINES:

FY19 activity write-ups due February 27, 2020

SIGNATORY-SPONSORED EVENTS:

BEMP's Crawford Symposium
Wednesday, March 11, 2020
4:00—7:00 pm
UNM's Student Union Building Ballroom



Photo: *Scenic view of the Middle Rio Grande;* Photo credit: *U.S. Bureau of Reclamation*

Charter for Fiscal Planning Committee
of the
Middle Rio Grande Endangered Species Collaborative Program

Overview
The Middle Rio Grande Endangered Species Collaborative Program (Program) By-laws, adopted by the Executive Committee on June 5, 2019 as amended, define the Program's organizational structure and discuss the functions of each organizational unit, including the Executive Committee, the Fiscal Planning Committee, Adaptive Management Committee, workgroups, and the Program Support Team. On June 5, 2019, the Executive Committee established the Fiscal Planning Committee with the directive that it report directly to the Executive Committee. The purpose of this charter is to further define the activities, roles, and responsibilities of the Fiscal Planning Committee as outlined in the By-laws.

Purpose
The Fiscal Planning Committee is created for the purpose of building a diverse financial support system for priority Program activities as set forth in the Long-Term Plan.

Composition
The Fiscal Planning Committee comprises Program Signatory representatives appointed by Executive Committee representatives. Participation may vary to adequately achieve the objectives set forth for each meeting.

Administration
The Program Support Team shall serve as the meeting facilitator and the single point of contact for the Fiscal Planning Committee. Responsibilities include the following administration and support duties:

- Coordinating meetings and meeting materials;
- Documenting and distributing action items and decisions;
- Providing notice to the Executive Committee and the Signatory representatives regarding meeting topics;
- Aiding to identify potential funding streams and other resources; and
- Providing Fiscal Planning Committee updates to the Program's other committees and workgroups.

Meetings
The Fiscal Planning Committee will meet quarterly at minimum, with additional meetings as needed to correspond with funding and other deadlines and timelines so as to fulfill its role.

Role and Responsibilities
The Fiscal Planning Committee's responsibilities include the following:

- Coordinate on Signatory funding capabilities (i.e. authorities, budget restraints, interests, deadlines) to support priority Program work
- Identify and pursue additional funding sources (i.e. grants, appropriations) in support of funding Program-related activities, including coordinating messaging for these efforts
- Identify other potential resources (i.e. partnerships, grants) to support Program-related project implementation
- Coordinate with other Program committees and workgroups to achieve the Fiscal Planning Committee's purpose

- Report and communicate requests to the Executive Committee on the pursuit of external funding and other resources to support Program activities

Individual signatories reserve the right to ensure appropriate use of their respective commitments consistent with applicable laws and regulations. The Fiscal Planning Committee and the Executive Committee may only make recommendations on how individual signatories allocate their respective funding, but the ultimate decision lies with the individual signatories.

Reporting Results and Communicating Decisions and Recommendations
The Fiscal Planning Committee shall report to the Executive Committee the results of securing funding and other resources for priority Program activities as set forth in the Long-Term Plan, as well as the identification of any remaining funding or other resource gaps, and recommendations for opportunities to fill those gaps.



MRGESCP Adaptive Management Work Group Update

Executive Committee Meeting

February 10, 2020

MRG Endangered Species Collaborative Program

Mission

The Middle Rio Grande Endangered Species Collaborative Program (MRGESCP) provides a collaborative forum to support scientific analysis and implementation of adaptive management to the benefit and recovery of the listed species pursuant to the Endangered Species Act within the Program Area, and to protect existing and future water uses while complying with applicable state, federal and tribal laws, rules, and regulations.

Long-term Program Goals

A. Establish and maintain a self-sustaining population of RGSM distributed throughout the MRG.

B. Maintain and protect the MRG recovery unit for SWFL.

C. Maintain and protect suitable YBCU habitat in the MRG.

D. Establish and maintain a self-sustaining NMMJM population in the MRG.

E. Maintain and protect the Pecos Sunflower in the MRG.

F. Avoid the future listing or up-listing of species in the Middle Rio Grande Endangered Species Collaborative Program area.

G. Manage available water to meet the needs of endangered species and their habitat.



Goal C Example: **Maintain and protect suitable YBCU habitat in the MRG.**

Strategy

- Fill knowledge gaps for each of the listed species in the MRGESCP Program area.
- Increase populations in appropriate areas.

Uncertainty

What environmental variables determine cuckoo nest site selection and success?



Project

Evaluation of YBCU Prey and Associated Host Plants

Identifying the prey base of YBCU and the host plants needed to support those prey, and evaluating whether those plants are suitable for inclusion in habitat restoration projects in the MRG.



Long-term Program Goals

A. Establish and maintain a self-sustaining population of RGSM distributed throughout the MRG.

B. Maintain and protect the MRG recovery unit for SWFL.

C. Maintain and protect suitable YBCU habitat in the MRG.

D. Establish and maintain a self-sustaining NMMJM population in the MRG.

E. Maintain and protect the Pecos Sunflower in the MRG.

F. Avoid the future listing or up-listing of species in the Middle Rio Grande Endangered Species Collaborative Program area.

G. Manage available water to meet the needs of endangered species and their habitat.



Next Steps

- One-one-one meetings scheduled with AMWG members to discuss the adaptive management process
- Development of a Science and Adaptive Management strategy
- Continue developing a Long-Term Plan
- Continue development of conceptual ecological models
- Development of a process to prioritize uncertainties
- Identification of critical uncertainties
- Transition to new Program structure

Middle Rio Grande Endangered Species Collaborative Program (MRGESCP) Cost Share Report

I. NON-FEDERAL SIGNATORY COST SHARE

U.S. Bureau of Reclamation's (Reclamation's) budget for MRGESCP-related activities requires a 25 percent match from the non-federal signatories. Table 1 shows Reclamation's annual MRGESCP-related budget total and the annual reported non-federal signatory contribution from federal FY01 through FY19. Reclamation's FY19 budget subject to cost share match totaled $3,433,162.00. The FY19 non-federal cost share totaled $2,565,081.08, or approximately 75 percent. The following non-federal signatories reported FY19 cost share:

- New Mexico Interstate Stream Commission
- Middle Rio Grande Conservancy District
- City of Albuquerque Open Space Division
- Bosque Ecosystem Monitoring Program
- University of New Mexico
- Albuquerque Bernalillo County Water Utility Authority

Table 1. Annual Breakdown of Non-Federal Cost Share

Federal Fiscal Year	Reclamation's Budget Amount Subject to Cost Share Match	Reported Non-Federal Cost Share Match	Percent Cost Share Met
FY01	$ 2,678,000.00	$ 588,965.02	22.0%
FY02	$ 6,968,271.00	$ 676,315.23	9.7%
FY03	$ 5,225,320.00	$ 2,119,560.27	40.6%
FY04	$ 3,964,984.00	$ 1,112,419.25	28.1%
FY05	$ 3,745,801.00	$ 1,361,120.11	36.3%
FY06	$ 7,064,120.00	$ 1,662,484.28	23.5%
FY07	$ 8,458,606.00	$ 2,359,140.22	27.9%
FY08	$ 8,109,366.00	$ 2,577,828.38	31.8%
FY09	$ 4,887,308.00	$ 1,578,545.77	32.3%
FY10	$ 4,008,423.00	$ 1,816,138.34	45.3%
FY11	$ 2,982,736.00	$ 1,248,427.27	41.9%
FY12	$ 1,457,225.00	$ 969,025.27	66.5%
FY13	$ 380,000.00	$ 1,135,223.41	298.7%
FY14	$ 1,178,000.00	$ 983,221.01	83.5%
FY15	$ 1,000,000.00	$ 1,009,649.00	101.0%
FY16	$ 3,304,197.00	$ 1,561,930.70	47.3%
FY17	$ 3,326,138.00	$ 2,271,462.57	68.3%
FY18	$ 3,355,654.00	$ 2,597,829.24	77.4%
FY19	$ 3,433,162.00	$ 2,565,081.08	74.7%
Total	**$ 75,527,311.00**	**$ 30,194,366.42**	**40.0%**

II. ALL SIGNATORY COST SHARE

FY19 combined federal and non-federal signatory MRGESCP cost share was approximately $8,758,508.00 (*U.S. Army Corps of Engineers funding not subject to non-federal match; *USACE amounts reflect the appropriation for the referenced fiscal year).

Table 2. Total Annual Contribution to MRGESCP Activities

Contributing Signatories	FY17 Annual Total	FY17 Percent Contribution	FY18 Annual Total	FY18 Percent Contribution	FY19 Annual Total	FY19 Percent Contribution
Non-Federal Signatory's	$2,271,463	~29%	$2,597,829	~31%	$2,565,081	~31%
U.S. Bureau of Reclamation	$3,326,138	~42%	$3,355,654	~40%	$3,433,162	~44%
U.S. Army Corps of Engineers	$2,367,000	~30%	$2,515,000	~30%	$2,117,000	~25%
Total	$7,964,601		$8,468,483		$8,333,274	

III. BREAKDOWN OF BUDGETS BY CATEGORY

Program Support

- Staff time at meetings (EC, by-laws, FPC)
- Program & Science Support Contract (Program Support portion)
- Program Portal
- U.S. Fish & Wildlife Service Program and Endangered Species Act Support

Science Support

- Staff time at meetings (ScW/HR, PMWG, AMWG)
- Program & Science Support Contract (Science Support portion)
- MRG and species-related studies and monitoring

Habitat

- Restoration projects
- Monitoring and studies

Rio Grande Silvery Minnow Propagation & Augmentation

- Facility operations and activities
- Augmentation activities
- Population monitoring and studies
- Genetic monitoring and studies
- Literature reviews

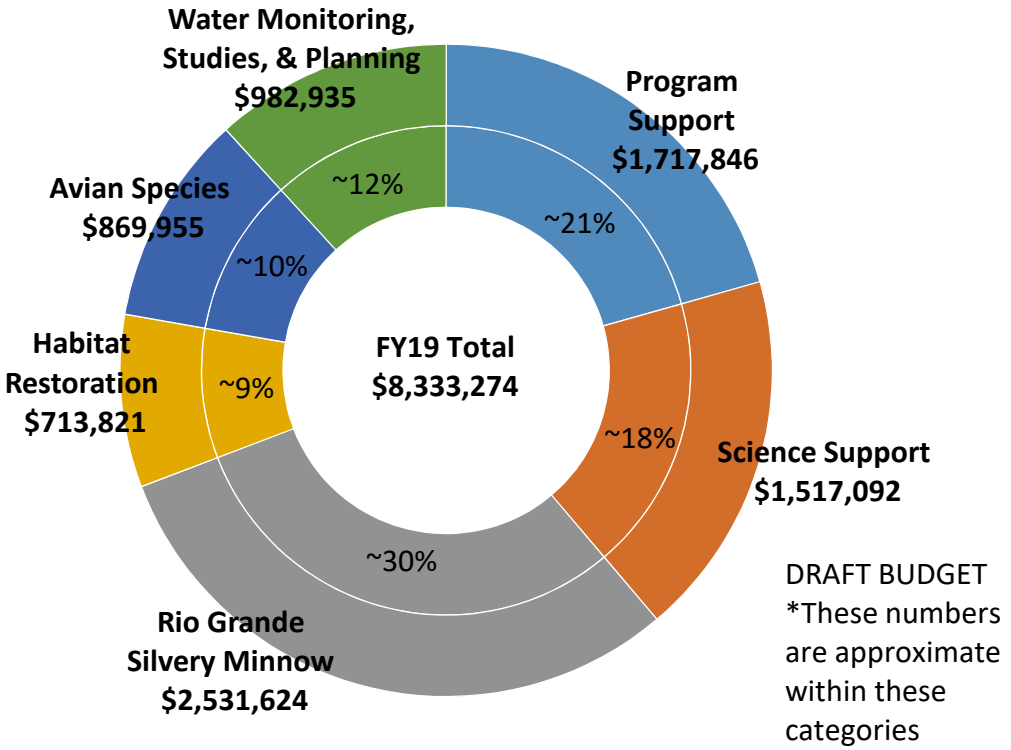
Avian Species

- Population monitoring and studies
- Genetic monitoring and studies

Water Studies, Planning & Operations

- Water leasing activities
- Water monitoring and studies

Figure 1. Breakdown of FY19 Spending by Category



Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

February XX, 2020

[NAME]
[TITLE]
U.S. Army Corps of Engineers
[ADDRESS]
[ADDRESS]

Re: U.S. Army Corps of Engineers Continued Planning and Administrative Assistance Funding for the Middle Rio Grande Endangered Species Collaborative Program

Dear [NAME]:

The Middle Rio Grande Endangered Species Collaborative Program (Collaborative Program) is comprised of 16 federal, state, tribal, local, and non-profit signatory agencies and organizations working towards the recovery of the Middle Rio Grande's (MRG) five federally-listed species: the Rio Grande silvery minnow (RGSM), the southwestern willow flycatcher (SWFL), the yellow-billed cuckoo (YBCU), the Pecos sunflower, and the New Mexico meadow jumping mouse (NMMJM). The U.S. Army Corps of Engineers (USACE) has been actively involved with the Collaborative Program since the beginning and participated in its pre-cursor, the Endangered Species Act Working Group, created in 2000. The USACE was one of the original signatories to the 2003 Memorandum of Understanding, which formally created the Collaborative Program. In 2008, USACE reaffirmed its commitment to the Collaborative Program by signing a new Memorandum of Agreement.

Since FY10, USACE has provided 30% to 50% of funding toward the Collaborative Program's priority activities each year. The Collaborative Program signatories recognize the crucial role USACE has played in supporting the recovery work for the listed species over the past two decades. We appreciate the agency's continued financial support by way of planning and administrative assistance under the Omnibus Appropriations Act of 2009 for Collaborative Program activities. The results of activities funded by USACE ensure the continued function of the Collaborative Program and development of science that supports better management and decision making related to the listed species and limited water resources within the MRG.

Between FY11 and FY18, USACE has contributed approximately $2,500,000 each year to the Collaborative Program's activities. However, in FY19 and FY20, congressional appropriations for USACE's Collaborative Program budget have decreased by over 47% from prior funding levels ($2,117,000 in FY19; $1,190,000 in FY20). On behalf of the Collaborative Program signatories, we are requesting the reinstatement of USACE's Collaborative Program budget of $2,500,000. These budget shortfalls adversely impact the abilities of the Collaborative Program signatories, partners, and other researchers working in the MRG to complete critical scientific analyses and long-term monitoring activities that benefit the MRG's listed species. Accomplishing the Collaborative Program's mission is contingent upon consistent funding and other resource contributions from all 16 signatories.

The reduced budget has resulted in loss of funding for several monitoring and surveying activities identified as priorities by the Collaborative Program in FY20. Researchers both within and outside of the Collaborative Program work on several ongoing and planned projects and studies that rely on the results of USACE-funded work. This work includes many long-term datasets. Gaps in these data can have significant negative impacts on analyses and the ability of agencies to make informed management decisions. The following is a list of some USACE-funded Collaborative Program priority activities that will not occur in FY20 as a result of budget cuts:

- Avian monitoring in the MRG
- Continuous water temperature monitoring of the MRG Basin
- Habitat restoration site surveying
- Los Lunas Habitat Restoration Project monitoring
- MRG groundwater monitoring
- Monitoring climate change in the MRG
- SWFL surveys on the Rio Grande in the Albuquerque metro area
- Tamarisk leaf beetle monitoring
- Water quality monitoring of aquatic refugia in the MRG

Since FY13, avian monitoring has provided baseline population data, population trends, and distribution of listed avian species in the MRG, which allows managers to make decisions that minimize negative impacts to the listed species and protect their populations. Since FY16, water quality monitoring has helped water managers determine how to support refugia for RGSM and the greater MRG fish community. Habitat restoration site surveying began in FY17 and support the development of general design guidelines and increased sustainability of restoration features for desirable RGSM habitat. Unfortunately, these and the other listed activities ceased in FY20, leaving gaps in data and information that are necessary for recovering the listed species. More information on each of the projects listed above and how they benefit the listed species can be found in the Middle Rio Grande Endangered Species Collaborative Program Fiscal Year 2018 Annual Report.

As a signatory of the Collaborative Program, USACE has made substantial contributions towards our mission. We thank you for your long-term support of the Collaborative Program over the past 20 years. As you work to finalize the FY21 and future Energy and Water Development Appropriations bills, the Collaborative Program urges you to commit at least $2,500,000 for the USACE-administered annual Collaborative Program budget. With reinstatement of this funding and continued collaboration amongst our signatories, the Collaborative Program will continue to work productively toward the benefit and recovery of the listed species in the MRG. We thank you for the many years of support and look forward to continuing our partnership.

Sincerely,

Debbie Lee
MRGESCP Program Manager

Project Description for
Soil Moisture Holding Capacity Study

I. Background

Native riparian vegetation thrives in conditions with moist soils, low salt content, shallow depths to groundwater, and opportunities for seasonal overbank flows. When these conditions are not met, less desirable, non-native vegetation may be established and potentially outcompete native vegetation. A better understanding of the bosque's soil moisture holding capacity would enable managers to take steps to increase the likelihood of native vegetation establishment and survival. A study of soil moisture holding capacity and topsoil health will provide valuable information to management, and especially restoration efforts, in the Middle Rio Grande bosque.

II. Objective

To design and implement a study to examine possible methods to increase soil moisture holding capacity with the end goal of increasing success of native vegetation establishment at habitat restoration sites. This could include evaluating soil improvements, microbial composition, and other potential amendments.

III. Conservation Benefit

The results of this study would inform future habitat restoration and increase the potential success of ecosystem restoration.

IV. Relationship to Panel Recommendations

This project idea is related to the following panel recommendations:

- Caplan (2018) SWFL critical uncertainty #1: What site selection and prioritization procedures contribute to the successful restoration of SWFL breeding habitats along the MRG?

V. Compliance Required?

If this study is carried out in the bosque, the researcher may need to secure Clean Water Act permits.

Project Description for
Evaluation of Yellow-billed Cuckoo Prey and Associated Host Plants

I. Background

Habitat restoration work for the southwestern willow flycatcher (SWFL) and YBCU in the Middle Rio Grande (MRG) mainly focuses on planting vegetation related to the nesting site. The YBCU's food intake needs are great, as juveniles grow rapidly and fledge in seven days. Their main food source is large insects, such as caterpillars, dragonflies, and cicadas. To our knowledge, little work has been done to cross-reference the vegetation needs of the YBCU prey base with plants suitable for habitat restoration projects in the MRG. Having a reference of such plants would inform future restoration planning, and allow restoration managers to plan for the food base needed to support YBCU populations.

II. Objective

Complete a literature search and research project identifying the prey base of YBCU and the host plants needed to support those prey, and evaluating whether those plants are suitable for inclusion in habitat restoration projects in the MRG.

III. Conservation Benefit

The results of this research project would facilitate the inclusion of YBCU prey host plants, suitable for the MRG, in habitat restoration projects. This would improve the prey base for the YBCU and contribute to greater nest success, thus improving the value of the habitat restoration site.

IV. Relationship to Panel Recommendations

This project idea is related to the following panel recommendations:

- Caplan (2018) YBCU critical uncertainty #1: Which abiotic and biotic variables predict suitable YBCU habitats in the MRG across multiple spatial and temporal scales?

V. Compliance Required?

No permits would be required to carry out this project.

Project Description for
An Analysis of Overbank Flow and Its Relationship with Southwestern Willow Flycatcher (SWFL) and Yellow-billed Cuckoo (YBCU) Territory Selection

I. Background

Restoration projects have created native riparian habitat, yet few of these sites in the Middle Rio Grande (MRG) support breeding populations of SWFLs. The magnitude, frequency, and duration of flooding and overbank flow strongly influence the structure and function of riparian habitat and the invertebrate communities that provide abundant food resources for SWFL and YBCU. SWFLs, in particular, often place their nests in vegetation hanging over standing water. Although data on hydrological conditions along the MRG exist, no studies have analyzed response of riparian vegetation or SWFL and YBCU territory selection to quantitative data on river flow regimes within the MRG. Results of this study would inform adaptive water management to optimize the creation and maintenance of flycatcher and cuckoo habitat, and would help prioritize locations for habitat restoration with the highest probability of success.

II. Objective

The design and implementation of a research project exploring a potential correlation between overbanking and SWFL and YBCU territory selection. This would entail using existing data of overbank flows and SWFL and YBCU survey data to determine if there was an observed increase in territory selection in an overbanked area during the year of overbanking, and in successive years. This project would also include an analysis of vegetation types before and after flooding events, and whether the vegetation was more suitable for SWFL and YBCU habitat.

III. Conservation Benefit

The results of this project would help predict SWFL and YBCU territory selection, and could be used to inform future restoration projects site selection and development.

IV. Relationship to Panel Recommendations

This project idea is related to the following panel recommendations:

- Caplan (2018) SWFL critical uncertainty #1: What site selection and prioritization procedures contribute to the successful restoration of SWFL breeding habitats along the MRG?
- Caplan (2018) YBCU critical uncertainty #1: Which abiotic and biotic variables predict suitable YBCU habitats in the MRG across multiple spatial and temporal scales?

V. Compliance Required?

No permits would be required to carry out this project.

Project Description for
An Evaluation of Aerial Imagery and Southwestern Willow Flycatcher (SWFL) and Yellow-billed Cuckoo (YBCU) Habitat

I. Background

Understanding the best locations to conduct habitat restoration for SWFL and YBCU in the Middle Rio Grande (MRG) would be a valuable approach to the management and conservation of these species. This could be accomplished by developing a GIS-based, habitat restoration suitability model for SWFL and YBCU. The foundation of this model would include using past survey and nest data of occupied SWFL and YBCU locations, and subsequently overlaying these layers with existing aerial imagery, vegetation maps, and habitat maps. This type of landscape-scale analysis would help determine the influence of patch size, edge effects, and adjacent land uses on SWFL and YBCU habitat uses. Habitat suitability model results would better inform habitat restoration site locations that provide the best opportunity for breeding activities.

II. Objective

An evaluation of aerial imagery of the MRG overlaid with occupied habitat for SWFL and YBCU in order to determine:

(1) any overlap in habitat characteristics for the two species, and
(2) any edge effects.

This would be include an analysis using existing aerial imagery, habitat maps, and vegetation maps. This project would not include collecting new data or imagery.

III. Conservation Benefit

The results of this project would inform habitat restoration efforts to maximize ability to attract both SWFL and YBCUs. It would also inform habitat restoration project siting based on adjacent and nearby land uses that would be beneficial to either or both species.

IV. Relationship to Panel Recommendations

This project description is related to the following panel recommendations:

- Caplan (2018) YBCU critical uncertainty #3: How similar are the YBCU and SWFL in their breeding habitat requirements in the MRG?
- Caplan (2018) YBCU critical uncertainty #1: Which abiotic and biotic variables predict suitable YBCU habitats in the MRG across multiple spatial and temporal scales?
- Caplan (2018) SWFL critical uncertainty #1: What site selection and prioritization procedures contribute to the successful restoration of SWFL breeding habitats along the MRG?

V. Compliance Required?

No permits would be required to carry out this study.

June 29, 2020

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

- *2020 Spring Minnow Action Team Recommendations [presentation]*
- *Draft April 2020 Minnow Action Team Recommendations [draft]*
- *Middle Rio Grande Endangered Species Collaborative Program Science and Adaptive Management Committee Draft Proposal [draft]*
- *U.S. Army Corps of Engineers Fiscal Year 2021 Unfunded Activities*
- *Middle Rio Grande Endangered Species Collaborative Program June 2020 Newsletter*
- *Report of the Population Monitoring Work Group to the Executive Committee of the Middle Rio Grande Endangered Species Collaborative Program*
- *Revised Middle Rio Grande Endangered Species Collaborative Program Population Monitoring Work Group 2020 Work Plan [revised]*
- *Science and Adaptive Management Committee Comment Matrix [spreadsheet]*
- *Science and Adaptive Management Committee Proposal [presentation]*

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Executive Committee (EC) Meeting
June 29, 2020
1:30 – 4:30 PM

Location: Zoom Meeting
https://west-inc.zoom.us/j/8983593120
Call-In: +1-669-900-6833
Meeting ID: 898-359-3120

Meeting Agenda

Meeting Objectives:

- *Hear updates on the adaptive management process*
- *Learn about the hydrology status for the year, and the Minnow Action Team recommendations for 2020*
- *Hear updates from the different work groups and committees*
- *Discuss the Science and Adaptive Management Committee proposed functions, composition, and formation process*

1:30 – 1:40	**Welcome, Introductions, Agenda Review** • Ground rules for Zoom meeting ➢ **Decision**: Approval of June 29, 2020 EC meeting agenda	*EC Co-chairs*
1:40 – 1:45	**February 2020 Meeting Summary** • Action Items Review ➢ **Decision**: Approval of February 10, 2020 EC meeting minutes Read-ahead: ☐ Draft February 10, 2020 EC Meeting Minutes	*EC Co-chairs*
1:45 – 1:50	**Program Manager Update** • Program Support Team Staffing Update • Work Plan Update Read-ahead: ☐ Newsletter	*Debbie Lee, Program Support Team (PST)*
1:50 – 2:05	**Hydrology Update**	*Jennifer Faler, U.S. Bureau of Reclamation*

		David Gensler, Middle Rio Grande Conservancy District (MRGCD)
2:05 – 2:15	**Minnow Action Team (MAT) Update and Recommendations** Read-ahead: ☐ Draft 2020 MAT Recommendations	*Anne Marken, MRGCD*
2:15 – 2:30	**Population Monitoring Work Group (PMWG) Update** ➢ **Decision**: Approval of revised 2020 PMWG work plan Read-aheads: ☐ PMWG EC Brief ☐ Revised PMWG Work Plan	*Rich Valdez, SWCA*
2:30 – 2:45	**Fiscal Planning Committee Update** • New co-chair appointments • Discussion of signatory funding issues Read-ahead: ☐ FY21 Unfunded Activities	*Julie Dickey, PST* *EC discussion*
2:45 – 3:00	**Break**	
3:00 – 4:10	**Science and Adaptive Management Committee (SAMC) Proposal** • Proposed SAMC function, composition, and formation process • Discussion Read-aheads: ☐ Revised SAMC Proposal ☐ Comment Matrix	*Facilitated discussion*
4:10 – 4:20	**Public Comment**	
4:20 – 4:25	**Announcements**	
4:25 – 4:30	**Meeting Summary and Action Items Review** ➢ Next EC Meeting: August 2020	*EC Co-chairs*
4:30	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Executive Committee (EC)
Meeting Minutes

June 29, 2020; 1:30 PM–4:30 PM
Location: Zoom Meeting

Decisions:

- ✓ Approval of the June 29, 2020 EC meeting agenda with the following amendments:
  - Move the hydrology update to just before the 15-minute break
- ✓ Approval of the February 10, 2020 EC meeting minutes with amendments to the hydrology and announcements sections
- ✓ Approval of the revised Population Monitoring Work Group (PMWG) Work Plan

Action Items:

WHO	ACTION ITEM	BY WHEN
Grace Haggerty and PST	Send the Program Support Team (PST) edits to the February 2020 EC minutes for changes as discussed during the EC meeting	6/29/2020
Janet Jarratt and PST	Discuss the Soil Moisture Holding Capacity Study	ASAP
Jennifer Faler and PST	Send the PST the hydrology notes from the U.S. Bureau of Reclamation (Reclamation) for distribution to the EC	6/30/2020
Lynette Giesen	Send Ashlee Rudolph and Jim Wilber cost estimates for different levels of maintenance for the Portal	7/1/2020
PST	Make changes to the Science and Adaptive Management Committee (SAMC) Proposal as discussed during the EC meeting	Prior to the EC workshop
PST	Schedule an EC workshop on the SAMC for mid-July	7/2/2020

Next Meeting: Mid-July SAMC Workshop via Zoom

Meeting Summary

Welcome, Introductions, Agenda Review

Ground rules for Zoom meeting
Agenda review

The EC co-chairs, John Stomp, Albuquerque Bernalillo County Water Utility Authority (ABCWUA), and Wayne Pullan, Reclamation, called the meeting to order, covered ground rules, and initiated introductions. The agenda was reviewed and approved with the amendment that the hydrology update be delayed until just before the 15-minute break.

- **Decision**: Approval of the June 29, 2020 meeting agenda by the EC with the amendment that the hydrology update be delayed until just before the 15-minute break

February 2020 Meeting Summary

Action items review

The February 2020 meeting minutes, decisions, and action items were approved by the EC with amendments to the hydrology and announcements sections. There was an inquiry into the action item regarding the Soil Moisture Capacity Study. The PST will follow-up with the EC representative to discuss the study further.

- **Decision**: Approval of February 2020 meeting minutes by the EC with amendments to the hydrology and announcements sections.
- **Action Item**: Grace Haggerty will send the PST edits to the February 2020 EC minutes for changes as discussed during the meeting
- **Action Item**: The PST will discuss the Soil Moisture Capacity Study further with Janet Jarratt.

Program Manager Update

Program Support Team staffing update
Work plan update
Newsletter

Debbie Lee, Program Manager with the PST, provided the Program Manager update. She introduced Catherine Murphy as the Program's Science Coordinator. The PST encouraged EC members to utilize the newsletter for work group updates and reserve the EC meetings for EC-level topics.

Minnow Action Team (MAT) Update and Recommendations

Anne Marken, Middle Rio Grande Conservancy District (MRGCD), presented the 2020 spring MAT recommendations (see presentation). The MAT adopted a 'survival strategy' due to low runoff projections and focused on protecting viable Rio Grande Silvery Minnow (RGSM) populations and egg collection for

propagation facilities. There was no discernible spring pulse at Otowi, Central, or San Acacia. The following are updates on the spring hydrology recommendations:

- Targeted releases from El Vado were not implemented.
- A jiggle was performed in May at the Isleta Diversion Dam and 113,247 eggs were collected.
- River connectivity was not maintained through mid-June. Drying began by the end of May.
- Diversion structures and wasteway returns were utilized for upstream fish movement and rescue activities.
- Supplemental water was used to minimize river drying in the spring.
- Angostura Reach remained perennial through the spring.
- Low flow conveyance channel pumps were used through the spring.

Updates on the spring biology recommendations are that eggs were collected for propagation facilities after the jiggle and USFWS began fish rescue efforts in early June. See presentation for spring monitoring recommendations. The preliminary summer MAT recommendations are to minimize channel drying, continue pumping at the south boundary, manage river recessions, keep Angostura Reach wet, utilize the Atrisco pump for emergencies, conduct fish rescue, monitor MRGCD outfalls, continue River Eyes monitoring, study habitat suitability at the south boundary pumps, and hold a MAT meeting on July 23rd if more coordination is needed. The MAT also compiled operations taken in 2018, another dry year, to explore options for 2020. The following are questions and comments after the presentation:

- How much can the New Mexico Interstate Stream Commission (NMISC) pumps at Atrisco contribute and for how long?
    - Maybe 1 cubic foot per second (cfs). NMISC can create a habitat refugium by raising a Langemann gate or keep the gate down and pump. About 25 acre feet of water is available.
- Water seems to be drying up and exercises like the MAT recommendations are important for figuring out options to maintain the RGSM.

PMWG Update

Rich Valdez, SWCA Environmental Consultants, presented a progress report on the PMWG and the group's revised work plan (see report and work plan). The group was formed in 2012 and given three tasks: 1) conduct a workshop on catch per unit effort, 2) review the Middle Rio Grande population monitoring plan, and 3) update the monitoring plan. Recently, the PMWG has also transitioned to informing the Program's adaptive management (AM) strategy. Task 1 was completed with the Hubert science panel, which resulted in 24 recommendations. Task 2 is in progress; the PMWG incorporated recommendations into the population monitoring contract, coordinated the Noon panel, and consolidated recommendations. It is now coordinating development of the RGSM population model and producing executive summaries on science topics from the panels. Task 3 is in progress, the PMWG made several inferences related to the monitoring plan.

The PMWG's 2020 Work Plan is split into four fundamental elements under Task 2. Another PMWG progress report will be provided to the EC and a presentation will take place at the last EC meeting of the year. The following is a question asked after the presentation:

- Does the work plan come with a hand-off to the SAMC or will the PMWG continue?

- The work plan finishes at the end of 2020. A lot of PMWG activities tie into the Program's AM process, particularly the development of hypotheses that can be tested through AM.

➢ **Decision:** EC approval of the revised 2020 PMWG Work Plan

Fiscal Planning Committee (FPC) Update

New co-chair appointments
Discussion of signatory funding issues

Julie Dickey, PST, gave the FPC update. The FPC met in early April to elect co-chairs and discuss fiscal year 2021 unfunded activities. Grace Haggerty, NMISC, was appointed the Non-federal Co-chair and Lynette Giesen, U.S. Army Corps of Engineer (USACE), was appointed the Federal Co-chair. The unfunded list of USACE activities will impact the work of other signatories. Funding opportunities for these activities and more were listed in the Program's June newsletter. The following were questions and comments raised after the update:

- The first item on USACE's list of unfunded activities is the Program Portal. It seems important and, if it is still being developed, what happens when it loses funding?
  - The Portal is funded until September, but funding will likely continue to December. USACE may continue hosting the Portal but nothing is definite.
- Is it possible to get a breakdown of costs for different levels of maintenance and development of the Portal?
  - Basic maintenance with no more development will cost $10,000 - $12,000 per year. This includes annually updating dataset.
- Can USACE provide a list of what it would fund if it could and cost estimates for those activities?
  - An EC representative from USACE will confirm what can be shared.
- Should the FPC and EC consider which entities are doing similar work in other reaches and see if they are able to pick up any unfunded activities?
  - This was the effort of the last FPC meeting and will continue to be discussed in the future.

The earliest USACE may get money is February 2021. After the end of FY20, Lynette G. and the incoming USACE commander are the only USACE members who will continue attending Program meetings. NMISC is also facing funding constraints. The State has a smaller 2020 budget than expected. Funding for Endangered Species Act (ESA) projects has not been decreased yet, so money for ESA-related work has not be affected. Across the board, the State will see a 4 percent decrease in funding. The Program needs to see what money is available and prioritize activities. Reclamation is receiving the normal amount of money, but there have been no opportunities for extra funding. The 2016 Middle Rio Grande Biological Opinion (BO) is still being carried out and Reclamation is seeing the full cost of it. Reclamation is overcommitted with funding and is not in a good position to help out with unfunded activities.

➢ **Action Item**: Lynette G. will send Ashlee Rudolph and Jim Wilber cost estimates for different levels of maintenance for the Portal

Hydrology Update

Jennifer Faler, Reclamation, gave a hydrology update for Reclamation. Reclamation began releasing water for Prior & Paramount (P&P) in June, supplementing the water released by MRGCD. When MRGCD runs out, full P&P operations are expected to happen soon. 13,000 acre-feet of RGSM water has been released of the 20,000 acre-feet for the year. The rest is expected to last the summer but all reaches will not remain wet. There isn't enough RGSM water to keep the Albuquerque Reach wet this year. This will be a challenging year for farmers and species.

David Gensler, MRGCD, gave a hydrology update for MRGCD. There was lower spring runoff in May than forecasted. About 250 cfs is being produced in Northern New Mexico. 80 percent of the water upstream of Cochiti is being used. 1,000 cfs was coming out of Cochiti for weeks because 2,000 acre-feet of supplementary water was coming out of storage per day, mostly from MRGCD. This storage water will last between two to three weeks. Around July 15th, MRGCD will enter P&P operations. Any water not going to the Pueblos will go to farmers. There is not enough water in 2020 to meet agricultural demands.

The following question was raised after the update:

- What would an average monsoon do for us?
    - Monsoon activity varies widely. We will likely get monsoon activity and MRGCD will use the water to serve famers as best they can. The Program's primary concern will be the species. There will be a reasonable array of wet spots in the river over the summer.

➢ **Action Item**: Jennifer F. will send the PST Reclamation's hydrology update for distribution to the EC.

SAMC Proposal

Proposed SAMC function, composition, and formation process
Discussion

Debbie L. presented a slideshow to introduce the SAMC Proposal and to guide discussion (see presentation). Key points from the presentation were:

- The SAMC is not a voting or decision-making group; it synthesizes and translates science for the EC.
- The EC is the Program's decision-making body.
- Questions arose during proposal development that must be answered by the EC.

Debbie L. opened discussion on foundational-level SAMC questions for the EC. Following are the SAMC Proposal questions and responses given during discussion:

1. Does the EC agree that the SAMC's focus is on science?
    - The Program's focus is science but the SAMC should offer an overall reality check and look at the unintended consequences of actions, so there is balance in the message to the EC.
    - Although the SAMC can offer a reality check, that reality needs to be based on scientific evidence.

- The Program's focus is on science relevant to management actions and within management constraints.
- Reclamation is unsure if there should be managers on the SAMC, as its focus should be on science. For example, it's inappropriate for water managers on the SAMC to give direction to the EC for managing water.
- The SAMC needs to be trustworthy and have the clout to elevate science up to the EC for decision-making.

✓ The EC agrees that the SAMC's focus in on science.

2. Does the EC agree that the EC provides the policy oversight component?
   - The Program is also a place to collaborate and share information.
     - Policy oversight is only one role of the EC.

   ✓ The EC agrees that the EC provides policy oversight to the SAMC.
3. Does the SAMC need express EC approval to convene and task Science and Technical (S&T) Ad Hoc Groups?

   ✓ The EC agrees that the SAMC can convene and task S&T Ad Hoc Groups without express EC approval provided that the SAMC give regular updates at EC meetings.
4. Are the outlined tasks appropriate for the SAMC? (see the SAMC responsibilities list on the SAMC Proposal)
   - The SAMC will need help completing its responsibilities. For example, Responsibility 1C will likely be done by the PST.
     - The sub-tasks under Responsibility 1 will be assigned to S&T Ad Hoc Groups.
     - There needs to be clarification on what the PST will do. Will they be part of S&T Ad Hoc Groups?
       - The PST's role is to provide administrative and scientific support to the Program and its groups.
     - Technical jobs should be assigned to the PST, especially document compilation.
     - The PST will be added to Responsibility 1C. Other contractors could also be completing the work and should be added to the responsibility as well.
   - Are there responsibilities missing?
     - The list is subject to change with direction from the EC.

   ✓ The EC agrees the outlined tasks are appropriate for the SAMC with suggested additions to Responsibility 1C and the caveat that the list is subject to change with direction from the EC.
5. Does the EC agree that no voting or decision-making authority belongs to the SAMC?
   - The SAMC can convene and task S&T Ad Hoc Groups without EC approval, so it does have some decision-making power.
     - Suggestion to add the caveat "except as authorized by the EC."
   - The proposal states that the SAMC should operate by consensus as much as possible. If there is disagreement, the SAMC will produce differing opinion reports for the EC. This prevents the SAMC from voting on science and the EC will see all sides of any disagreements.
   - Suggestion to split the questions into two: 1) Should the SAMC operate by consensus and write differing opinion reports when there is disagreement? 2) Does the SAMC have no voting or decision-making authority except as authorized by the EC?

     ✓ 1) The EC agrees that the SAMC should operate by consensus or provide differing opinion reports.

     ✓ 2) The EC agrees that the SAMC should have no voting power or decision-making authority, except as authorized by the EC.

- The language might be too limiting, but if it becomes problematic, the EC can change it.

6. Is the proposed term limit appropriate?
    - The proposed term limit for SAMC members is one year with the ability to renew three times for a four-year total.
    - It takes a long time for Program members to get on track. Also, the area is small and term limits may eliminate the few options we have. Should we consider term limits when it actually becomes a problem?
        - There should be term limits as it prevents stagnation by enabling new voices to be heard.
        - If we actively recruit, we can get more interest in SAMC participation.
    - One-year terms are too short. Fresh ideas are important but the Program needs to be realistic about the number of people who can be involved. There could be a provision to get around the term limits, such as overriding them by vote.
    - Suggestion for two-year terms that can be extended by one-year terms three times for a five-year term total to give the Program the flexibility to keep people.
        - There could include a provision to extend terms past five years.
        - Disagreement with extending terms past five years. There should be forced turnover. Four years would be better.
            - The proposal states four years.
    - Can a SAMC member only do one four-year term or can they take a few years off and come back?
        - The proposal states that a member cannot serve more than four consecutive years. They must take a year off before coming back.
    - ✓ The EC agrees to an initial two-year term with one-year term limits thereafter that can be extended up to two times, with the provision of some flexibility as needed.
7. What is the appropriate size to maintain a functional science-focused group?
    - No more than 7.
    - Small groups are more productive if everyone is on the same page. If the Program wants more participation and collaboration, it needs more people. There are more than 6-7 opinions for how to do things and they need to be reflected. The SAMC can't offer a reality check as a small group.
        - The SAMC's objective discussions will be about the strength and validity of scientific evidence. There won't be a lot of room for subjectivity.
        - AM is figuring out how to be responsive and flexible. That has additional implications for the SAMC. That's where the SAMC can offer a reality check by listing out the unintended consequences of actions. If that doesn't happen at the SAMC-level, it has to happen at the EC-level. The SAMC needs to be more inclusive.
            - The SAMC is supposed to develop a "tool box" of AM measures based on scientific evidence that anyone can utilize. The SAMC is not making decisions; that is the EC's role.
            - The proposal offers the chance for the Program to hear from new voices. There are non-State and non-Federal people listed for the different member positions. There is also an outside member position.
            - The SAMC is not doing AM; it is using science hypotheses to learn about species and water uses. It's not appropriate for the Program to tell managers what to do.

- The SAMC is the Science and *Adaptive Management* Committee. One EC representative was under the impression that the S&T Ad Hoc Groups would deal with science hypotheses and the SAMC would add in AM as a reality check. Otherwise, the committee is just a science committee.
    - The Program supports AM through science.
    - No agency can be forced into utilizing the Program's work. The SAMC is not a decision-making body; decisions are made by the EC. The SAMC facilitates the application of scientific evidence into AM by the EC.
- Where is the AM taking place?
    - There are different types of AM; it could be at the project level, for example.
    - Reclamation understood that the Program would develop a science and AM process within two years, and that it would inform the RIO program.
    - The benefit of the Program is that it can be a science machine that provides an objective look at what needs to be done to answer management questions. The Program doesn't manage anything but it can give recommendations to action agencies. The Program is contributing to AM through science and management recommendations.

- A smaller SAMC opens up conversations wider.
- The SAMC needs to get going. It won't be perfect at first but it can be changed. Suggestion for four more spaces on the SAMC, two RGSM experts and two hydrologists.
    - The proposal states that one or two experts can be added to the SAMC. These experts can be in the area that the SAMC needs at the time, including RGSM and hydrology. These members allow the SAMC to stay nimble but be responsive.
    - If there is only one RGSM person on the SAMC, the group can't be scientifically rigorous. There are so many different views about RGSM biology; one person can't represent them all.
- One representative supports a group size of 9-11 members. They do not believe the SAMC will work unless the EC understands what work groups will actually do the work. They believe strong leadership by the Science Coordinator is necessary.
    - The SAMC is not conducting all the Program's scientific activities. The S&T Ad Hoc Groups will be tasked with carrying out scientific activities.
    - There are three options for when scientists cannot reach consensus on evidence presented: 1) If it doesn't affect or inform management, the differing opinions will be documented and the committee will move on; 2) if the matter is consequential but not time-sensitive, an S&T Ad Hoc Group will be proposed to address it; 3) if the matter is consequential and time-sensitive, the basis of the disagreement will be documented, to include opposing opinions and rationale, and sent to the EC for decision-making.
    - The EC will decide if there needs to be more than one technical expert in an area to encapsulate the differing opinions. The SAMC does not give the final word on scientific evidence in the Program.
- What does the EC think the SAMC member number should be?
    - Reclamation – 5-7
    - USFWS – 7

        - USACE – No more than 7
        - Assessment Payers Association of the MRGCD – More than 7
        - University of New Mexico – 5-7
        - New Mexico Department of Game and Fish – 5-7
        - NMISC – 9-11
    - Is there anything that bars the SAMC or the Science Coordinator from inviting additional experts to meetings?
        - No.
        - The SAMC can get opinions from other experts; it provides a synopsis of those opinions to the EC.
- The proposed SAMC composition is more fitting for the independent science panel. The external science panel should be formed first and foremost. A different composition can be proposed for the SAMC.
- The EC will meet for a SAMC workshop to address the rest of the SAMC Proposal in mid-July via Zoom, before the next EC meeting.

➢ **Action Item**: The PST will make changes to the SAMC proposal as discussed during the EC meeting
➢ **Action Item**: The PST will schedule an EC workshop on the SAMC for mid-July

Public Comment

There was no public comment.

Announcements

The following announcements were made:

- Lori Walton has left Reclamation to join USFWS in Prescott, Arizona.
- Reclamation's other bird expert is Chris Grosso.
- For the next seven weeks, Jennifer Faler will serve as Acting Regional Director in addition to her role as Albuquerque Area Manager. There may be another Reclamation member filling in for her at upcoming EC events.
- Brent Esplin, former EC Federal Co-chair, is now Reclamation's Regional Director of the Missouri Basin Region and Arkansas-Rio Grande-Texas Gulf Region based out of Billings, Montana.
- Seth Willey's term as the USFWS Ecological Services Field Office Director is coming to an end. By the next EC meeting, there will be a new USFWS EC representative.

➢ **Next EC meeting date:** August 2020

Meeting Participants

Participant	Organization
Alan Hatch	Pueblo of Santa Ana
Anne Marken	Middle Rio Grande Conservancy District
April Fitzner	U.S. Army Corps of Engineers
Ashlee Rudolph	U.S. Bureau of Reclamation
Catherine Murphy	Program Support Team
Chris Shaw	New Mexico Interstate Stream Commission
Dale Strickland	Program Support Team
Daniel Picard	U.S. Bureau of Reclamation
Danielle Galloway	U.S. Army Corps of Engineers
David Gensler	Middle Rio Grande Conservancy District
Debbie Lee	Program Support Team
Derek Jarner	Pueblo of Isleta
Elizabeth Anderson	Albuquerque Bernalillo County Water Utility Authority
Grace Haggerty	New Mexico Interstate Stream Commission
Jaimie Park	Pueblo of Isleta
Janet Jarratt	Assessment Payers Association of the Middle Rio Grande Conservancy District
Jennifer Faler	U.S. Bureau of Reclamation
Jim Wilber	U.S. Bureau of Reclamation
John Stomp	Albuquerque Bernalillo County Water Utility Authority
Julie Dickey	Program Support Team
Kate Mendoza	Albuquerque Bernalillo County Water Utility Authority
Kim Eichhorst	Bosque Ecosystem Monitoring Program
Kyle Harwood	Buckman Direct Diversion Board
Lynette Giesen	U.S. Army Corps of Engineers
Mary Carlson	U.S. Bureau of Reclamation
Matthew Wunder	New Mexico Department of Game & Fish
Megan Osborne	University of New Mexico
Melissa Mata	U.S. Fish and Wildlife Service
Michael Porter	U.S. Army Corps of Engineers
Michael Scialdone	Pueblo of Sandia
Michelle Tuineau	Program Support Team
Mike Marcus	Assessment Payers Association of the Middle Rio Grande Conservancy District
Paul Tashjian	Audubon New Mexico
Rich Valdez	SWCA Environmental Consultants
Ryan Gronewold	U.S. Army Corps of Engineers
Seth Willey	U.S. Fish and Wildlife Service
Trevor Stevens	U.S. Army Corps of Engineers
Vicky Ryan	U.S. Fish and Wildlife Service
Wayne Pullan	U.S. Bureau of Reclamation

2020 SPRING MINNOW ACTION TEAM RECOMMENDATIONS

TO THE MIDDLE RIO GRANDE ENDANGERED SPECIES COLLABORATIVE PROGRAM EXECUTIVE COMMITTEE

JUNE, 29TH 2020

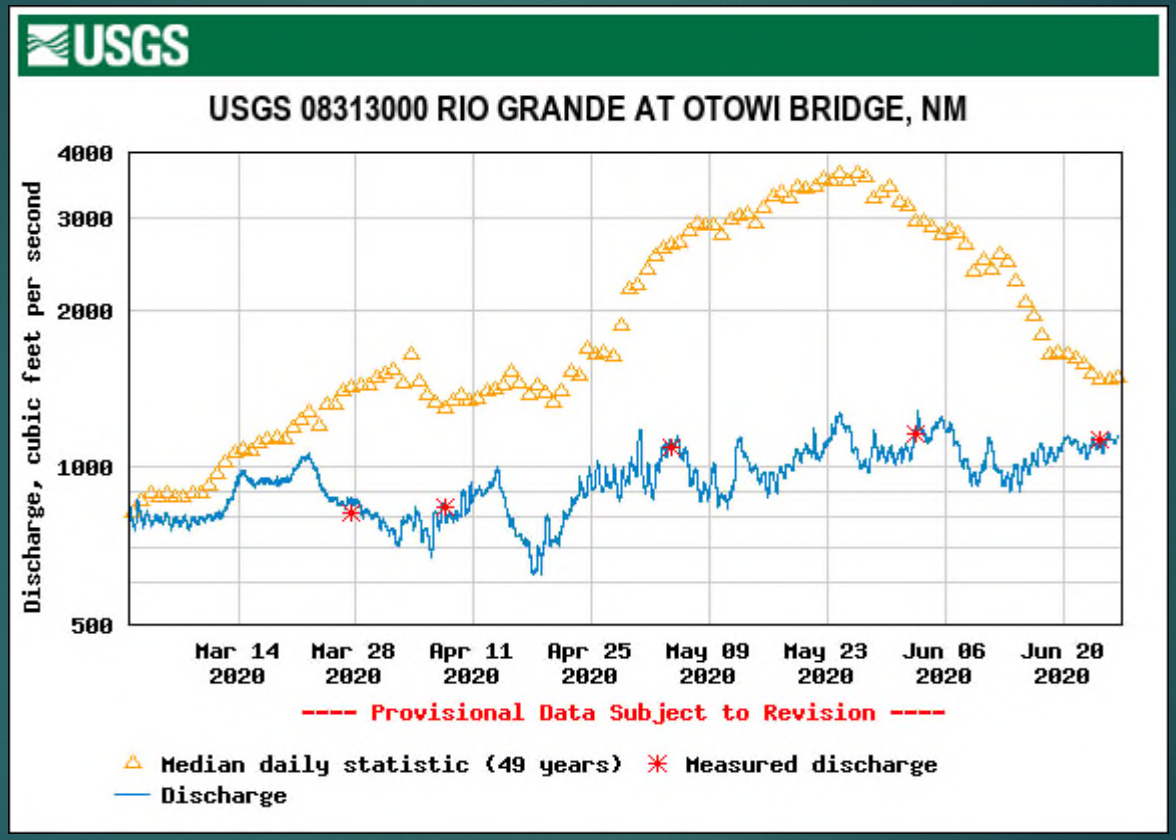
2020 SPRING MAT SUMMARY

- The MAT has held four meetings to discuss the hydrologic and biologic conditions for RGSM in 2020.
- Recommendations were developed to provide the best possible conditions for the species given the current circumstances.
- The MAT adopted a 'survival strategy' due to the projections for low runoff conditions.
  - This strategy focuses largely on protecting viable RGSM populations as possible and allow egg collection for captive propagation facilities.
  - Spring recommendations were developed based on this strategy.

SILVERY MINNOW CONDITION

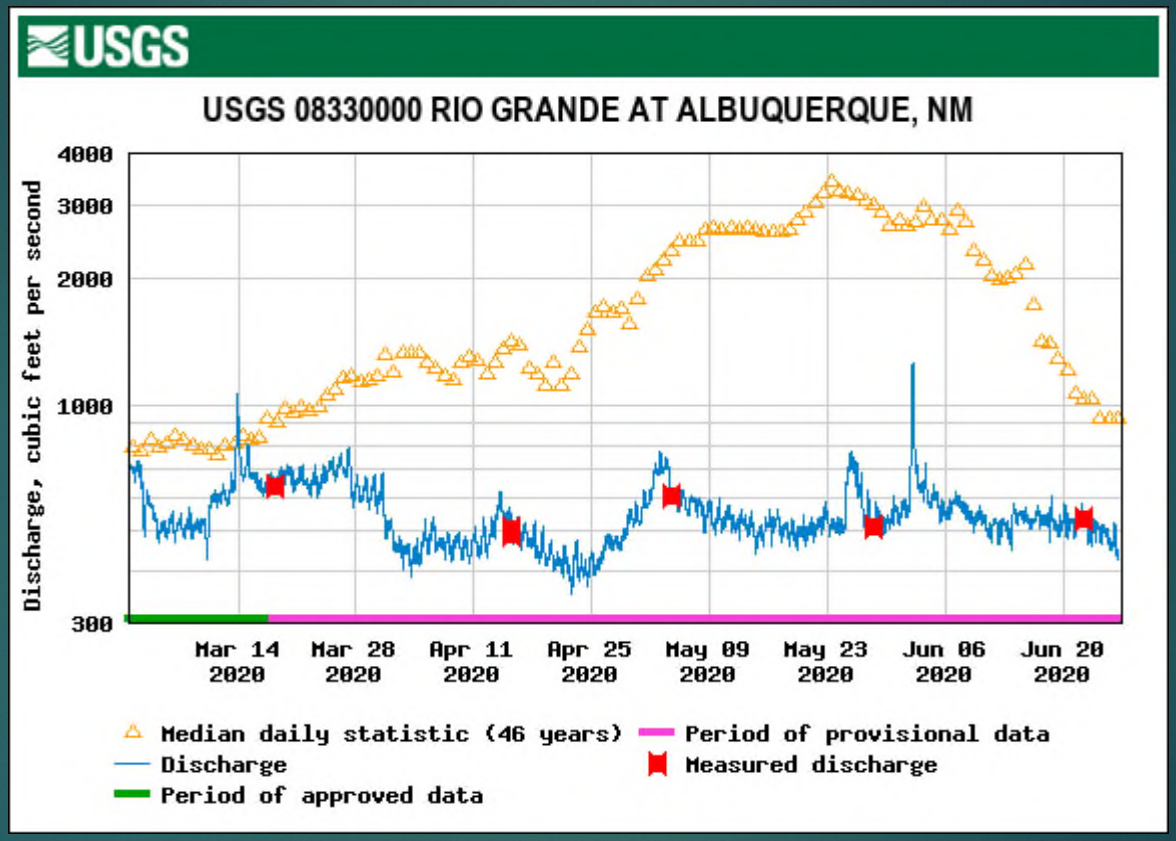
- October 2019 CPUE for Rio Grande Silvery Minnow was 2.11 (Dudley, 2020), despite record runoff in 2019.
- It has been suggested this CPUE could be a result of the low numbers of the 2018 cohort.
- The 2018 October CPUE was 0.10 (Dudley, 2019).

2020 SPRING FLOW AT OTOWI



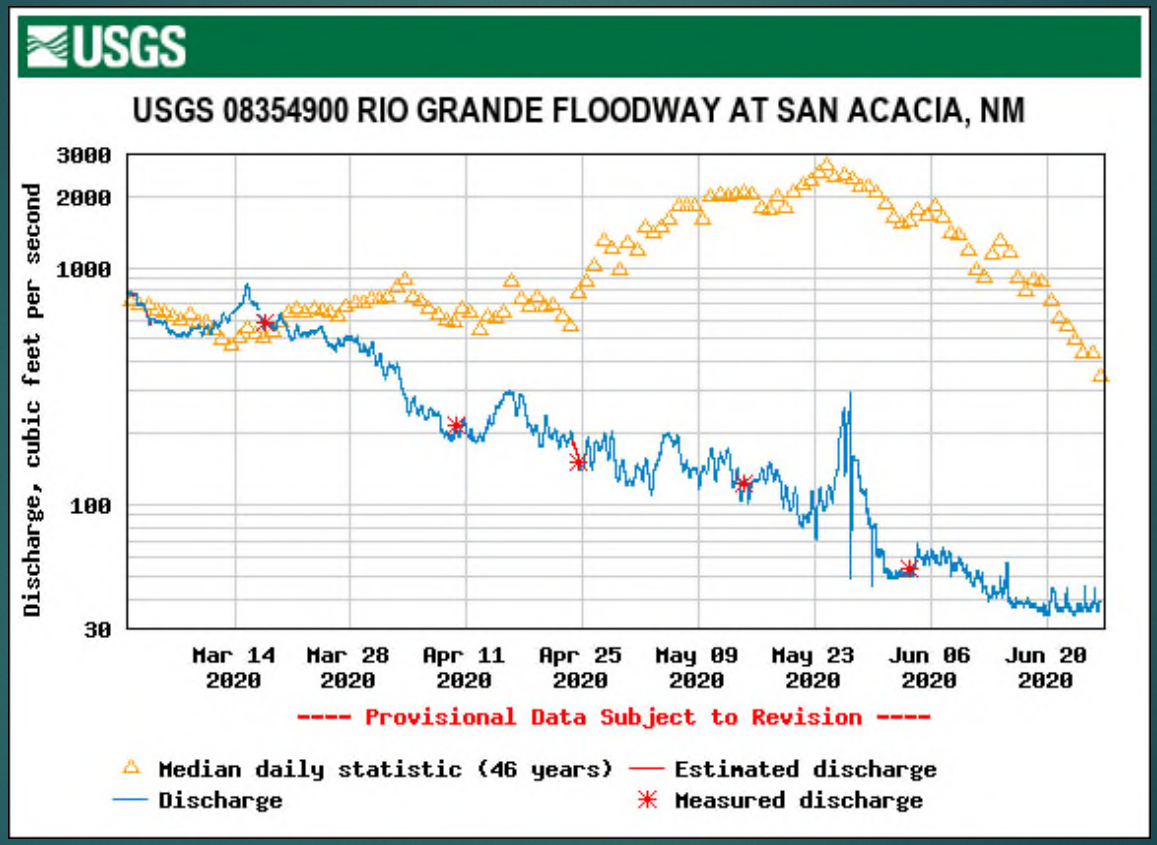
https://nwis.waterdata.usgs.gov/nm

2020 SPRING FLOW AT CENTRAL



https://nwis.waterdata.usgs.gov/nm

2020 SPRING FLOW BELOW SAN ACACIA



https://nwis.waterdata.usgs.gov/nm

SPRING HYDROLOGY RECOMMENDATIONS (1)

- If conditions on the Rio Chama allow, target a release(s) from El Vado to coincide with the main stem RG peak flow(s) in an attempt to create or enhance the spring floodpulse with the goal of promoting spawning and larval rearing for RGSM in the Middle Rio Grande.
  - Spring runoff timing and volume did not allow for this recommendation to be implemented.

SPRING HYDROLOGY RECOMMENDATIONS (2)

- Create a short duration instantaneous increase in flow to trigger spawning.
  - From 2 am Sunday May 24th- 3 am May 26th, MRGCD suspended non-pueblo diversions at the Isleta Diversion Dam creating a temporary spike in flows in the Isleta and San Acacia reaches of the river.
  - Volunteers from multiple agencies, coordinated by the City of Albuquerque Biopark, collected 113,247 eggs for captive propagation facilities (Lang, 2020).

SPRING HYDROLOGY RECOMMENDATIONS (3)

- Maintain river connectivity through at least mid-June to minimize mortality of YOY.
  - Drying occurred in the San Acacia Reach by the end of May and in the Isleta Reach by June 12th.
- Utilize diversion structures and wasteway returns to manage the rate of river recession to reduce fish mortality.
  - Bypasses at Isleta and San Acacia diversion dams were reduced incrementally to ensure that the rates of recession allowed for fish movement upstream, and for rescue activities to occur.

SPRING HYDROLOGY RECOMMENDATIONS(4)

- Minimize river channel drying with supplemental water and small releases at MRGCD wasteways and below diversion dams.
  - Supplemental water was used to minimize river channel drying in the spring.
- Keep Angostura Reach perennial.
  - Angostura reach has remained connected through the spring.
- Use LFCC Pumps at the Bosque Del Apache south boundary through the summer.
  - Reclamation has used the LFCC pumps through the spring. They are conducting a study to evaluate the efficacy of this pumping.

SPRING BIOLOGY RECOMMENDATIONS

- Collect RGSM eggs for captive propagation facilities.
  - 113,247 eggs were collected during the short duration increase in flow in the Isleta Reach in May.
- Conduct fish rescue where early drying is expected.
- Conduct fish recue and incorporate distributing rescued fish to sections of the river that are not expected to dry.
  - FWS service began fish rescue efforts in Early June. Due to Covid-19 restrictions, these efforts began after drying had already occurred in the San Acacia reach.

SPRING MONITORING RECOMMENDATIONS

- Water operations coordination and "River Eyes" should begin as early as possible.
- Identify areas of inundation at low to moderate flows.
- Continue to monitor through the April 1 and May 1 forecasts and continue to adjust recommendations.

PRELIMINARY SUMMER HYDROLOGY RECOMMENDATIONS

- Minimize channel drying, provide refugia for RGSM in Isleta Reach outfalls.
- Continue pumping at south boundary of BDA while studying suitability of RGSM habitat.
- Manage river recessions to reduce mortality.
- Keep Angostura Reach wet if possible.
- Utilize ISC pump at Atrisco for emergencies.

PRELIMINARY SUMMER BIOLOGY/MONITORING RECOMMENDATIONS

- Conduct fish rescue as drying occurs.
- Monitor fish populations in some MRGCD outfalls in the Isleta Reach.
- Continue "River Eyes" monitoring.
- Study the habitat suitability of the south boundary pumps.
- Hold an additional MAT meeting on July 23rd, if further coordination is needed.

2018 OPERATIONS

- Maintain flows in MRG for as long as possible
  - Main channel drying from 4/2 to 9/12 (McKenna, 2019)
  - 47.6 unique miles of drying (McKenna, 2019)
- Short duration instantaneous increases in flow for egg collection
  - Four events with ABCWUA and MRGCD facilities coupled with rain events resulted in 159,558 RGSM eggs collected (Lusk, 2018)
- River Eyes began March 29, 2018
- Diversions were used to control the rate of river recessions
- MRGCD wasteways in Isleta reach utilized to create refugia
- ABCWUA provided Reclamation with SJC to maintain RGSM flows in Angostura Reach
- 70,797 live RGSM rescued 27 YOY and 342 hatchery reared (Archdeacon, 2019)

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Dudley, R. Platania, S., White, G. 2020. *Rio Grande Silvery Minnow Population Monitoring during 2019.* American Southwest Ichthyological Researchers (ASIR). Albuquerque, NM.

Lang, K. 2020. *2020 and Learning how to Jiggle*. Presentation to Minnow Action Team, June 10th, 2020.

Lusk, J., Lang, K., 2018. *Summary of 2018 Jiggle operations and silvery minnow egg collections. U.S. Fish and Wildlife Service and City of Albuquerque Biological Park ACF. Presentation.*

McKenna, C. 2019. 2019 *RiverEyes Monitoring Report*. Prepared for U.S. Bureau of Reclamation, Albuquerque Area Office. Prepared by GeoSystems Analysis, Inc., under Sub-Contract with AJAC Enterprises. Albuquerque,NM.

QUESTIONS

April 2020 Minnow Action Team Recommendations

RGSM Condition

1. October 2019 CPUE for Rio Grande Silvery Minnow (RGSM) was 2.11 (Dudley et al., 2020). In 2019, high spring runoff conditions were expected to produce good recruitment of RGSM. However, the CPUE was lower than expected. It was suggested that this was most likely a result of the low numbers of 2018 cohort. In 2018, the October CPUE was 0.1 RGSM/100 m^2 (Dudley et al., 2019).

Hydrology Conditions

1. April 1 Forecast is for 385,000 acre-feet (AF) RG at Otowi with 125,000 AF inflow to El Vado March-July. As of the April 1 forecast flows at Otowi, March-July, shown at 53% of average.

2. More than 27,000 acre-feet of water have been stored in El Vado as of April 1, 2020. At the end of 2019, MRGCD had no native conservation water in storage in El Vado having released their remaining RG water from El Vado in late 2019 to assist with New Mexico's Rio Grande Compact (RGC) delivery obligations. The RGC Accrued Debit for 2020 is approximately 39,000 AF (accounting method 2).

3. Approximately 39,000 AF of RG water will be retained at El Vado this spring and may be released at the end of the irrigation season pursuant to Articles VI and VIII of the RGC.

4. Current P&P reserve is estimated at 20,000 AF based on April 1 forecast.

5. El Vado is currently limited to approximately 115,000 AF of total storage due to required rehab/repairs.

6. Remaining storage space in El Vado will be used by MRGCD to capture RG this spring to provide supplemental irrigation water during the 2020 season.

7. The April model runs indicate MRGCD will need all stored RG and most of its currently stored SJC to complete irrigation season.

8. MRGCD will need to maximize its storage before Article VII restrictions are in place – currently expected to be in June or July.

9. Reclamation expects to have approximately 26,000 AF SJC in storage or leased for 2020.

10. The Strategic Water Reserve and other sources have approximately 1,238 AF that could be used for ESA and Compact compliance purposes.

Recommendation: Based on April forecasts, the MAT believes it necessary to plan for low runoff conditions and adoption of a 'survival strategy'. However, because spring runoff timing

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and magnitude are still uncertain and runoff could still create spawning and possibly recruitment conditions, the MAT recommends planning for those conditions.

Hydrologic

1. If spring runoff volume and timing on the Rio Chama allow, target a release(s) from El Vado to coincide with the main stem RG peak flow(s) in an attempt to create or enhance the spring floodpulse with the goal of promoting spawning and larval rearing for RGSM in the Middle Rio Grande. El Vado operations should be attempted before Article VII restrictions are in place and should avoid flood control operations on the Rio Chama.

2. If flows are insufficient to cue RGSM spawning, the MAT will recommend brief small-scale flow manipulations (jiggles) at diversion dams to trigger RGSM spawning for egg collection purposes. The MAT recommends that the coordination of these efforts should occur as soon as possible, while continuing to monitor natural runoff conditions to determine if a "jiggle" is needed. The coordination will occur through the Albuquerque Biopark, the USFWS Fish and Wildlife Conservation Office, the Middle Rio Grande Conservancy District and other RGSM conservation facilities to plan and conduct these activities.

3. Maintain river connectivity through at least mid- June to minimize mortality of any young-of-year (YOY) produced.

4. Utilize diversion structures and wasteway returns to manage the rate of river recession to reduce fish mortality.

5. Minimize river channel drying with supplemental water and small releases at MRGCD wasteways and below diversion dams.

6. Keep Angostura Reach perennial.

7. Use LFCC pumps at the Bosque del Apache south boundary through summer.

Biologic:

1. Collect RGSM eggs and larvae for captive propagation facilities. Target these efforts in areas or during runoff events that have historically produced a high number of eggs in past egg collection efforts.

2. Conduct fish rescue where early drying is expected.

3. Fish salvage operations could incorporate distribution of salvaged fish to locations other than directly upstream. Salvaged fish could be placed in locations that are not expected to dry, within the reaches they were collected.

4. *What other biology recommendations are suggested? MAT members please provide any biological suggestions.*

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Monitoring:

1. Water operations coordination and "River Eyes" should begin as soon as needed. Possibly as early as April 1.

2. Identify areas of inundation at moderate/low flow.

3. Continue to monitor through April 1 and May 1 forecasts and adjust these recommendations as conditions warrant.

4. The MRGCD will continue to utilize drain outfalls as refugia for RGSM and monitoring of fish populations in these outfalls will be conducted this irrigation season.

5. ISC will conduct floodplain and in-channel research and monitoring for eggs, larvae and adults during the spawning and larvae rearing timeframe. The ISC will assist with staff and contractors on egg collection and fish rescue activities. The ISC will continue to monitor restoration projects and assess their effectiveness at the 1,000 to 3,000 cfs range.

6. USACE has planned to monitor sediment and inundation at restoration sites. Due to budgetary limitations there has not been confirmation this work will occur.

7. ABCWUA in partnership with ISC contracted SWCA to monitor RGSM at habitat restoration sites within the Angostura reach. As of April 24th, gravid fish were identified in the sites and 36 larval fish were found near the Corrales recreation site.

8. ABCWUA will begin egg monitoring above its diversion on May 1st and will continue to monitor through month of May.

9. Reclamation will continue habitat restoration monitoring in the San Acacia reach. They will continue to contract population and egg monitoring, augmentation, and genetic monitoring. Reclamation is also conducting a project with USU on fish movement using PIT-tagged fish in the Isleta and San Acacia reaches. Egg monitoring began the week of April 20th.

10. Bio park will begin egg monitoring the week of April 27th.

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Literature Cited

Dudley, R.K., Platania, S.P. and White, G.C., 2019. Rio Grande Silvery Minnow population monitoring during 2018. *Submitted to the US Bureau of Reclamation, Albuquerque, New Mexico, USA.*

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Valdez, RA, Haggerty, GM, Richard, K, Klobucar, D. Managed spring runoff to improve nursery floodplain habitat for endangered Rio Grande silvery minnow. *Ecohydrology*. 2019; 12:e2134. https://doi.org/10.1002/eco.2134.

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Middle Rio Grande Endangered Species Collaborative Program (MRGESCP)

Science and Adaptive Management Committee (SAMC) Draft Proposal

Revised: June 23, 2020

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I. PROPOSAL INTRODUCTION

In moving towards using science and adaptive management as the MRGESCP's structured decision-making framework, the Executive Committee (EC) agreed to form a committee to coordinate the implementation of science and adaptive management activities. This document proposes how the Science and Adaptive Management Committee (SAMC) will operate, its formation, its responsibilities and functions, and its relationships with other MRGESCP committees and ad hoc groups.

The SAMC is not a voting or decision-making group. It will translate and synthesize scientific results and recommendations, including the rationale for any supported differences of opinion within the MRGESCP, to the EC. The EC holds decision-making authority for the MRGESCP.

The primary role of the SAMC is to translate the results of field studies, modeling and monitoring activities into best research and management practices. It is the EC's responsibility to appraise the science-based recommendations within the context of existing policy (i.e. MRGESCP mission and goals, and applicable laws and regulations), and communicate them to implementing entities and external stakeholders. The EC is also responsible for providing direction to the MRGESCP's committees and groups.

Topics for the EC's June 29th discussion are derived from the written and verbal comments received on the proposal. Text boxes in each section highlight topics for EC discussion with relevant comments. Some comments in this proposal have been abbreviated; please see the Comment Matrix for full comments.

Further topics have been identified for EC discussion at a future meeting (see below). The topics outlined for the EC's June 29th discussion (located within each section of the proposal) should be decided upon prior to addressing these future topics.

1. How will the External SAMC member(s) be funded?
2. If no third-party management exists, who will hold the MRGESCP Science Coordinator position?
3. How will the EC decide which topics are appropriate starting points and/or annual "themes"? What is appropriate for year 1?
4. What is the interface between the SAMC and the EC with any kind of independent peer review?
5. Address the view that a ratio of federal to non-federal representatives should exist.

II. PURPOSE

The SAMC coordinates MRGESCP-related science initiatives and signatory efforts through identifying and assigning scientific tasks to Science and Technical Ad Hoc Groups; compiling the results of scientific studies, modeling, and monitoring efforts; and translating scientific findings into recommendations for best management practices in the Middle Rio Grande

Purpose – Note for the EC:

1. The EC will have oversight of the SAMC, including:
    a. Providing direction to the SAMC
    b. Reviewing science-based recommendations from the SAMC
    c. Deciding whether or not to communicate recommendations to implementing entities and external stakeholders

EC Discussion:

1. Agreement that the SAMC's focus is on science?
2. Does the EC provide the policy oversight component (i.e. attention to MRGESCP mission and goals; laws and regulations)?
3. Considering the EC will have oversight of the SAMC, does the SAMC need express EC approval to convene and task a Science and Technical Ad Hoc Group?

Related Comments:

1. # 15: How is the SAMC different from the EC?
2. Comment #'s 16, 18, 19 [Theme: The SAMC should be science-focused]
3. # 17: Change to: The SAMC serves to initiate, evaluate, guide, and communicate science and adaptive management efforts for the MRGESCP, particularly to reduce scientific uncertainties important to water management efforts related to listed species in the MRG.

III. RESPONSIBILITES

Coordinate and lead the implementation of the MRGESCP's Science and Adaptive Management Program:

1. **As per direction from the EC, convene and coordinate the efforts of the Science and Technical Ad Hoc Groups to complete tasks, including the following** *(see *Note 1; see Appendix C: Science and Technical Ad Hoc Group Formation*):
    A. Complete executive summaries to identify alternative hypotheses regarding critical uncertainties
    B. Develop scopes of work to test research hypotheses and/or collect necessary data
    C. *Compile, synthesize and encapsulate the results of field studies, modeling and monitoring to develop recommendations
    D. *Update the Science and Adaptive Management Plan as new information and opportunities become available
    E. Update conceptual ecological models to incorporate new information

    **Note 1*: With EC approval, the SAMC may complete specific tasks, or they may task Science and Technical Ad Hoc Groups to complete tasks
2. **Review MRGESCP-related field studies, modeling and monitoring activities, and translate the results into best research and management practices**
    A. Identify issues that require or would benefit from outside review
    B. Provide suggestions to the EC regarding independent peer review
3. **Work with the Fiscal Planning Committee (FPC) to coordinate EC-approved work products (e.g. studies, projects)**
    A. The FPC will determine resources available to complete work
    B. The FPC will work with the SAMC to determine implementation schedules based on funding availability
    C. The SAMC will work with the EC to determine implementation schedules based on regulatory commitments
    D. The EC will approve implementation schedules
    E. The EC will approve work products to move forward
4. **Regularly communicate updates at each EC meeting, including the following**:
    A. Present potential work products and status of in-progress work products
    B. Propose formation of Science and Technical Ad Hoc Groups with draft charges for EC review and approval
    C. Propose implementation schedules
    D. Suggested amendments to the Science and Adaptive Management Plan
    E. Provide documented range of SAMC opinions, as necessary, for EC review and direction (*see Page 10, Section V. 2. For areas of non-consensus on the interpretation of scientific information*)
    F. New science-based recommendations for best research and management practices
    G. New recommendations for independent peer review

III. Responsibilities – Notes for the EC:

1. The anticipated time commitment for SAMC members is 10-15 hours per month
2. Administrative coordination is intended to be handled by the MRGESCP Science Coordinator
3. The EC holds final decision making authority for the direction of each MRGESCP initiative that the FPC, the SAMC, and the SAMC's ad hoc groups undertake

EC Discussion:

1. Assuming the EC agrees that the SAMC is a science focused group, are the outlined tasks appropriate for the SAMC?
2. Does the EC agree that no voting or decision-making authority belongs to the SAMC?

See Comment Matrix: #'s 20 - 39

IV. COMPOSITION AND FORMATION

1. Composition

A. 6/7 member positions, 1 facilitator (*see Positions and Qualifications*)
   i. 5 MRGESCP member positions
   ii. At least 1 external expert position member
   iii. 1 SAMC Facilitator (MRGESCP Science Coordinator)

B. Serve a 1-year term
   i. Ability to reapply for a position in 3 subsequent terms
   ii. Individuals may not serve more than 4 subsequent years on the SAMC

C. SAMC Facilitator (MRGESCP Science Coordinator)
   i. Coordinate meetings
   ii. Facilitate the administrative functions to include:
      1. Drafting Science and Technical Ad Hoc Group charges
      2. Coordinating with the FPC, S&T Ad Hoc Groups, and any independent peer review tasks
      3. Relaying updates and recommendations to the EC

2. Positions and Qualifications (*see Application Packages for overall qualifications*)

A. Aquatic Ecology Expertise: Scientist knowledgeable in aquatic ecology

- Michael Porter
- Dana Price
- Eric Gonzales
- Mike Marcus
- Thomas Archdeacon
- Alison Hutson*
- Megan Osborne*
- Tom Turner*
- Rich Valdez*
- Wade Wilson*
- Kathy Lang*
- Rob Dudley* **
- Douglas Tave* **
- ??

B. Terrestrial Ecology Expertise: Scientist knowledgeable in terrestrial ecology

- Vicky Ryan
- Stephen Ryan
- Lori Walton**
- Dana Price
- Meaghan Conway
- Jeff Sanchez**
- Paul Tashjian*
- Amy Erickson*
- Jon Hayes*
- ??

C. Ecosystem Expertise: Scientist knowledgeable in ecosystem function

- Matthew Wunder
- Nathan Schroeder*
- Cody Walker*
- Michael Scialdone*
- Yasmeen Najmi
- Paul Tashjian*
- Amy Erickson*
- Kim Eichhorst*
- Kim Fike*
- Ondrea Hummel*
- Todd Caplan*
- Chad McKenna*
- ??

D. Hydrology Expertise: Hydrologist knowledgeable in hydrology and water operations

- Grace Haggerty
- Paul Tashjian
- David Gensler
- Ryan Gronewold
- Anne Marken
- Trevor Birt
- Carolyn Donnelly**
- Dagmar Luellen**
- Nabil Shafike**
- Ed Kandl**
- ??

E. Executive Committee Position:

i. Provide the larger Program perspective
ii. Ensure topics and recommendations are current within the scope as decided by the EC
iii. Provide direction for the completion of summary documents to the EC

F. External Expert Position(s): (*Note: the EC may decide that more than one external expert may be needed in a given year – see examples below*)

i. Provide objective input throughout the adaptive management process, especially for complex issues
ii. Provide an outside, big-picture perspective that is free of conflict
iii. Examples of expertise: science communicator; climate scientist; statistician; environmental planner; watershed scientist
iv. May be internal or external to the Middle Rio Grande
v. *Future Discussion*: May be volunteers; may be jointly funded by signatories; may be funded by one signatory

- U.S. Geological Survey
- The Nature Conservancy Rio Grande Water Fund
- National Oceanic and Atmospheric Administration
- ??

G. SAMC Facilitator (MRGESCP Science Coordinator)

i. Skill in translating science to communicate effectively across professional levels
ii. Doctorate degree in an area of applied science

Notes for EC Consideration:

1. Assuming the EC agrees that the SAMC members are voted in by the EC, and that the SAMC is not a voting or decision-making body: Provisions have not been made for alternate members and meetings will accommodate all member schedules
2. Original term limit stated as serving staggered terms for 2 years, not to exceed 4 total years

EC Discussion:

1. **Is the proposed term limit appropriate?**
2. **What is the appropriate size to maintain a functional science-focused group?**
    a. #41: The SAMC is on the cusp of being too large and unwieldy. I don't see any positions that can be removed without diminishing the SAMC capabilities. The composition resembles a governing board for an NGO, which [is] a good approach.
    b. #42: The make-up of the group is very complicated. [The EC needs discussion] of whether there needs to be such requirements [, or if it can be simplified. We think 9-11 people would be good, 7 seems a little small.
    c. #43: I understand the smaller is better concept but I think many of the signatories may be interested in a larger role in the program.
3. **If additional membership is proposed, what value do the additional members offer to the efforts of the SAMC?**
    a. #61: Add an Agricultural Expert member
    b. #63: Make the [Aquatic Ecology Expert] position be two people. So much emphasis is on water and RGSM, this concerns me as to the potential for bias.
    c. #64: Is this [Terrestrial Ecology Expert] both birds, mouse, and sunflower? Are there other expertise needed?
    d. #66: Because you are doing AM planning and implementation perhaps this [Hydrology Expert] can be 2 positions, one water ops and one ecosystem hydrology/modeler or other expertise
4. **If additional membership is proposed, what are the proposed member's qualifications on a science-focused group?**
5. **Assuming a science-focused group, is an EC member position appropriate?**
    a. #67: Delete Executive Committee member position
    b. #68: The EC member can represent the SAMC to the EC. It would be useful to have somebody knowledgeable about policy on the SAMC.
    c. #69: Should [EC member] be more of an advisor or liaison rather than a EC Member?
    d. #70: EC position seems unnecessary given the SAMC should be a small group of experts focused on science
6. ***Is holding a SAMC position a conflict of interest for contractors and tribes?**
7. **Should contractors and tribes be permitted to hold SAMC positions as MRGESCP members (see position #'s 1-4)?**
8. **What about applicants that are a contractor to a MRGESCP signatory (e.g. NMISC & SWCA; USACE & Tetra Tech), and contractors that are MRGESCP signatories (e.g. BEMP, UNM, Pueblos)?**
9. ****Should individuals employed by a MRGESCP signatory, but not active MRGESCP members, be permitted to hold a SAMC position? Are they able to apply for the External Expert position?**

Notable Related Comment: #3

3. Formation Process

A. Executive Committee
   i. Recommend names of individuals that may have time to sit on the SAMC
   ii. Work with the MRGESCP Science Coordinator to invite potential individuals to apply for SAMC positions

B. Interested Individuals
   i. Individuals with interest in positions 1-4 and 6 work with the Science Coordinator to complete the respective application package (*see Application Packages*)
   ii. If an individual is interested in being considered for more than one position, one application package must be filled out for each position

C. MRGESCP Science Coordinator
   i. Work with interested individuals to complete and submit an application package (*see Application Packages*)
   ii. Submit application packages to the EC

D. Executive Committee
   i. Review application packages
   ii. Nominate one or more EC member(s) for position #5 (if more than one EC member expresses interest, the EC will vote on the position)
   iii. Each signatory's EC representative casts one vote per SAMC position

E. Prospective Date for SAMC Launch: 2020 - Late fall/Early winter

EC Discussion:

1. Is the formation process clearly outlined?
2. Is the formation process appropriate?

See Comment #'s: 2, 27, 86

V. MEETING OPERATIONS

1. The SAMC will operate under a modified version of Robert's Rules of Order, including the following:
    A. Each agenda after the first meeting will include time for non-member comment; individuals must request time two days prior to the meeting and will have up to 3 minutes to speak
    B. Only SAMC members may participate in meeting deliberations. Prior to the meeting, the SAMC members may invite Ad Hoc Group leaders and outside experts to participate on specific agenda items as needed
    C. Formal agendas will be drafted for review and approval at each meeting. Draft meeting materials will be made publically available on the Program Portal one week prior. The draft materials will be distributed to the SAMC members via email one week prior
    D. Each meeting will have formal meeting minutes, which will be used to document meeting deliberations and decisions, and communicate activities to the MRGESCP and external interested parties
    E. The finalized agendas, read aheads, and minutes will be included in the MRGESCP's Annual Administrative Record and stored on the Program Portal
2. If the SAMC cannot reach consensus during the translation of scientific results:
    A. SAMC member(s) will document the various opinions, each with justification
        i. The opinions will be provided to the EC for review and direction
        ii. The EC may direct the SAMC to use the documented opinions to inform a Science and Technical Ad Hoc Group's further actions
        iii. The EC may work with the SAMC to determine if a form of independent peer review is necessary
3. SAMC members will abide by all federal, state, tribal, and local agency rules and regulations regarding conflict of interest

EC Discussion:

1. What is the best way for the science-focused committee to be productive while allowing for non-member input?

VI. EVALUATION

Executive Committee

1. The MRGESCP Science Coordinator will provide an annual update
    a. SAMC's work plan status
2. Evaluation of the SAMC members

EC Discussion:

1. What should be included in the annual update?
2. How should the SAMC be evaluated, and at what frequency?

APPENDIX A: **APPLICATION PACKAGES**

1. APPLICATION PACKAGE FOR SAMC SIGNATORY MEMBER TOPICAL EXPERT POSITIONS

The SAMC coordinates MRGESCP-related science initiatives and signatory efforts through identifying and assigning scientific tasks to Science and Technical Ad Hoc Groups; compiling the results of scientific studies, modeling, and monitoring efforts; and translating scientific findings into recommendations for best management practices in the Middle Rio Grande.

The SAMC comprises seven member positions (i.e., 5 Program signatory members and at least 1 external expert member). Selected individuals serve a one-year term limit, with the ability to reapply for a position in 3 subsequent years. Individuals may not serve more than 3 consecutive terms (4 years) on the SAMC. This application package is for SAMC Positions 1 – 4. The SAMC positions are as follows:

1. **Aquatic Expert: Scientist knowledgeable in aquatic ecology**
2. **Terrestrial Expert: Scientist knowledgeable in terrestrial ecology**
3. **Ecosystem Expert: Scientist knowledgeable in ecosystem function**
4. **Hydrology Expert: Scientist knowledgeable in hydrology, water operations and policy**
5. Executive Committee Position: Provide the larger Program perspective, ensure topics and recommendations are current within the scope as decided by the EC, and provide direction for the completion of summary documents to the EC
6. External Member Position: Provide objective input throughout the adaptive management process, especially for complex issues; Provide an outside perspective, free of conflict, and expertise in a specified area as determined by the EC; may be internal or external to the MRG

The SAMC will meet every other month to discuss work products and conduct committee business. The time commitment for each member will vary, but is expected to be approximately 10-15 hours per month during meeting months. Time will include document reviews and the provision of comments; discussions with Program members, the MRGESCP Science Coordinator, and SAMC members; and preparing for and attending meetings.

To be considered for a position, please complete the following form and submit to the MRGESCP Science Coordinator via email at [email] along with your resume (limit 2 pages) by close of business on MM/DD/YYYY. If you are interested in being considered for more than one position, one application package must be completed for each position.

Name: Click or tap here to enter text.

Job Title: Click or tap here to enter text.

Affiliation: Click or tap here to enter text.

Daytime Phone Number: Click or tap here to enter text.

Email Address: Click or tap here to enter text.

Position for which you are applying (choose one per application package):

Choose one per application

Specific area(s) of research/expertise: Click or tap here to enter text.

Years of experience in your respective field: Click or tap here to enter text.

Years of experience working the Middle Rio Grande: Click or tap here to enter text.

Years of experience working with the MRGESCP, and in what capacity:

Click or tap here to enter text.

Why would you like to serve on the Science and Adaptive Management Committee?

Click or tap here to enter text.

Please describe any specific experience working directly with the listed species of the Middle Rio Grande (i.e., New Mexico meadow jumping mouse, Pecos sunflower, Rio Grande silvery minnow, southwestern willow flycatcher, yellow-billed cuckoo) related to the topical area for which you are applying:

Click or tap here to enter text.

In your own words, describe what adaptive management means to you:

Click or tap here to enter text.

In your opinion, how can the MRGESCP contribute to adaptive management in the Middle Rio Grande?

Click or tap here to enter text.

In one sentence, describe the biggest challenge facing the Middle Rio Grande:

Click or tap here to enter text.

How would you maintain scientific impartiality as a member of the SAMC?

Click or tap here to enter text.

By signing this application, you are committing to abide by the following statement:

> *As a member of the SAMC, I agree to uphold high scientific standards, work collaboratively, and advocate for the best science possible. I understand that if selected, I would be serving in the capacity as a technical expert in a specific field, and not as a representative of a specific organization. All views expressed in SAMC meetings will be my own and not those of my organization.*

Please sign and date this application by typing in the respective boxes, attach the application with your resume (limit 2 pages, no photos), and submit via email to the MRGESCP Science Coordinator by COB on MM/DD/YYYY.

Thank you for your interest in the Middle Rio Grande Endangered Species Collaborative Program.

Click or tap here to enter text.	Click or tap to enter a date.
Type Your Name	Today's Date

2. APPLICATION PACKAGE FOR SAMC EXTERNAL MEMBER AND SUBJECT MATTER EXPERT POSITIONS

The SAMC coordinates MRGESCP-related science initiatives and signatory efforts through identifying and assigning scientific tasks to Science and Technical Ad Hoc Groups; compiling the results of scientific studies, modeling, and monitoring efforts; and translating scientific findings into recommendations for best management practices in the Middle Rio Grande.

The SAMC comprises seven member positions (i.e., five Program signatory members, 1 external member, and one subject matter expert member). Selected individuals serve a two-year term limit, with the ability to reapply for a position in the subsequent year. Individuals may not serve more than two consecutive terms (4 years) on the SAMC. This application package is for SAMC Positions 6 and 7. The SAMC positions are as follows:

1. Aquatic Expert: Scientist knowledgeable in aquatic ecology
2. Terrestrial Expert: Scientist knowledgeable in terrestrial ecology
3. Ecosystem Expert: Scientist knowledgeable in ecosystem function
4. Hydrology Expert: Scientist knowledgeable in hydrology, water operations and policy
5. Executive Committee Position: Provide the larger Program perspective, ensure topics and recommendations are current within the scope as decided by the EC, and provide direction for the completion of summary documents to the EC
6. **External Member Position: Provide objective input throughout the adaptive management process, especially for complex issues; Provide an outside perspective, free of conflict, and expertise in a specified area as determined by the EC; may be internal or external to the MRG**

The SAMC will meet every other month to discuss work products and conduct committee business. The time commitment for each member will vary, but is expected to be approximately 10-15 hours per month during meeting months. Time will include document reviews and the provision of comments; discussions with Program members, the MRGESCP Science Coordinator, and SAMC members; and preparing for and attending meetings.

To be considered for a position, please complete the following form and submit to the MRGESCP Science Coordinator via email at [email] along with your resume (limit 2 pages) by close of business on MM/DD/YYYY. If you are interested in being considered for more than one position, one application package must be completed for each position.

Name: Click or tap here to enter text.

Job Title: Click or tap here to enter text.

Affiliation: Click or tap here to enter text.

Daytime Phone Number: Click or tap here to enter text.

Email Address: Click or tap here to enter text.

Position for which you are applying (choose one per application package):

Choose one per application

Specific area(s) of research/expertise: Click or tap here to enter text.

Years of experience in your respective field: Click or tap here to enter text.

Years of experience working with the MRGESCP, and in what capacity:

Click or tap here to enter text.

Why would you like to serve on the Science and Adaptive Management Committee?

Click or tap here to enter text.

Please describe any specific experience working directly with the listed species of the Middle Rio Grande (i.e., New Mexico meadow jumping mouse, Pecos sunflower, Rio Grande silvery minnow, southwestern willow flycatcher, yellow-billed cuckoo) related to the topical area for which you are applying:

Click or tap here to enter text.

In your own words, describe what adaptive management means to you:

Click or tap here to enter text.

In your opinion, how can the MRGESCP contribute to adaptive management in the Middle Rio Grande?

Click or tap here to enter text.

If you are not currently active in the Middle Rio Grande Endangered Species Collaborative Program as a Program signatory, explain your specific interest in participating in the SAMC, and the perspectives and expertise you and/or your organization brings that is specific to the specified area of focus:

Click or tap here to enter text.

In one sentence, describe the biggest challenge facing the Middle Rio Grande:

Click or tap here to enter text.

How would you maintain scientific impartiality as a member of the SAMC?

Click or tap here to enter text.

Please provide the name, phone number and email address of at least one active MRGESCP participant as a reference:

Click or tap here to enter text.

By signing this application, you are committing to abide by the following statement:

> *As a member of the SAMC, I agree to uphold high scientific standards, work collaboratively, and advocate for the best science possible. I understand that if selected, I would be serving in the capacity as a technical expert in a specific field, and not as a representative of a specific organization. All views expressed in SAMC meetings will be my own and not those of my organization.*

Please sign and date this application by typing in the respective boxes, attach the application with your resume (limit 2 pages, no photos), and submit via email to the MRGESCP Science Coordinator by COB on MM/DD/YYYY.

Thank you for your interest in the Middle Rio Grande Endangered Species Collaborative Program.

Click or tap here to enter text.	Click or tap to enter a date.
Type Your Name	Today's Date

Application Packages

EC Discussion:

1. After reviewing both application forms, consider if these are the right questions to ask applicants.
    a. Will the questions reveal leadership skills?
    b. Will the questions reveal skills working as an effective team member?
2. How will the MRGESCP ensure impartiality amongst SAMC members?
    a. Review the following – By signing this application, you are committing to abide by the following statement: As a member of the SAMC, I agree to uphold high scientific standards, work collaboratively, and advocate for the best science possible. I understand that if selected, I would be serving in the capacity as a technical expert in a specific field, and not as a representative of a specific organization. All views expressed in SAMC meetings will be my own and not those of my organization.

See Comment #'s (12, 47, 62, 63, 84 – regarding bias), (101 – 103 regarding qualifiers for participation)

APPENDIX B: EXAMPLE MEETING AGENDAS

1. First Meeting Agenda Example

Welcome and Introductions *Science Coordinator*

- Members and roles

Overview of Executive Committee Direction *Science Coordinator*

- SAMC Charter
- Work Plan

Collaborative Program Work Plan *Science Coordinator*
Facilitated Discussion

- First Quarter planning
    - Hypotheses from conceptual ecological models
        - Discussion and decision on which to move forward
        - Map out process pathways for each hypothesis
    - Planned activities and steps to achieve them
    - Ad Hoc Groups to convene

➢ Agreement on hypotheses to move forward
➢ Agreement on Ad Hoc Groups to form
❖ **Next Step**: Provide EC update and seek approval on hypotheses and Ad Hoc Groups

Ad Hoc Group Formation *Facilitated Discussion*

- Development of draft charges for EC review
    - Specific tasks
    - Timelines
    - Work products
    - Membership

➢ Agreement on the elements of draft Ad Hoc Group charges and membership
➢ Direction to PST to draft charges for EC review and approval

Meeting Summary and Action Items Review *Science Coordinator*

Adjourn

2. General Meeting Agenda Example

Welcome and Introductions *Science Coordinator*

10 minutes **Non-Member Comment Period**

- By request at least two business days prior to the meeting
- Time limited
  - No more than 10 minutes total time for pre-prepared comments
  - 3 minutes per person (10 minute time limit includes 3 commenters and 1 minute for switching commenters)

Updates from the Ad Hoc Group Chairs *Ad Hoc Group Leaders*

- Progress reports
- Presentations if necessary
- Deliverables to review
- Comments and questions

➢ SAMC agreement on next steps
  - Updates to models
  - Items for EC review and approval
  - Additional Ad Hoc Group formation if needed

Work Plan Updates *Science Coordinator*
Facilitated Discussion

- Progress reports
  - Additional planned activities and steps to achieve them
  - Discussion on outstanding action items
  - Additional Ad Hoc Groups to convene if needed

➢ Action items to implement the work plan
➢ Plan for EC update and approval

Review directions from the EC since last meeting

- Hypotheses to move forward
- Ad Hoc Groups to convene

➢ Direction to PST to contact proposed members
➢ Direction to PST to convene Ad Hoc Groups once charges are approved (by the SAMC via email)

Meeting Summary and Action Items *Science Coordinator*

Adjourn

APPENDIX C: SCIENCE AND TECHNICAL AD HOC GROUP FORMATION

With EC approval, the SAMC will convene and coordinate Science and Technical Ad Hoc Groups to complete assigned tasks (*See SAMC Responsibilities)*

1. The SAMC will:
    A. Identify the tasks needed to implement the Science and Adaptive Management Plan with direction from the EC
    B. Develop Science and Technical Ad Hoc Group charge (*see Charge Template below*) to complete a specific task, including:
        i. Timelines and deadlines
        ii. Deliverable(s)
        iii. Identify Preliminary Membership
    C. Direct the PST to draft Ad Hoc Group charges for their review
    D. Direct the PST to contact the identified Ad Hoc Group members to secure their commitment
    E. The SAMC may ask other individuals to join the group if an identified member declines

2. The Science and Technical Ad Hoc Groups will:
    A. Meet as needed to carry out their charge, with support from the PST
    B. Select a group leader
        i. Progress updates to the SAMC
        ii. Communicate issues to the SAMC immediately
    C. Complete the assigned deliverables within the specified timeline

3. Once the Ad Hoc Groups submit work to the SAMC, the SAMC will take next steps, which may include the following:
    A. Request the existing Ad Hoc Group make revisions
    B. Translate scientific results into recommendations for EC approval
    C. Document the range of SAMC opinions for areas of non-consensus
    D. Get EC approval to convene a new Science and Technical Ad Hoc Group to address subsequent steps
        i. Develop a new charge

Science and Technical Ad Hoc Group
Charge Template

Approved by Executive Committee on [*DATE*]
Approved by the Science and Adaptive Management Committee on [*DATE*]

I. Originating Committee

Only the Executive Committee and the Science and Adaptive Management Committee can create an ad hoc group. The ad hoc group reports to their originating committee, or as assigned.

II. Ad Hoc Group Charge

Detail the ad hoc group charge. Include specific tasks and the MRGESCP objectives addressed by those tasks.

III. Membership

A. Criteria for membership

Provide a list of qualifications and/or interests members should possess

B. Member List

List the proposed members of the ad hoc group here, including affiliation and job title. The total membership should take into account the expertise needed to carry out the group's charge, and the group should be kept at a manageable size in order to complete the task within the timeline detailed in this document.

IV. Tasks and Deliverables

*List the specific tasks the ad hoc group is being directed to complete to fulfill their charge, and the deliverable(s) associated with each task. Tasks can be a concrete activity (e.g., data analysis, a scope of work, a model), or be process-oriented (e.g., develop options for addressing a hypothesis for the SAMC's consideration). *Add or delete numbers for additional tasks as needed*

1. **Task One Name**
   Details of task one
   Objective of Task One
   How will this task contribute to the group's overall charge?
   Deliverable(s):
   Clearly state the expected outcome

2. **Task Two Name**
   Details of task two
   Objective of Task Two
   How will this task contribute to the group's overall charge?
   Deliverable(s):
   Clearly state the expected outcome

V. Timeline and Reporting Scheduling

Complete the table, noting when tasks are expected to be complete, any subtasks, and the expected deliverable(s) to be submitted to the originating committee for review. The tasks in the table should match with those listed above. Each task should include updates to the originating committee.

Task	Subtask	Deliverable	To Be Completed By
Task one	Subtask 1A	Deliverable Name	Deadline
	Subtask 1B	Deliverable Name	Deadline
Task two		Deliverable Name	Deadline

FY21 Unfunded Activities

The following list of activities were funded by U.S. Army Corps of Engineers (USACE) through FY20. In FY21, these activities will be defunded as a result of USACE budget cuts.

1. MRGESCP Program Portal and database
2. Bosque Ecological Monitoring Program
3. Avian monitoring in the MRG
4. Multi-agency study for identifying restoration priorities for threatened tamarisk-dominated habitat to benefit future habitat for SWFL
5. Multi-agency Los Lunas habitat restoration project
6. Habitat restoration site surveying
7. SWFL surveys on the Rio Grande in the Albuquerque metro area
8. Tamarisk leaf beetle monitoring
9. Multi-agency assessment and quantification of sediment and discharge at Arroyo de los Piños
10. Changes in terrestrial soil loss in the MRG basin to 2100
11. Development and application of a HEC-RAS, mobile-bed, sediment transport model of the MRG
12. MRG groundwater monitoring
13. Multi-agency engineering modeling applications for quantifying habitat for the RGSM
14. Multi-agency environmental flow analysis of hydrograph and population parameters for RGSM recruitment
15. Evaluating the grain size of bedload transported from arroyos into the Rio Grande
16. Evaluation of sediment dynamics in habitat restoration features of the Albuquerque Reach
17. Monitoring climate change in the MRG
18. Water quality monitoring of aquatic refugia in the MRG
19. Multi-agency continuous water temperature monitoring of the MRG basin
20. YBCU noise and telemetry study

MIDDLE RIO GRANDE ENDANGERED SPECIES COLLABORATIVE PROGRAM

June 2020 Newsletter

FEATURED IN THIS ISSUE:

- Letter From the Program Manager
- Hydrology Update
  - May 2020 Jiggle
- Program Spotlight
- 2020 Graduates Spotlight
- Program Updates
  - Farewell Brent, Welcome Wayne
  - Science & Adaptive Management Plan Timeline
  - Recent Publications
  - Unfunded FY21 Activities
  - Funding Opportunities
- Upcoming Dates and Deadlines

Letter From the Program Manager

Dear Collaborative Program signatories, partners, and friends,

2020 has not been what any of us expected, and with every new turn, we have been forced to be flexible, innovative, and creative as we find new ways to operate. Coincidentally, these are the exact traits the Program needs as it establishes itself as a science-based program that informs adaptive management (AM). While this year has been and will continue to be challenging, it also offers an opportunity for us all to become more reflective and forward-thinking.

For the Program Support Team (PST), an unofficial theme of the year has been communication: how to facilitate better communication within the Program, whether amongst signatories or between scientists and technical experts, and how to translate complex technical information into a coherent and comprehensible message for the larger community. These avenues of communication are all vital to the Program's role in AM of the Middle Rio Grande (MRG).

Another unofficial theme for the Program has been planning for the future. The Program is in the last stretch of developing and transitioning to a self-sustaining AM framework that endures for a long time to come. To support this AM effort, the PST is developing a tool for the Program to track potential scientific questions, management options, and links between the two. Additionally, the Program is populating a project bank, which serves as an incubator for project ideas and accounts for the necessary hydrologic, biologic, and management conditions that are needed to implement each project. This will allow the Program to provide recommendations that meet the specific needs of a given time.

This Program is full of dedicated and passionate individuals doing great work. Our goal for the rest of 2020 is to build on that work by connecting the right pieces, improving communication, and out-planning for the future. These steps will poise the Collaborative Program to become a key part of AM in the MRG today and tomorrow.

Best wishes,
Debbie Lee
Program Manager

May 2020 Jiggle: Love in the Time of Corona

Update provided by Catherine Murphy, PST

This spring, Rio Grande silvery minnows (RGSM) ignored social-distancing guidelines thanks to the Minnow Action Team (MAT)'s successful late-May jiggle. The following partners participated in coordinating efforts: Middle Rio Grande Conservancy District, U.S. Fish and Wildlife Service, New Mexico Interstate Stream Commission, SWCA Environmental Consultants (SWCA), and the City of Albuquerque BioPark (BioPark), with assistance from the Albuquerque Bernalillo County Water Utility Authority, U.S. Bureau of Reclamation (Reclamation), and U.S. Army Corps of Engineers (USACE).

As a result of careful coordination between the groups, diversions for non-Pueblo irrigation were suspended at the Isleta Diversion Dam at 2 a.m. on Sunday, May 24th and resumed at 3 a.m. on Tuesday, May 26th. The flow modification created a sustained 300-500 cfs pulse of water intended to cue RGSM to spawn in several downstream reaches, where volunteers were positioned with egg-collecting equipment. In addition, the San Acacia Dam was kept open until 4 a.m. on Wednesday, May 27th to allow the majority of the pulse to continue down into the San Acacia Reach.

Beginning on May 25th, more than 113,000 RGSM eggs were collected from Los Chavez to San Marcial, with greater

(continued on page 3)



View of the jiggle from the Isleta Diversion Dam on the evening of Sunday, May 24th.
Credit: Catherine Murphy, PST



Pauletta Dodge (SWCA) and Anne Marken (MRGCD) clean an egg collector while trying not to spread COVID-19.
Credit: Catherine Murphy, PST

Hydrology Update (continued)



RGSM eggs on a collector screen.
Credit: Pauletta Dodge, SWCA

(continued from page 2)

than 80% collected at Highway 346 near Jarales, New Mexico. According to Kathy Lang with the BioPark, when large numbers of eggs are collected during a jiggle, some are transported to the Southwestern Native Aquatic Resources & Recovery Center (ARRC) in Dexter, NM and the remainder are usually taken to the BioPark. The fish hatched from these eggs are reared and kept for use as broodstock or they are tagged and released later the same year. During this year's event, the Southwestern Native ARRC received approximately 66,000 eggs, 50,000 to 70,000 eggs were transported to the BioPark, and additional collections were made by SWCA for the Los Lunas Silvery Minnow Refugium.

Flow alterations conducted in past years included a short-term jiggle in mid-May of 2013, a longer-term "recruitment flow" modification in mid-May of 2014, and four separate jiggles throughout the Angostura and Isleta Reaches in early to late May 2018. Summary data from these events indicate that jiggles in the Isleta Reach are most successful when they are conducted later in May and for longer than 24 hours. Additionally, keeping gates open at the San Acacia Dam may generate a secondary spawning event downstream. Together, the multi-agency coordination accomplished for the event, the dedication of the volunteers and staff, and the sharing of results and lessons learned exemplify the value and impact of adaptive management in the MRG.

Congratulations to the MAT on a successful 2020 jiggle!



RGSM egg attached to detritus.
Credit: Pauletta Dodge, SWCA

Program Spotlight

Michael Porter

U.S. ARMY CORPS OF ENGINEERS



Michael 'Mick' Porter is a fisheries biologist who has worked in the MRG for 19 years. He currently works for the Albuquerque District in the Environmental Resources section. Previously, he spent seven years at Reclamation. Porter has bachelor's and master's degrees from Eastern New Mexico University and earned his doctorate in fisheries biology from the University of Oklahoma. His teaching experience includes courses at several universities and the Gulf Coast Research Laboratory. He has volunteered for science trips in the Grand Canyon and Gulf of Mexico.

As a certified fisheries biologist for the Albuquerque District, Porter is responsible for protecting the endangered RGSM. He works to understand the habitat, behavior, diet, and reproductive cycle of the RGSM. Helping to better understand the RGSM through his broad, in-depth knowledge of fish biology and ecology is Porter's greatest contribution to the Albuquerque District. His expertise is further utilized by the USACE Environmental Research and Review Group.

Porter became a fisheries biologist because he enjoys collaborative problem-solving of challenging puzzles. Understanding fish ecology requires him to connect seemingly unrelated observations to form hypotheses, then create the techniques necessary to gather data that answer big questions. He enjoys using what he learns from engineers and scientists to discover how RGSM life history contributed to its persistence.

Porter views adaptive management as the framework for success in the MRG. His approach to adaptive management is grounded in his experience racing sailboats. While at the helm of a sailboat, he saw firsthand that success depended on constant observation of changing conditions, learning, and adjustment — all key steps in the adaptive management cycle.

Porter believes the convergence of population biology and environmental flow offers opportunities to learn more about RGSM persistence in the MRG. Looking forward, he predicts that understanding advances in population dynamics and fluvial geomorphology will shift management of the species away from construction of small patches of nursery habitat and towards a more resilient ecosystem approach.



The Kids Are Alright

BOSQUE SCHOOL GRADUATES IN ACTION

We are proud to spotlight two of the highest-achieving graduates of Bosque School: Alyssa Nelson and Isabel Dalton. These young women were co-recipients of the Aldo Leopold Legacy Award thanks to their tireless work on wildlife projects. The distinction is granted to those who engage in building a land ethic for a healthier environmental and human community, and these students have more than earned the award.









Clockwise starting top left: Isabel pipetting in the lab; Mexican gray wolf; Northern leopard frog; Alyssa holding a small snake
Credits: Student photos by Katie Elder; animal photos by Dan Shaw, Bosque Ecosystem Monitoring Program

Both students have done extensive work on multiple wildlife projects in the MRG and developed unique focuses. Alyssa's work focused on mapping the spread of chrytid fungus in efforts to protect species of amphibians across New Mexico. Isabel researched the effect of pack size on captive Mexican gray wolves' stress using fecal glucocorticoids. This past February, Alyssa and Isabel traveled to Arizona to present their work at the 53rd Joint Annual Meeting of the Arizona and New Mexico Chapters of the American Fisheries Society and The Wildlife Society.

In addition to their individual projects, these talented scientists enjoyed plenty of other wildlife adventures through their work on turtles, RGSM, and porcupine projects. In fact, both students were said to have earned "over a million" extra credit points by volunteering for any wildlife projects that needed help.

After graduation, both students plan to continue their educations. While Isabel will study the Kentucky cave shrimp of the Flint-Mammoth cave system at Berea College, Alyssa will attend the University of San Francisco as a political science major focusing on environmental justice and policy. Before heading off to college, both young women will spend their summer hiking, backpacking, and camping in New Mexico. Undoubtedly, their many experiences as wildlife adventurers and scientists will help shape their future journeys.

Program Updates

FAREWELL BRENT ESPLIN, WELCOME WAYNE PULLAN

Brent Esplin served as the Program's Federal Co-chair since 2014. His tenure as co-chair ended in 2020 and he recently made way for Wayne Pullan (pictured to the right) to join the Program as the new Federal Co-chair.

Wayne is the Deputy Regional Director of Reclamation's Upper Colorado Basin Region. He oversees a variety of water and hydropower programs in Arizona, Colorado, New Mexico, Texas, Utah, and Wyoming. He stepped into his new Program role in April 2020.

PLEASE JOIN US IN WELCOMING WAYNE PULLAN TO THE MRGESCP!



Science & Adaptive Management Plan Timeline

Periodic items to the Adaptive Management Work Group (AMWG)	**JUNE 1—AUGUST 5**
AMWG review period	**AUGUST 20—SEPTEMBER 17**
PST & AMWG individual review meetings	**AUGUST 28—SEPTEMBER 17**
PST revision period	**SEPTEMBER 17—29**
Full revised draft to AMWG as read-ahead	**SEPTEMBER 30**
AMWG meeting	**WEEK OF OCTOBER 5**
PST revision & technical editing period	**OCTOBER 8—16**
Executive Committee (EC) review period	**OCTOBER 19—DECEMBER 2**
PST & EC members individual review meetings	**OCTOBER 26—NOVEMBER 18**
PST revision period	**NOVEMBER 18—DECEMBER 4**
Final draft to EC as read-ahead	**WEEK OF DECEMBER 7**
EC meeting & final draft approval	**WEEK OF DECEMBER 14**

Recent Publications

The following are recent publications provided by MRGESCP participants:

Dudley RK, Platania SP, White GC. 2020. ***Rio Grande Silvery Minnow Population Monitoring During 2019***. Final Report submitted to the U.S. Bureau of Reclamation.

Dudley RK, Platania SP, White GC. 2020. ***Rio Grande Silvery Minnow Population Monitoring During April 2020***. Submitted to the U.S. Bureau of Reclamation.

Hatch MD, Abadi F, Boeing WJ, Lois S, Porter MD, Cowley DE. 2020. ***Sustainability management of short-lived freshwater fish in human-altered ecosystems should focus on adult survival***. PLoS ONE 15(5): e0232872. https://doi.org/10.1371/journal.pone.0232872

Regier PJ, González-Pinzón R, Van Horn DJ, Reale JK, Nichols J, Khandewal A. 2020. ***Water quality impacts of urban and non-urban arid-land runoff on the Rio Grande***. Science of the Total Environment 729. https://doi.org/10.1016/j.scitotenv.2020.138443

Unfunded FY21 Activities

The following activities were funded by USACE through fiscal year 2020 (FY20). In FY21, these activities will be defunded due to budget cuts. Please review this list and contact Lynette Giesen at lynette.m.giesen@usace.army.mil with any questions and funding opportunities.

- ◊ Avian Monitoring in the MRG
- ◊ Bosque Ecological Monitoring Program
- ◊ Changes in Terrestrial Soil Loss in the MRG Basin to 2100
- ◊ Development and Application of a HEC-RAS, Mobile-bed, Sediment Transport Model of the MRG
- ◊ Evaluating the Grain Size of Bedload Transported from Arroyos into the Rio Grande
- ◊ Evaluation of Sediment Dynamics in Habitat Restoration Features of the Albuquerque Reach
- ◊ Habitat Restoration Site Surveying
- ◊ Monitoring Climate Change in the MRG
- ◊ MRG Groundwater Monitoring
- ◊ MRGESCP Portal and Database
- ◊ Multi-agency Assessment and Quantification of Sediment and Discharge at Arroyo de los Piños
- ◊ Multi-agency Continuous Water Temperature Monitoring of the MRG Basin
- ◊ Multi-agency Engineering Modeling Applications for Quantifying Habitat for the RGSM
- ◊ Multi-agency Environmental Flow Analysis of Hydrograph and Population Parameters for RGSM Recruitment
- ◊ Multi-agency Los Lunas Habitat Restoration Project
- ◊ Multi-agency Study for Identifying Restoration Priorities for Threatened Tamarisk-Dominated Habitat to Benefit Future Habitat for SWFL
- ◊ SWFL Surveys on the Rio Grande in the Albuquerque Metro Area
- ◊ Tamarisk Leaf Beetle Monitoring
- ◊ Water Quality Monitoring of Aquatic Refugia in the MRG
- ◊ YBCU Noise and Telemetry Study

Funding Opportunities

Endangered Species Act Collaborative Projects

New Mexico Water Trust Board/New Mexico Finance Authority

Application Cycle: early August 2020—mid-December 2020

The 2001 Legislature enacted the Water Project Finance Act, which created the Water Project Fund. Under the Act, there are five project types eligible for consideration of financial assistance, of which, Endangered Species Act (ESA) Collaborative Projects are considered. The Water Trust Board supports implementation of river riparian and watershed restoration projects that aid in the recovery of listed species, satisfy water demands for the species, or reduce the likelihood of additional listings.

Qualified entities seeking funding for water projects from the Water Trust Board must submit an application each year. Qualified entities include state departments and municipal entities. For more information, visit the New Mexico Finance Authority website: https://www.nmfa.net/financing/water-programs/water-project-fund/

2020 National Fish Passage Program

Department of Interior, U.S. Fish and Wildlife Service

Application Due: September 30, 2020

The National Fish Passage Program is a voluntary program that provides direct technical and financial assistance to partners. Activities that restore fish passage also support the modernization of the country's infrastructure such as road culverts, bridges and water diversions. Example project types include dam removals, culvert replacements, and the installation of fishways. For more information, visit the grants.gov website: https://www.grants.gov/web/grants/view-opportunity.html?oppId=321478

State Wildlife Grant Program

Department of Interior, U.S. Fish and Wildlife Service

Application Due: August 31, 2020

The State Wildlife Grant Program provides states, the District of Columbia, commonwealths and territories federal grant funds for the development and implementation of programs for the benefit of wildlife and their habitats, including species that are not hunted or fished. Eligible activities include both conservation planning and implementation activities. For more information, visit the grants.gov website: https://www.grants.gov/web/grants/view-opportunity.html?oppId=314325

2020 National Fish Habitat Action Plan

Department of Interior, U.S. Fish and Wildlife Service

Application Due: September 30, 2020

The Fish and Wildlife Management Assistance Program provides technical and financial assistance to other federal agencies, states, local governments, Native American tribes, non-governmental organizations, citizen groups, and landowners for the conservation and management of fish and wildlife resources. This includes minimizing the establishment, spread, and impact of aquatic invasive species. Specifically, aquatic habitat conservation projects under this program must protect, restore, and enhance fish and aquatic habitats, as outlined in the National Fish Habitat Action Plan. Likewise, projects under this program, directly or indirectly, support and promote public access to recreational fishing opportunities and the sustainable use of other natural resources. For more information, visit the grants.gov website: https://www.grants.gov/web/grants/view-opportunity.html?oppId=321454

Upcoming Dates & Deadlines

Upcoming Meetings

Genetics Ad Hoc Group Meeting
June 25, 2020
9:00 AM—11:00 AM

Executive Committee Meeting
June 29, 2020
1:30 PM—4:30 PM

Minnow Action Team Meeting
July 23, 2020
9:00 AM—11:00 AM

Middle Rio Grande Deadlines

New Mexico Water Trust Board 2021 application cycle begins
August 2020

State Wildlife Grant Program applications due
August 31, 2020

2020 National Fish Passage Program applications due
September 30, 2020

2020 National Fish Habitat Action Plan applications due
September 30, 2020

CALL FOR ABSTRACTS

A River Runs Through It: People, Wildlife, and Habitat

RiversEdge West is calling for abstracts for its 19th Annual Research and Management Conference in Grand Junction on February 16—19, 2021 at Colorado Mesa University. You are invited to explore the ways in which river restoration impacts people, wildlife, and habitat for native species.

Abstracts for oral presentations and symposia are due October 16, 2020. Abstracts for poster presentations are due January 15, 2021. Email your abstract(s) in a Word document to Cara Kukuraitis at ckukuraitis@riversedgewest.org. For more information, follow the link: https://riversedgewest.org/events/2021-conference.



Photo: Scenic view of the MRG; Photo Credit: Mike Marcus, Assessment Payers Association of the Middle Rio Grande Conservancy District

Report of the Population Monitoring Workgroup
To the Executive Committee of the
Middle Rio Grande Endangered Species Collaborative Program

Richard Valdez, PMWG Chair
June 29, 2020

Introduction

The Population Monitoring Workgroup (PMWG) was formed by the EC in July 2012 for the purpose of evaluating and updating the fish monitoring plan for the Middle Rio Grande (MRG). The PMWG was charged with three tasks (1) Conduct a Workshop on CPUE, (2) Review the MRG Population Monitoring Plan, and (3) Update the Monitoring Plan. Recently, the PMWG has transitioned toward supporting the MRG Adaptive Management Process by helping to address scientific uncertainty and information gaps.

Meetings and Membership

Meetings are held every 1-4 months to allow time for analyses and membership availability. Meetings are attended by 15-20 MRG stakeholder representatives and interested parties. The meetings are open to the public and the notes and proceedings of each meeting are archived with WEST. Starting in March 2020, meetings are being held by webinar because of the COVID-19 Pandemic.

Actions and Accomplishments

Task 1: Conduct a Workshop on CPUE

- May 2014: Survey to EC on fish monitoring needs (DBSA 2015).
- Dec 8-10, 2015: Workshop with Independent Science Panel (Hubert, Fabrizio, Hughes).
- Apr 13, 2016: Final Report of Science Panel (Hubert et al. 2016).

Task 2: Review MRG Population Monitoring Plan

- Mar 23, 2017: PMWG requested that Reclamation incorporate eight Panel recommendations into Population Monitoring Contract.
- Jun 2017: Final Report on RGSM Scientific Uncertainties for AM (Noon et al. 2017).
- Nov 29, 2017: Consolidated review and prioritization of Science Panel Recommendations (Table 1).
- Jun 15, 2018: PMWG begin analyses of panel recommendations (e.g., Valdez 2018).
- Nov 11, 2018: Contracted biometrician initiates Integrated RGSM Population Model to evaluate management actions and science panel recommendations (Yackulic 2018).
- Feb 26, 2020: PMWG begins executive summaries of scientific topics identified from prioritized science panel recommendations (coordinated with Adaptive Management).

Task 3: Update the Monitoring Plan (inferences from Tasks 1 and 2)

- 27 years (1993-2020); long-term program with consistent methodology has value.
- RGSM CPUE has been used in:
    - Recovery criteria (USFWS 2010).
    - 2016 BiOp ITS (USFWS 2016).
    - Four modeling efforts (Miller, Goodman, Yackulic, Walsworth/Budy).
    - Estimates of survival, growth, recruitment reconcile with modeled trends.
- Modeling shows that CPUE appears to represent population trends over time.
- High variability in CPUE provides low precision for status of population, and change detection to management actions; these continue to be evaluated.
- Increased sample size and targeted mesohabitat sampling are also being evaluated.

Table 1. Science topics from Hubert and Noon Science Panel Recommendations.

Science Topic
1. Relationship of CPUE and true population size of RGSM
2. Age-specific survival of RGSM
3. Size and age-specific fecundity of RGSM
4. Relationship of demographic rates and abiotic and biotic factors
5. Evaluate existence and strength of density dependence to limit population
6. Effect of augmentation on RGSM Population
7. Contribution of salvaged RGSM to population dynamics
8. Develop and deploy "vertically-integrating" Moore egg collectors
9. Effect of environmental cues on spawning onset and activity
10. Age composition of RGSM population
11. Selectivity of gears used to sample RGSM
12. Spatial extent and historical availability of habitat and hydraulic quality used by RGSM
13. Roles and relative contributions to fish production by age in channel and floodplain habitats
14. Evaluate management potential for fish production by reach
15. Consolidation of mesohabitats for monitoring RGSM
16. Compute CPUE from larval and standard seines by age
17. Evaluate effect of zero catches on CPUE and sample design
18. Effect of environmental factors on seine capture probability
19. Mixture model and alternatives for computing RGSM CPUE
20. Use classification and regression trees, boosted regression trees, or random forests to examine relationships between hydrologic variables and CPUE
21. Effect of increased sample size on RGSM monitoring
22. Implement studies using different sampling designs

Middle Rio Grande Endangered Species Collaborative Program
Population Monitoring Work Group (PMWG)
2020 Work Plan

The Population Monitoring Workgroup (PMWG) is charged by the Executive Committee (EC) of the MRGESCP with evaluating the monitoring program and demographics for the Rio Grande Silvery Minnow (RGSM) in the Middle Rio Grande, in accordance with three tasks: (1) conduct a workshop on CPUE methodology, (2) review the fish population monitoring plan and demographics, and (3) update the monitoring plan. Task 1 was completed in 2016, and Task 2 is currently being executed by the PMWG.

The PMWG plans to conduct and complete the following elements under Task 2 in 2020:

Elements	Sub-Element	Target Completion Date
1. Integrate and prioritize consolidated recommendations from two science panels[1]	1a. Consolidate recommendations	1a. February 18, 2020
	1b. Complete Executive Summaries on six to eight recommendations to aid in the ranking and implementation processes	1b. September 15, 2020
	1c. Work with WEST to integrate recommendations into AM process	1c. Ongoing
2. Develop and review integrated RGSM model[2]	2a. Complete base model	2a. February 26, 2020
	2b. Review model parameters	2b. July 15, 2020
	2c. Conduct sensitivity analyses, and run scenarios	2c. September 15, 2020
	2d. Complete draft working model	2d. December 20, 2020
3. Develop draft report of Integrated RGSM model and preliminary results	3a. Complete Preliminary Draft Report on Integrated RGSM Model	3a. December 20, 2020
4. Reports to EC	4a. Draft Progress Report to EC	4a. June 2020
	4b. Present preliminary findings to EC	4b. June EC Meeting
	4c. End of Year Report to EC	4c. Last 2020 EC Meeting

[1] Hubert Science Panel Report was completed in 2016; Noon Science Panel Report was completed in 2017.
[2] Dr. Charles Yackulic of the USGS has been retained through the NMISC to develop an integrated model.

Comment #	Revised Proposal Section ID	EC Brief Section ID	Old Proposal Section ID	Comment	Response
1	n/a		General	Suggest start conversation at EC with reminder that the EC agreed to the new Program structure, including all new groups except the EC	
2	IV. 2. & Appendix A	IV. Bullet 2	IV. 3. d.	This [application packages] seems rather insulting to the Collaborative Program entities. I think there are many people who would contribute highly. Maybe discuss a workshop and from that develop a good start for membership. Throw the names for each discipline in a hat and grab them out and they begin the committee composition. Do this every year or two. Fair, impartial, and PST and Science Coordinator will have to make the best	See the full SAMC proposal detailing the list of suggested potential candidates and the Application Packets
3	IV. EC Discussion		General	Justify why the EC should support this 'radical' SAMC for the CP. The SAMC proposal would benefit the CP by reducing the time staff spent in long meetings, just like the EC wants to cut back their time in EC meetings. This supports agencies by allowing staff more time to work on agency priorities, increasing their effectiveness, and more control on their fiscal resources. The justification should build on EC preferences to have more control on CP while focusing decisions and tasks. The EC can exert more control by selecting SAMC members based on their leadership skills and knowledge, leading to more productive tasks assigned to ad hoc / review groups. Likewise, the suggested nomination process will better support the EC and SAMC by emphasizing leadership. The balance for expert and agency representation created by the IT/QCRT structure described above can be used by good leaders to address concerns raised by a few members.	See section - backup for EC discussion point
4	n/a		General	The proposal is well thought out and read clearly	
5	n/a		General	[The proposal] makes sense	
6	n/a		General	How do you get around the trust issues?	Improving communication and using transparent processes with active participation from all

7	n/a	General	How to balance agency / expert participation on SAMC tasks assigned to ad hoc teams. I suggest establishing a structure of an ad hoc implementation team (IT) w/ a complementary Quality Control review team (QCRT). This would allow the SAMC to assign smaller-right sized creative ad hoc implementation teams to writing, analysis, creative tasks that would be reviewed by a larger team (QCRT) that includes experts & agencies that were not represented in the implementation team. That allows the SAMC to focus on better IT composition to implement the task while addressing the need for more agency / expert involvement in the overall process. Suggest existing workgroups like the Population Monitoring & MAT are likely to retain the current membership, but encouraged to use the ad hoc IT/QCRT structure	Did not get to this comment, may address once the EC has convened if needed
8	n/a	General	Once questions were answered, the proposal makes sense	
9	n/a	General	[The proposal] is clear and makes sense	
10	III. 3. G.	General	The non-fed group thinks this group has too much authority	See revised proposal section(s) indicated
11	III. 1. A.; III. 3. F.	General	Make sure the science being done is linked to management	See revised proposal section(s) indicated
12	Application Packages	General	Question: How to avoid perception of bias if [external] members are paid by a signatory?	See revised proposal section(s) indicated
13	V. EC Discussion	General	Question: What is the process to get agency thoughts to the SAMC?	See revised proposal section(s) indicated
14	n/a	General	In description, be clear on projects vs. studies	Section deleted
15	II.	II.	How is the SAMC different than the EC?	See section for EC discussion point
16	II.	II.	We still believe an independent science panel is important to review this groups work on a regular basis. We don't see this group as the independent science panel.	The SAMC is intended to be a small group of experts guiding scientific reviews and proposing recommendations for independent peer review as necessary.

17	II.	I.	II.	Change to "The SAMC serves to initiate, evaluate, guide, and communicate science and adaptive management efforts for the MRGESCP, particularly to reduce scientific uncertainties important to water management efforts related to listed species in the MRG."	See section for EC discussion point
18	II.		II.	The SAMC should focus on science. The EC should be the policy link	See section for EC discussion point
19	II.		II.	Make sure the SAMC is science-focused	See section for EC discussion point and related revisions throughout the document
20	III. 1. E.; III. 4. E.	II.	III.	Add #4 "Revise SAM plan annualy to incorporate new information and opportunities"	See revised proposal section(s) indicated
21	III.		III.	SAMC Responsibilities: Leadership is an important concept for AM that should be specifically identified as a SAMC responsibility. Teamwork and problem-solving are also important concepts for effective AM, but understand if you can't work that into the bullet points.	See revised proposal section(s) indicated
22	III. 1- 4		III.	In general, too many responsibilities assigned to SAMC which is a small group of experts.	See revised proposal: revisions clarify that 4 main responsibilities are outlined, with the option to complete work by assigning it to other groups as needed.
23	III.	II. 1.	III. 1.	Change to "Manage the EC-approved science and adaptive management efforts"	Change not made; see revised proposal section indicated
24	III.		III. 1.	Change "Direct" to "Coordinate	See revised proposal section(s) indicated
25	III. 3.		III. 1.	Should this [FPC] be an EC task?	See revised proposal section(s) indicated

26	II.; III. 2.		III. 1. A & B	There seems to be a lot of responsibility given to this group. It seems to be both a Science and Policy committee. It may be better to have this group deal only with science. For example, in the Responsibilities section, III.1.A. seems very reasonable, but III.B. seems to step over into policy and decision making.	See EC discussion point and revised proposal section(s) indicated
27	IV. 3. D.	IV. Bullet 5	IV. 3. d. iii.	This is not necessary and again uncomfortable. We aren't sending people to the moon here. We are grateful EC signatories are providing staff to work on the SAMC and other more important work groups and efforts.	This has been added as a topic for EC discussion
28	III. 1. A - E +Note 1		III. 1. A. i-iv	Request revision of the SAMC proposal to make clear that the ad hoc groups will do work like complete scopes of work and data analyses	See revised proposal section(s) indicated
29	III. 1. A - E +Note 2		III. 1. A. i-v	These should all be Science and Technical Ad Hoc Group responsibilities, not the SAMC.	See revised proposal section(s) indicated
30	II. 4. E & G		III. 1. B. ii.	The ISP/science advisory panel can be another avenue if the SAMC can't make consensus. Relationship between the ISP and the SAMC should be really direct	See revised proposal section(s) indicated; ISP/science advisory panel will be detailed at a later date
31	III. 3. A - D		III. 2. A & B	Section III.2. seems like it should be more of the Fiscal Planning Committee's responsibility. SAMC should just prioritize projects but not determine funding or schedule based on funding.	See revised proposal section(s) indicated
32	III. 3. A - D	II. 2.	III. 2. A & B	Change to "Coordinate with project-level workgroups to plan, implement, and report on scientific and adaptive management projects" [FPC]	See revised proposal section(s) indicated
33	III. 3. A - D		III. 2. A & B	These are Fiscal Planning Committee functions, not SAMC functions.	See revised proposal section(s) indicated
34	III. 3. A - D		III. 2. A & B	[coordinate with FPC] Seems outside the scope of the SAMC	See revised proposal section(s) indicated
35	III. 3. A - D		III. 2. A & B	Concern that the coordination with the FPC might be an EC function the SAMC shouldn't have	See revised proposal section(s) indicated

36	III. 4. F.	II. 3.	III. 3.	Change to "Recommend species and water management opportunities and changes to the EC based on evaluation of projects"	See revised proposal section(s) indicated
37	III. 4.		III. 3.	Explicitly say a SAMC update at each EC meeting.	See revised proposal section(s) indicated
38	III. 4. F.		III. 3.	Include under functions regular reports to the EC, not just communicating scientific-based recommendations	See revised proposal section(s) indicated
39	I.; II.; III. 2.		III. B. ii.	This [translating science…] should be a primary function of the SAMC	See revised proposal section(s) indicated
41	IV.		IV. 1 & 2.	The SAMC is on the cusp of being too large and unwieldy. However, I don't see any positions that can be removed without diminishing the SAMC capabilities. Good job with formulation. The composition resembles a governing board for an NGO, which I view as a good approach. You may want to develop language in Sections IV.1 and IV.2 to reinforce this concept for the EC. The examples for external member and SME use climate science for both. I suggest revising so the examples don't overlap and emphasize these positions would bring different perspectives to the SAMC.	See EC discussion point and revised proposal section(s) indicated
42	IV.		IV. 1.	The make-up of the group is very complicated. I think we need some discussion at the EC of whether there needs to be such requirements, or if it can be simplified. We think 9-11 people would be good, 7 seems a little small.	See EC discussion point and revised proposal section(s) indicated
43	IV.	III. Bullet 1	IV. 1.	I understand the smaller is better concept but I think many of the signatories may be interested in a larger role in the program. The EC is not the place to get work done. So this group and workgroups have to work well together in order for this to work. Seems like there is a big disconnect between the SAMC and the workgroups that needs to be thought out –no evidence of that in this documents – and then described.	See EC discussion point and revised proposal section(s) indicated

44	IV.		IV. 1.	Only having one member per role can lead to issues with meeting scheduling or a quorum. Consider provisions for an alternate per position.	See EC discussion point and revised proposal section(s) indicated
45	IV.		IV. 1.	Question: Who chooses the alternate? The main member, or the EC?	See EC discussion point and revised proposal section(s) indicated
46	IV.	III. Bullet 1; sub-bullet 1	IV. 1. a. i.	(Voting?) [5 Members]	The SAMC is not intended to be a voting body.
47	IV. EC Discussion	III. Bullet 1; sub-bullet 2	IV. 1. a. i.	If RGSM is our main concern I think that most projects will be minnow related. Therefore the other members won't have much input and if that expert is from certain agencies there could be strong biases that can set us back from learning.	See EC discussion point and revised proposal section(s) indicated
48	IV. EC Discussion		IV. 1. a. i-iii.	Is there a required ratio of Fed to non-fed?	See topic for future EC discussion
49	IV. EC Discussion	III. Bullet 1; sub-bullet 2	IV. 1. a. ii-iii	nonvoting? [1 External Member, 1 SME]	The SAMC is not intended to be a voting body.
50	IV.	III. Bullet 1; sub-bullet 3	IV. 1. a. ii-iii	The area of focus? Two outside members? I'm ok with SAMC inviting scientists in to help on subject matter in general. They don't need to sit on a committee that meets often though)	See full proposal
51	III. & IV.	III. Bullet 1; sub-bullet 3	IV. 1. a. ii-iii	Why not just get the Independent Peer Review started and leave the external reviews there?	See full proposal
52	IV. 1. B. i-ii.	III. Bullet 2	IV. 1. b.	If everyone gets on the committee at the same time then how to stagger?	See revised proposal section(s) indicated
53	IV. 1. B. i-ii.		IV. 1. b.	I like the idea of term limits	Noted
54	IV. 1. B. i-ii.		IV. 1. b.	External members: Liked idea of having 1 year terms renewable up to 3 times (total 4 years)	See revised proposal section(s) indicated
55	IV. 1. B. i-ii.		IV. 1. b.	Suggest External and SME positions aren't 2 year terms, but one year with renewal.	See revised proposal section(s) indicated
56	IV. 1. C.		IV. 1. c.	If the Science Coordinator is the chair, does this person vote?	See revised proposal section(s) indicated

57	IV. 1. C.; IV. 1. H.		IV. 1. c.	Are they [the Science Coordinator] just an administrator?	See topic for EC discussion and revised proposal section(s) indicated
58	IV. 1. C.		IV. 1. c.	Also, who will this person [the Science Coordinator] be if there is not third-party management?	See topic for future EC discussion and revised proposal section(s) indicated
59	IV.		IV. 2.	Not a wide variety of Program representation in this group, could end up being more federal than non-federal representatives.	See topic for EC discussion and revised proposal section(s) indicated
60	Appendix A		IV. 2.	Suggestion to add list of qualifications/skills to help EC think through SAMC membership (ex: leadership, collaborative)	See revised proposal section(s) indicated
61	IV.	V.	IV. 2.	Add an Agricultural Expert position	See topic for EC discussion and revised proposal section(s) indicated
62	Appendix A		IV. 2.	Bias based on agency POV would be hard to remove for individual members	See revised proposal section(s) indicated
63	IV.	V. 1.	IV. 2. a.	Make the [Aquatic Ecology Expert] position be two people. So much emphasis is on water and RGSM, this concerns me as to the potential for bias.	See topic for EC discussion and revised proposal section(s) indicated
64	IV.	V. 2.	IV. 2. b.	Is this [Terrestrial Ecology Expert] both birds, mouse, and sunflower? Are there other expertise needed?	See full proposal
65	IV.	V. 3.	IV. 2. c.	I assume the ecosystem expertise also understand ecosystem. Not sure what you are looking for here.	See full proposal
66	IV. 2. D.	V. 4.	IV. 2. d.	Because you are doing AM planning and implementation perhaps this [Hydrology Expert] can be 2 positions, one water ops and one ecosystem hydrology/modeler or other expertise.	See topic for EC discussion and revised proposal section(s) indicated

67	IV. 2. E.	V. 5.	IV. 2. e.	Delete Executive Committee member position	See topic for EC discussion and revised proposal section(s) indicated
68	IV. 2. E.		IV. 2. e.	The EC member can represent the SAMC to the EC. It would be useful to have somebody knowledgeable about policy on the SAMC.	See topic for EC discussion and revised proposal section(s) indicated
69	IV. 2. E.		IV. 2. e.	EC position: Should this person be more of an advisor or liaison rather than a full EC Member?	See topic for EC discussion and revised proposal section(s) indicated
70	IV. 2. E.		IV. 2. e.	EC position seems unnecessary given the SAMC should be a small group of experts focused on science	See topic for EC discussion and revised proposal section(s) indicated
71	IV. 2.		IV. 2. f & g.	External members and SME's for the SAMC should likewise have the support of their organizations, but may be nominated by CP agencies (not a requirement).	See revised proposal section(s) indicated
72	future discussion		IV. 2. f & g.	External members: Goal is volunteers, but put in that they could be jointly funded	See topic for future EC discussion
73	future discussion		IV. 2. f.	Who pays for this person's [External Member] time to be on the SAMC?	See topic for future EC discussion
74	future discussion		IV. 2. f.	I like the idea of having an external member of the SAMC, where does the funding for this position come from?	See topic for future EC discussion
75	future discussion		IV. 2. f.	Are there provisions for paying external members?	See topic for future EC discussion
76	future discussion & IV. 2.	V. 7.	IV. 2. g.	Bring in expertise as needed and provide small budget to do so. Can then eliminate this [Subject Matter Expert] position.	See topic for future EC discussion and revised proposal section(s) indicated

77	future discussion & IV. 2.		IV. 2. g.	Does this person [Subject Matter Expert] rotate into the SAMC depending on the specific science topics being discussed?	See topic for future EC discussion and revised proposal section(s) indicated
78	future discussion		IV. 2. g.	Also, who pays for this person's [Subject Matter Expert] time to be on the SAMC?	See topic for future EC discussion and revised proposal section(s) indicated
79	IV. 3. A. i.	IV. Bullet 2	IV. 3.	I think the EC members could offer names [of interested individuals as SAMC members] that have the time to sit on the SAMC.	See revised proposal section(s) indicated
80	future discussion	IV. Bullet 1	IV. 3. a. i.	What is this? [area of focus recommendation example] Sounds like a waste of time. How are we discussing getting projects completed from this focus?	Focus area temporarily deleted and awaiting future EC discussion
81	future discussion	IV. Bullet 1	IV. 3. a. i.	Better to have SAMC provide options for focus studies and then have the EC decide.	Focus area temporarily deleted and awaiting future EC discussion
82	future discussion		IV. 3. a. i.	First area of focus needs to be asking science questions and providing the science-based answers for uncertainties, CEM hypotheses and monitoring questions.	Focus area temporarily deleted and awaiting future EC discussion
83	future discussion		IV. 3. a. i.	Forecasting and scenario planning should come out of the resolution of scientific uncertainties. Our first area of focus should be resolving the current uncertainties around monitoring.	Focus area temporarily deleted and awaiting future EC discussion
84	VI. 2. & Appendix A		IV. 3. b.	In the Columbia River, they have a list of skills and qualifications to consider when deciding who to appoint to the science group. They try and get at implicit bias, not just conflict of interest related to contracting.	See revised proposal section(s) indicated
85	III. 1. E.; III. 4. E.		III.	There should be some reference to the actual adaptive management plan in the proposal, with the SAMC having the responsibility of updating the AM Plan annually.	See revised proposal section(s) indicated
86	IV. 3. D.	IV. Bullet 4	IV. 3. d. ii.	Why is this [EC nomination of EC member] necessary? The EC member really only represents themselves. I think it is not a good idea and likely will not have time to devote to this committee.	This has been added as a topic for EC discussion

87	III. 1 - 3		III. 1. A.	The functions seemed to be a lot of work - highlight the delegation better.	See revised proposal section(s) indicated
88	Appendix B		IX. 1 & 2	The agendas give the perception the SAMC is like an EC. Suggest redoing them to show the EC is still providing direction and the SAMC is pushing products up.	See revised proposal section(s) indicated
89	n/a	Intro	n/a	Is this group [SAMC] assisting the Science Coordinator or visa versa?	See full proposal
90	n/a	Intro	n/a	None of this was useful. How about, this is the PST's proposal for the purpose and composition of the SAMC. Is this a decision item for the EC in June? If so, say so.	See full proposal
91	Appendix C; III.		S&T Ad Hocs	Would like more detail on how ad hoc groups are formed and composed. Question of agency representation on those groups.	See revised proposal section(s) indicated
92	IV. 2.		V.	I would reframe the discussion on CP staff members who are also contractors to focus on leadership and team work. I think the EC could become stuck in this rabbit hole. Likewise, if an agency nominates someone who has been more peripheral to the CP, they should be evaluated on their merits rather than having tenure in the CP. This is an opportunity for new perspectives.	See revised proposal section(s) indicated
93	IV. 2. A - E		V.	Under Section V. you should move the list of potential members to a separate list. It distracts readers into thinking about who they think should be on the SAMC. It would be useful to compile a supporting spreadsheet of all the agency and contractor experts, with columns listing their skills. The SAMC can use it for identifying people for the ad hoc committees. I would emphasize the opportunities for everyone (who is interested) to participate on the ad hoc committees under the direction of the SAMC.	See revised proposal section(s) indicated
94	future discussion		V.	How does the EC decide an area of focus?	Focus area temporarily deleted and awaiting future EC discussion
95	future discussion		V.	More details on the area of focus.	Focus area temporarily deleted and awaiting future EC discussion

96	future discussion	V.	Question: Would the members change when the area of focus changes?	Focus area temporarily deleted and awaiting future EC discussion
97	n/a	V. 5.	Can any CP signatory apply for these positions or just those listed here?	No signatory is precluded from applying for a SAMC position
98	IV. 2. & EC discussion	V. EC discussion	Add tribal agencies to the conflict of interest list	See revised proposal section(s) indicated
99	future discussion	V. Example 2	I think the SAMC should be focusing on the science uncertainties in each reach and how those are resolved, not necessarily the project planning.	Focus area temporarily deleted and awaiting future EC discussion
100	future discussion	V. Example 3	Science to understand how to improve habitat restoration or what restoration efforts are effective is a useful subject for the SAMC.	Focus area temporarily deleted and awaiting future EC discussion
101	IV. 2.	VI.	SAMC qualifications (for all members) must include leadership and team skills in addition to technical expertise (governing board concept). These skills are very different from supervisory or contract oversight. A single leader may be productive on the SAMC. A SAMC composed of more leaders with team skills is more likely to move the program forward. I would add several leadership / team work / problem-solving requirements to the application form.	See topic for future EC discussion and revised proposal section(s) indicated
102	Appendix A	VI.	I think the SAMC applications (1-4) should be supported (signature /letter) by the CP agency chief/ EC member, and forwarded through the CP agency representative. A nomination letter / support signed by the agency would elevate serving on the SAMC as representing the agency and the CP. I recognize that a more formal process won't guarantee better leadership, but it may help. For the EC representative, the EC should nominate the person(s), hopefully based on their leadership / teamwork skills.	This is not applicable to all signatories

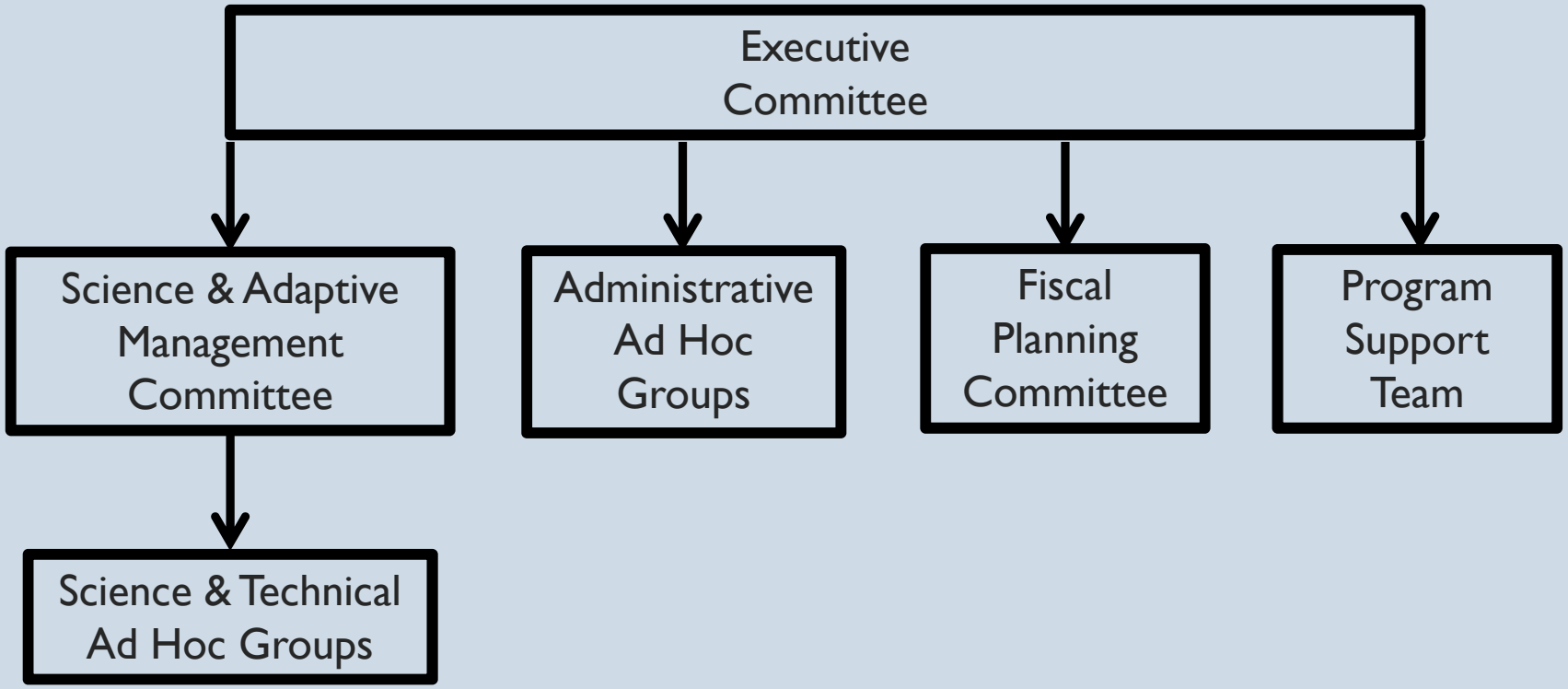
103	Appendix A	VI.	Move the VI. SAMC applications into an attachment (preferred) or to the end of the detailed proposal (minimum). If the EC wants to review the application forms, that should occur after they accept the basic SAMC proposal. This squirrel will keep the EC distracted for hours. Much better as a homework assignment.	See revised proposal section(s) indicated
104	V.	VII. Bullet 1, sub-bullet 1	Since the EC does not require two days advanced notice for public comment, I don't think the SAMC should have that either. You want participation and public engagement in the Program, so public comment should be signed up for on a sign-up sheet available prior to the meeting.	This has been added as a topic for EC discussion.
105	V.	VII. Bullet 1, sub-bullet 1	Public comment is too rigid. Wants to have people attend meetings and hear the conversations	This has been added as a topic for EC discussion.
106	V.	VII. Bullet 1, sub-bullet 3	Add "and read-aheads"	See revised proposal section(s) indicated
107	V. 2. iii.	VII. Bullet 2	Items with disagreement should be referred for independent peer review. Can the SAMC decide to send something for independent peer review, or is that an EC decision? Items referred to an independent peer review panel should be pertinent to achieve Program goals. If the item of issue does not support achieving a Program goal, it may not be beneficial to send for independent peer review by the Program.	The SAMC can make a recommendation, but the EC is the ultimate decision maker on independent peer review. Many factors play into whether or not independent peer review is appropriate or possible (possible = resources).

SCIENCE AND ADAPTIVE MANAGEMENT COMMITTEE PROPOSAL

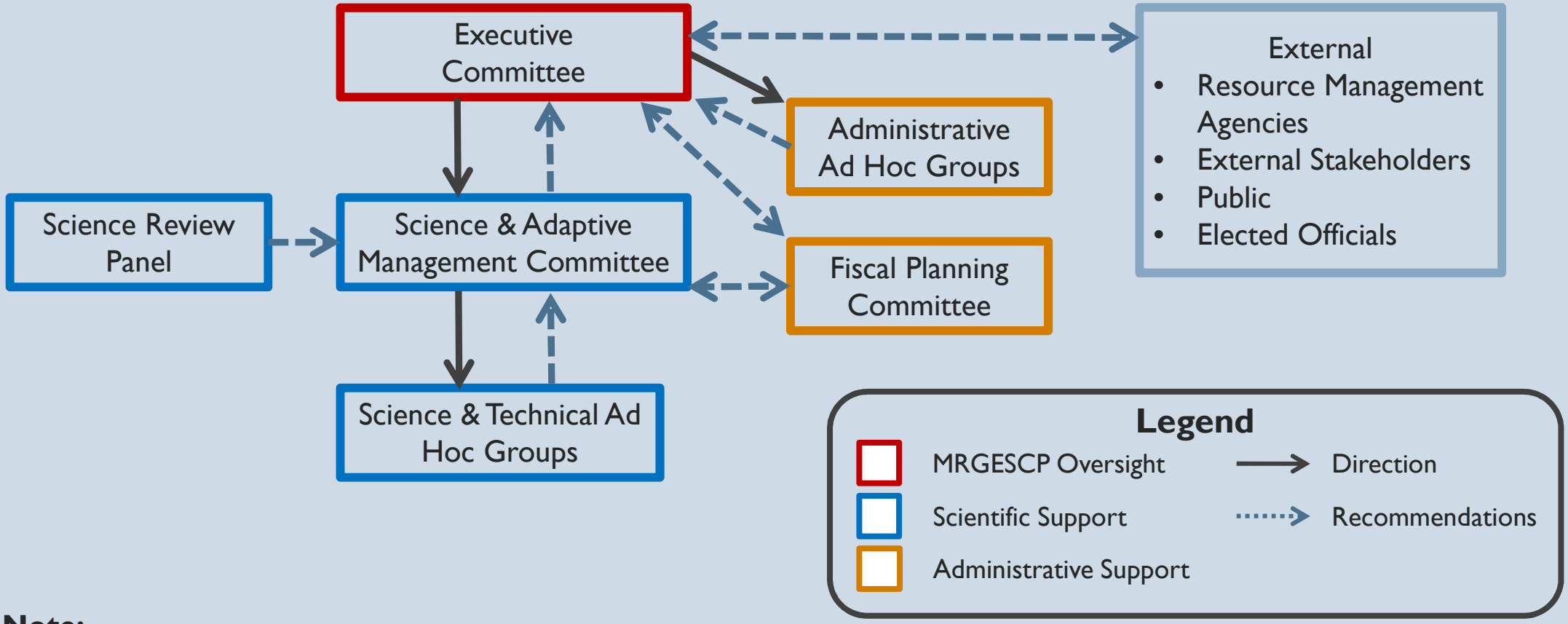
Executive Committee Meeting

June 29, 2020

MRGESCP HIERARCHICAL STRUCTURE



OPERATIONAL STRUCTURE FOR IMPLEMENTING THE MRGESCP'S SCIENCE & ADAPTIVE MANAGEMENT PROGRAM



Note:

The **Program Support Team** (PST) coordinates the overall MRGESCP operations, including providing administrative, scientific and technical support for the meetings and the lines of direction and recommendations. The PST has not been added to this directional process structure.

KEY POINTS

1. Page 2: Several questions arose that are more appropriate for a future meeting, once the foundation has been agreed upon by the EC
2. The SAMC is not a voting or decision-making group
    a. Responsibility: Translate and synthesize scientific results and recommendations, including the rationale for any supported differences of opinion within the MRGESCP, to the EC
3. The EC is the decision-making body for the MRGESCP
    a. Provide direction to committees and groups
    b. Consider the science-based recommendations within a policy context
    c. Communicate final recommendations to implementing entities and external stakeholders

PURPOSE

Questions:

1. Does the EC agree that the SAMC's focus is on science?
2. Does the EC agree that the EC provides the policy oversight component (i.e., attention to MRGESCP mission and goals; laws and regulations)?
3. Does the SAMC need express EC approval to convene and task Science and Technical Ad Hoc Groups?

RESPONSIBILITIES

Questions:

1. Are the outlined tasks appropriate for the SAMC?
2. Does the EC agreed that no voting or decision-making authority belongs to the SAMC?

COMPOSITION AND FORMATION

Questions:

1. Is the proposed term limit appropriate?
2. What is the appropriate size to maintain a functional science-focused group?
3. If additional membership is proposed, what value do the additional members offer to the efforts of the SAMC?
4. If additional membership is proposed, what are the proposed members' qualifications on a science-focused group?

CONTINUED: COMPOSITION AND FORMATION

Questions:

5. Assuming a science focused group, is an EC member appropriate?
6. Is holding a SAMC position a conflict of interest for contractors?
    a. Should contractors be permitted to hold SAMC positions as MRGESCP members?
    b. What about applicants that are a contractor to a MRGESCP signatory? Contractors that are MRGESCP signatories?
7. Should individuals employed by a signatory but not active Program participants be permitted to hold a SAMC position as a signatory member? Are they able to apply for the External Expert position?

FORMATION PROCESS

Questions:

1. Is the formation process clearly outlined?
2. Is the formation process appropriate?

MEETING OPERATIONS

Questions:

1. What is the best way for the science-focused committee to be productive while allowing for non-member input?

EVALUATION

Questions:

1. What should be included in the annual update?
2. How should the SAMC be evaluated, and at what frequency?

APPLICATION PACKAGES

Questions:

1. After reviewing both application forms, consider if these are the right questions to ask applicants
   a. Will the questions reveal leadership skills?
   b. Will the questions reveal skills working as an effective team member?

CONTINUED: APPLICATION PACKAGES

Questions:

1. How will the MRGESCP ensure impartiality amongst SAMC members?
    a. Review the following – *By signing this application, you are committing to abide by the following statement: As a member of the SAMC, I agree to uphold high scientific standards, work collaboratively, and advocate for the best science possible. I understand that if selected, I would be serving in the capacity as a technical expert in a specific field, and not as a representative of a specific organization. All views expressed in SAMC meetings will be my own and not those of my organization.*

September 1, 2020

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

Draft Executive Committee Science and Adaptive Management Committee Workshop Decisions [draft]

Middle Rio Grande Endangered Species Collaborative Program Science and Adaptive Management Committee Proposal [revised]

Middle Rio Grande Endangered Species Collaborative Program Fiscal Year 2019 Annual Report [draft]

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Executive Committee (EC) Meeting
September 1, 2020
1:00 – 3:30 PM

Location: Zoom Meeting
https://west-inc.zoom.us/j/8983593120
Call-In: +1-669-900-6833
Meeting ID: 898-359-3120

Meeting Agenda

Meeting Objectives:

- *Approve the Fiscal Year 2019 (FY19) Annual Report*
- *Approve the Science and Adaptive Management Committee (SAMC) proposal*
- *Agree on SAMC membership next steps*

1:00 – 1:10	**Welcome, Introductions, Agenda Review** • Ground rules for zoom meeting ➢ **Decision**: Approval of September 1, 2020 EC meeting agenda	*EC Co-chairs*
1:10 – 1:25	**June 2020 Meeting Summary** • Action Items Review ➢ **Decision**: Approval of June 29, 2020 EC meeting minutes Read ahead: ☐ June 29, 2020 EC meeting minutes	*EC Co-chairs*
1:25 – 1:35	**Program Manager Update** • Newsletter • Work Plan Update • Science Symposium planning update • FY19 Annual Report Approval ➢ **Decision**: Approval of MRGESCP FY19 Annual Report Read ahead: ☐ MRGESCP FY19 Annual Report	*Debbie Lee, Program Support Team (PST)*

1:35 – 2:15	**Science and Adaptive Management Committee (SAMC) Proposal** • Review of August SAMC workshop agreements • Revised SAMC proposal • Discussion Read ahead: ☐ Agreements from August SAMC workshop ☐ Revised SAMC proposal ➢ **Decision**: Approve implementation of SAMC ➢ **Action Item**: Draft SAMC charter	*Facilitated discussion*
2:15 – 2:30	**Break**	
2:30 – 3:00	**SAMC Next Steps** • SAMC application process • EC vetting and voting process ➢ **Decision**: Areas of expertise for SAMC members ➢ **Action Item**: Formation of EC sub-committee to review SAMC membership applications and present recommendations to full EC ➢ **Action Item**: Administer SAMC application process	*Facilitated discussion*
3:00 – 3:10	**Public Comment**	
3:10 – 3:20	**Announcements**	
3:20 – 3:30	**Meeting Summary and Action Items Review** ➢ Next EC Meeting: Late October 2020 to vote on SAMC membership and convene the SAMC	*EC Co-chairs*

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Executive Committee (EC)
Meeting Minutes

September 1, 2020; 1:00 PM–4:00 PM
Location: Zoom Meeting

Decisions:

- ✓ Approval of September 1, 2020 EC meeting agenda
- ✓ Approval of June 29, 2020 EC meeting minutes with an amendment to the hydrology section
- ✓ Approval of the Fiscal Year 2019 (FY19) Annual Report
- ✓ Approval of the Science and Adaptive Management Committee (SAMC) proposal
- ✓ Approval of the SAMC application
- ✓ Approval of an Administrative Ad Hoc Group with the following participants to review SAMC applications and provide recommendations to the EC:
    - o Anne Marken, Middle Rio Grande Conservancy District (MRGCD)
    - o Grace Haggerty, New Mexico Interstate Stream Commission (NMISC)
    - o Jim Wilber, U.S. Bureau of Reclamation (Reclamation)
    - o Kate Mendoza, Albuquerque Bernalillo County Water Utility Authority (ABCWUA)
    - o Janet Jarratt, Assessment Payers Association of the MRGCD (APA)
    - o Shawn Sartorius, U.S. Fish and Wildlife Service (USFWS)

Action Items:

WHO	ACTION ITEM	BY WHEN
Program Support Team (PST)	Draft a SAMC charter	10/20/2020
PST	Send out an email with the SAMC application and cover letter	9/8/2020
MRGESCP	Encourage qualified individuals to apply for the SAMC	9/25/2020
PST and Administrative Ad Hoc Group	Finalize SAMC positions using list of desired expertise from EC discussion	End of September, Early October
PST and Administrative Ad Hoc Group	Review SAMC applications	End of September, Early October
Administrative Ad Hoc Group	Provide recommendations for SAMC membership to the EC	10/20/2020
PST	Schedule EC meetings for October 27, 2020 and December 17, 2020	9/2/2020
PST	Send out requests for cost share and FY20 Annual Report write-ups	September/October 2020

Next Meeting: October 27, 2020; 2:00 – 4:00 PM

Meeting Summary

Welcome, Introductions, Agenda Review
Agenda review

Wayne Pullan, Reclamation, opened the meeting and led introductions. The EC approved the meeting agenda with no amendments.

- ✓ **Decision**: Approval of the September 1, 2020 meeting agenda by the EC

June 2020 Meeting Summary
Minutes review

The June 2020 meeting minutes, decisions, and action items were approved by the EC with an amendment to the hydrology update.

- ✓ **Decision**: Approval of June 29, 2020 EC meeting minutes by the EC with an amendment to the hydrology section

Program Manager Update
Newsletter
FY19 Annual Report Approval
Work plan update
Science Symposium update

Debbie Lee, Program Manager, presented an update.

- The next newsletter will be released later in September.
- The FY19 Annual Report was approved by the EC.
- The PST is developing a Program work plan to be adopted by the EC. It covers the implementation of the Program's science and adaptive management process, which will largely be driven by the SAMC.
- The Adaptive Management Work Group (AMWG) is currently reviewing the Science and Adaptive Management (S&AM) Plan before it is sent to the EC.
- The Program is planning the 2020 Science Symposium, tentatively scheduled for December 1-3, 2020. The event will be virtual and a call for abstracts was sent out. Meeting participants are invited to distribute the call for abstracts to interested parties.

- ✓ **Decision**: Approval of the FY19 Annual Report by the EC

- ➢ **Action Item**: Program participants distribute the call for abstracts to interested parties

Science and Adaptive Management Committee (SAMC) Proposal
Review of August SAMC workshop agreements
Revised SAMC proposal
Discussion

The SAMC proposal was revised to reflect the agreements from the SAMC Workshop on July 16, 2020. The EC approved the SAMC proposal with no amendments. The Program will move to implement the SAMC.

- ✓ **Decision**: Approval of the SAMC proposal by the EC

SAMC Next Steps
SAMC application process
EC vetting and voting process

The PST will draft a SAMC charter based on the approved SAMC proposal for EC review and approval at the next meeting. The approved proposal states the SAMC has eight members, four with specified areas of expertise and four with flexible areas of expertise. The four flexible areas of expertise must be decided. Catherine Murphy, Senior Science Coordinator, presented a preliminary draft work plan for the SAMC with listed tasks. These were the main points from the draft work plan:

- Implementing the S&AM Plan will require two levels of effort:
  - The first effort is updating the knowledge base and objectives that will guide the Program's science initiatives. This will primarily be achieved through the Adaptive Management (AM) Database and synthesis of existing information. A product of this work is the development and refinement of the Long-Term Plan, which prioritizes activities based on relevance to Program goals.
  - Second effort is enhancing the resilience and readiness of the Program through planning and risk analysis. This requires learning from past efforts, exploring scenarios, and developing action plans. This will allow the Program to be more responsive to changing river and regulatory conditions.
- The PST proposes to implement a SAMC work plan once the SAMC convenes in November 2020 through 2021, with six main tasks:
  - Update Program objectives
    - A workshop will be held to evaluate past objectives and establish new objectives, if needed.
  - Evaluate the population monitoring program
    - Catherine M. and Rich Valdez, the Population Monitoring Work Group (PMWG) chair, discussed transitioning the work of the standing PMWG to Ad Hoc groups. The PMWG will briefly summarize its accomplishments over the last 8 years, and recommend tasks to be carried over to the SAMC. The PMWG will sunset, and the SAMC will break down its tasks into smaller pieces and assign them to Science and Technical (S&T) Ad Hoc Groups.
  - Synthesize findings from the Science Symposia
    - The focus of the science symposium is sharing information. The SAMC will synthesize information from each symposium and apply it to the Program's models and knowledge base.
  - Utilize conceptual ecological models (CEMs)
    - The Rio Grande silvery minnow (RGSM), yellow-billed cuckoo, and southwestern willow flycatcher CEMs have been developed and will be integrated into the AM Database and utilized to develop projects. The Pecos sunflower and New Mexico meadow jumping mouse CEMs are still in development.
  - Improve science communication

        - Refinement of communication processes outlined in the S&AM Plan (including scopes of work, document review, and use of the CEMs) will be coordinated by the SAMC.
    - Plan for the future with adaptive science
        - Learn from past efforts and apply the lessons learned. Look at river and climate forecasts and come up with action plans for various scenarios. This will enable the Program to be more responsive and to provide direction for scientific studies.
- These six tasks help guide the choice of flexible skillsets needed on the SAMC. The following skillsets were suggested by Catherine M. to meet the listed tasks:
    - Knowledge of the system and species
    - Population modeling or genetics
        - The Population Monitoring and the Genetics and Propagation Programs have generally operated separately. Having a genetics perspective on the SAMC could inform the Population Monitoring Program by incorporating genetic considerations into RGSM population dynamics.
    - Technical synthesis of scientific writing and interpretation of science across a variety of disciplines
    - Knowledge of species ecology and experimental design
    - Technical writing and statistical analysis
    - Climate science and forecasting
    - Risk management

Following Catherine M.'s presentation, the EC members discussed potential expertise that could be included on the SAMC. The following roles were proposed:

- Physical scientist, such as another hydrologist or a geomorphologist
- Climate expert
- Urban planner
- Geneticist
- Biometrician or statistician

The following additional points were raised during the EC discussion:

- An ecological statistician could help review the SAMC tasks.
    - The PST can provide statistical services through the current Program and Science Support Contract.
- Reclamation, MRGCD, and others coordinate on the Rio Grande Basin Study. The study looks at the future of the Basin, including climate change, using hydrology projections for the next 100-150 years. As the Program may want to include a climate scientist on the SAMC, it could interface with the Basin Study. Alternatively, the Program could be regularly informed by the study.
- A physical scientist is missing.
    - A soil scientist might be useful as a soil moisture study was proposed.
    - There could be two hydrologists; one that has modeling expertise and one that has expertise in geomorphology or sedimentology.
    - Some of the signatories originally suggested having two hydrologists on the SAMC, but there do not appear to be any specific tasks related to hydrology on the SAMC work plan. As the low water situation in 2020 will likely continue in 2021, it would be helpful to have some connection to the water.

        - Hydrology is inherent in many of the listed tasks, such as identifying management actions and refining and using the RGSM CEM. It is also vital to planning.
- The SAMC may need someone with expertise in urban growth or planning to understand how water use will progress in the future.
    - As we are concerned about the impacts of climate change, we may need to understand how urban water demands may change.
    - The SAMC can query the utility managers. They spend a lot of time and money on projections and know what the plans are. Some do climate change modeling.
    - The urban planning needs to stay in the Basin Study because it involves looking at water uses and making projections. The information can be used by the Program, but the Program is primarily focused on looking at future actions as they relate to species.
- This group seems to be morphing into water planning. If this is a science committee dealing with endangered species, it does not need to do water planning. If the SAMC wants to be collaborative, there needs to be transparent discourse on what the Program's values are.
    - The purpose of the SAMC is to be the funnel for science information. The SAMC openly translates science into recommendations with supporting evidence for best management practices.
    - Transparency is enhanced when Program members take ownership of the AM Database and contribute to it.
- The SAMC is not the only place for technical experts. The S&T Ad Hoc Groups will need experts to deal with specific issues.
- Some of the experts mentioned can be invited to present to the SAMC if they are not members.
- It may be more helpful to have scientific generalists on the SAMC that can speak to a variety of disciplines. They can interpret the work of the S&T Ad Hoc Groups for the non-scientists on the EC.
- The EC will form an Administrative Ad Hoc Group to review SAMC applications and make recommendations to the EC. The Ad Hoc Group will use the list of desired areas of expertise as a guide for reviewing the SAMC applications.
    - The group will likely meet once.
    - The following EC members volunteered to sit on the Administrative Ad Hoc Group:
        - Anne Marken, MRGCD
        - Grace Haggerty, NMISC
        - Jim Wilber, Reclamation
        - Kate Mendoza, ABCWUA
        - Janet Jarratt, APA
        - Shawn Sartorius, USFWS
    - To ensure no conflict of interest, members of the Administrative Ad Hoc Group cannot apply for the SAMC.
    - The EC approves the SAMC application included in the SAMC proposal.
        - The PST will accept applications over the next three weeks.
        - The Administrative Ad Hoc Group will meet in early-mid October to review the applications. Then, the EC will meet and vote on membership.
    - How will the Program outreach for SAMC applicants?
        - The EC decided applicants could either self-nominate or be nominated by others.
        - Program members are invited to nominate others or apply for themselves.

- The PST will put together an email that can be easily forwarded.
- The intent is to cast a wide net and invite new people in.

✓ **Decision**: EC approval of the SAMC application
✓ **Decision**: EC approval of an Administrative Ad Hoc Group to review SAMC applications and provide recommendations to the EC

➢ **Action Item**: The PST will draft a SAMC charter
➢ **Action Item**: The PST will send out an email with the SAMC application and cover letter
➢ **Action Item**: The MRGESCP will encourage qualified individuals to apply for the SAMC
➢ **Action Item**: The Administrative Ad Hoc Group will convene to review SAMC applications, finalize SAMC positions using the proposed list of expertise from EC discussion, and provide recommendations for SAMC membership to the EC

Hydrology Update

Jennifer Faler, Reclamation, presented a hydrology update.

- The New Mexico Office of the State Engineer and MRGCD successfully coordinated with Colorado and Texas to free up Compact water, resulting in 38,000 acre-feet (ac-ft) of additional water through August and part of July. MRGCD has stretched that supply for the irrigators. This also allowed the Albuquerque Reach to remain wet. The water is expected to run out Monday, September 7th.
- Water managers are working to get an additional 12,000 ac-ft for September. MRGCD is planning to stop operations at the end of September. In October, whatever native water isn't used to meet Pueblo obligations will stay in the river. Prior and Paramount (P&P) water is stored and will be released over the next month or so.
- There is an emergency meeting on Friday, September 4th in case the water deal for the additional 12,000 ac-ft doesn't happen to talk about drying and salvaging in the Albuquerque Reach.
- The three-month outlook shows above average temperatures. La Niña is slightly favored through 2021 with a 50-55% chance.
- The 2020 water operations will have repercussions on 2021 water operations. The 38,000 ac-ft from the Compact means that New Mexico enters the year with an increased debit. Although snow pack is always the first option, the water managers are preparing for next year. MRGCD is planning on a shortened 2021 irrigation season.

Public Comment

No public comments were received.

Announcements

- The PST will send out cost share requests to non-federal signatories.
- The PST will send out a form for the annual report that will also inform the AM Database.

➢ **Action Item**: The PST will send out requests for cost share and FY20 Annual Report write-ups

Future Meetings

- October 26, 2020 from 2:00 to 4:00 PM
  - The EC will vote on SAMC membership.

    - The following read aheads will be distributed one week prior to the meeting:
        - The applications that the Administrative Ad Hoc Group proposes.
        - A brief summary of the process the group went through to make their recommendations.
- December 17, 2020 from 9:00 AM to 12:00 PM
    - The EC will approve work plans for Program groups.
- Buckman Direct Diversion will present on their Biological Opinion at an EC meeting sometime the first quarter of 2021.

➢ **Action Item**: The PST will schedule EC meetings for October 27, 2020 and December 17, 2020

Meeting Participants

Participant	Organization
Alan Hatch	Pueblo of Santa Ana
Alyssa O'Brien	City of Albuquerque, Open Space Division
Andy Dean	U.S. Fish and Wildlife Service
Anne Marken	Middle Rio Grande Conservancy District
April Fitzner	U.S. Army Corps of Engineers
Bill Grantham	New Mexico Office of the Attorney General
Catherine Murphy	Program Support Team
Chris Shaw	New Mexico Interstate Stream Commission
Clayton Derby	Program Support Team
Colleen Langan-McRoberts	City of Albuquerque, Open Space Division
Debbie Lee	Program Support Team
Elizabeth Anderson	Albuquerque Bernalillo County Water Utility Authority
Grace Haggerty	New Mexico Interstate Stream Commission
Janet Jarratt	Assessment Payers Association of the Middle Rio Grande Conservancy District
Jennifer Faler	U.S. Bureau of Reclamation
Jim Wilber	U.S. Bureau of Reclamation
John Stomp	Albuquerque Bernalillo County Water Utility Authority
Julie Dickey	Program Support Team
Kate Mendoza	Albuquerque Bernalillo County Water Utility Authority
Kim Bannerman	Department of Interior, Office of the Solicitor
Kim Eichhorst	Bosque Ecosystem Monitoring Program
Kyle Harwood	Buckman Direct Diversion
Lynette Giesen	U.S. Army Corps of Engineers
Mark Kelly	Albuquerque Bernalillo County Water Utility Authority
Matthew Wunder	New Mexico Department of Game and Fish
Max Henkels	New Mexico Department of Agriculture
Megan Osborne	University of New Mexico
Melissa Mata	U.S. Fish and Wildlife Service
Michael Scialdone	Pueblo of Sandia
Michelle Tuineau	Program Support Team
Mike Marcus	Assessment Payers Association of the Middle Rio Grande Conservancy District
Page Pegram	New Mexico Interstate Stream Commission
LTC Patrick Stevens	U.S. Army Corps of Engineers
Paul Tashjian	Audubon New Mexico
Ryan Gronewold	U.S. Army Corps of Engineers
Shawn Sartorius	U.S. Fish and Wildlife Service
Trevor Birt	New Mexico Interstate Stream Commission
Trevor Stevens	U.S. Army Corps of Engineers
Vicky Ryan	U.S. Fish and Wildlife Service
Wayne Pullan	U.S. Bureau of Reclamation

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Executive Committee (EC)
Science and Adaptive Committee (SAMC) Workshop Decisions

July 16, 2020; 2:00 PM–4:30 PM
Location: Zoom Meeting

1. <u>EC position on the SAMC.</u>
    - There is an advisory EC position on the SAMC that does not count towards total membership.
2. <u>Third-party contractors on the SAMC.</u>
    - SAMC eligibility is as open as possible and the EC approves contractors to sit on the SAMC on a case-by-case basis. This policy is open to revision in the future.
3. <u>Number of SAMC members.</u>
    - Additional subject matter experts:
        - o There are up to eight members on the SAMC, plus the advisory EC and facilitator positions. There are four base positions and up to four flexible positions. The four base positions are for experts in the following fields: Aquatic Ecology, Terrestrial Ecology, Ecosystem, and Hydrology. Areas of expertise for the four flexible positions are decided by the EC and SAMC.
        - o There is no fixed federal to non-federal ratio. The EC will consider overall committee balance when selecting SAMC members.
    - Formation process:
        - o SAMC candidates are nominated or can apply on their own. All candidates must submit an application.
        - o The EC strives to reach consensus on SAMC appointments. If consensus cannot be reached, all agreed upon qualified applicants for a position will be put into a pool and one member will be randomly selected to join the SAMC.
    - Meeting Operations:
        - o SAMC meeting deliberations are open to SAMC members only.
        - o If meetings are open, the audience of non-SAMC members does not participate in SAMC discussion.
        - o Non-SAMC members may be invited to participate on specific agenda topics by the SAMC.
        - o SAMC meetings are closed to facilitate technical discussions and collaboration among SAMC members. The Open Meetings Act does not apply to SAMC meetings because the group will not be involved in “the formation of public policy or the conduct of business by vote.”

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Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Meeting Participants

Participant	Organization
Alan Hatch	Pueblo of Santa Ana
Anne Marken	Middle Rio Grande Conservancy District
April Fitzner	U.S. Army Corps of Engineers
Catherine Murphy	Program Support Team
Colleen Langan-McRoberts	City of Albuquerque Open Space Division
Dale Strickland	Program Support Team
Elizabeth Anderson	Albuquerque Bernalillo County Water Utility Authority
Grace Haggerty	New Mexico Interstate Stream Commission
Janet Jarratt	Assessment Payers Association of the Middle Rio Grande Conservancy District
Jennifer Faler	U.S. Bureau of Reclamation
Jim Wilber	U.S. Bureau of Reclamation
Julie Dickey	Program Support Team
Kate Mendoza	Albuquerque Bernalillo County Water Utility Authority
Kyle Harwood	Buckman Direct Diversion
Lynette Giesen	U.S. Army Corps of Engineers
Matthew Wunder	New Mexico Department of Game & Fish
Michael Porter	U.S. Army Corps of Engineers
Michelle Tuineau	Program Support Team
Mike Marcus	Assessment Payers Association of the Middle Rio Grande Conservancy District
Page Pegram	New Mexico Interstate Stream Commission
Paul Tashjian	Audubon New Mexico
Rick Carpenter	Buckman Direct Diversion
Seth Willey	U.S. Fish and Wildlife Service
Tom Turner	University of New Mexico
Wayne Pullan	U.S. Bureau of Reclamation

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Middle Rio Grande Endangered Species Collaborative Program (MRGESCP)

Science and Adaptive Management Committee (SAMC) Draft Proposal

Revised: June 23, 2020

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I. PROPOSAL INTRODUCTION

In moving towards using science and adaptive management as the MRGESCP's structured decision-making framework, the Executive Committee (EC) agreed to form a committee to coordinate the implementation of science and adaptive management activities. This document proposes how the Science and Adaptive Management Committee (SAMC) will operate, its formation, its responsibilities and functions, and its relationships with other MRGESCP committees and ad hoc groups.

The SAMC is not a voting or decision-making group. It will translate and synthesize scientific results and recommendations, including the rationale for any supported differences of opinion within the MRGESCP, to the EC. The EC holds decision-making authority for the MRGESCP.

The primary role of the SAMC is to translate the results of field studies, modeling and monitoring activities into best research and management practices. It is the EC's responsibility to appraise the science-based recommendations within the context of existing policy (i.e. MRGESCP mission and goals, and applicable laws and regulations), and communicate them to implementing entities and external stakeholders. The EC is also responsible for providing direction to the MRGESCP's committees and groups.

II. PURPOSE

The SAMC coordinates MRGESCP-related science initiatives and signatory efforts through identifying and assigning scientific tasks to Science and Technical Ad Hoc Groups; compiling the results of scientific studies, modeling, and monitoring efforts; and translating scientific findings into recommendations for best management practices in the Middle Rio Grande.

III. RESPONSIBILITES

Coordinate the implementation of the MRGESCP's Science and Adaptive Management Program:

1. **As per direction from the EC, convene and coordinate the efforts of the Science and Technical Ad Hoc Groups to complete tasks, including the following** *(see *Note 1; see Appendix C: Science and Technical Ad Hoc Group Formation*):
    A. Complete executive summaries to identify alternative hypotheses regarding critical uncertainties
    B. Develop scopes of work to test research hypotheses and/or collect necessary data
    C. Compile, synthesize and encapsulate the results of field studies, modeling and monitoring to develop recommendations
    D. Update the Science and Adaptive Management Plan as new information and opportunities become available
    E. Update conceptual ecological models to incorporate new information

    Note 1: With EC approval, the SAMC may complete specific tasks, or they may task Science and Technical Ad Hoc Groups, the Program Support Team (PST), or other contractors to complete tasks
    Note 2: The PST's role is to provide administrative and scientific support for the SAMC, S&T Ad Hoc Groups, and their assigned tasks. The PST will draft documents, compile information, and complete other work as necessary to support these groups.

2. **Review MRGESCP-related field studies, modeling and monitoring activities, and translate the results into best research and management practices**
    A. Identify issues that require or would benefit from outside review
    B. Provide suggestions to the EC regarding independent peer review
3. **Work with the Fiscal Planning Committee (FPC) to coordinate EC-approved work products (e.g. studies, projects)**
    A. The FPC will determine resources available to complete work
    B. The FPC will work with the SAMC to determine implementation schedules based on funding availability
    C. The SAMC will work with the EC to determine implementation schedules based on regulatory commitments
    D. The EC will approve implementation schedules
    E. The EC will approve work products to move forward
4. **Regularly communicate updates at each EC meeting, including the following**:
    A. Present potential work products and status of in-progress work products
    B. Propose formation of Science and Technical Ad Hoc Groups with draft charges for EC review and approval
    C. Propose implementation schedules
    D. Suggested amendments to the Science and Adaptive Management Plan
    E. Provide documented range of SAMC opinions, as necessary, for EC review and direction (*see Page 10, Section V. 2. For areas of non-consensus on the interpretation of scientific information*)
    F. New science-based recommendations for best research and management practices
    G. New recommendations for independent peer review

The EC holds final decision-making authority for the direction of each MRGESCP initiative. Neither the FPC, the SAMC, the Ad Hoc Groups, nor the PST hold any decision-making power, except as authorized by the EC.

IV. COMPOSITION AND FORMATION

1. Composition

A. 8 member positions, 1 facilitator (*see Positions and Qualifications*)
    i. 4 core subject matter expert positions:
        1. Aquatic ecology expertise
        2. Terrestrial ecology expertise
        3. Ecosystem expertise
        4. Hydrology expertise
    ii. 4 flexible positions that will be filled based on science-related needs
    iii. 1 Facilitator (MRGESCP Science Coordinator)
    iv. 1 ex officio EC member position (does not count toward the 8 full members)
B. Serve a 2-year term
    i. Ability to apply for 1-year term limit extensions for up to 2 subsequent years
    ii. Individuals may not serve more than 4 subsequent years on the SAMC, except as authorized by the EC

C. Facilitator (MRGESCP Science Coordinator)
    i. Coordinate meetings
    ii. Facilitate the administrative functions to include:
        1. Drafting S&T Ad Hoc Group charges
        2. Coordinating with the FPC, S&T Ad Hoc Groups, and any independent peer review tasks
        3. Relaying updates and recommendations to the EC

D. Executive Committee Ex Officio Position:
    i. Serves in an advisory capacity to the SAMC
    ii. Provide the larger Program perspective
    iii. Ensure topics and recommendations are within the scope as decided by the EC
    iv. Provide direction for the completion of summary documents to the EC

E. External Experts
    i. Individuals outside the Program may hold a seat on the SAMC
    ii. Provide expertise that may not be available within the Program
    iii. Provide objective input throughout the adaptive management process, especially for complex issues
    iv. Provide an outside, big-picture perspective that is free of conflict
    v. May be internal or external to the Middle Rio Grande
    vi. *Future Discussion*: May be volunteers; may be jointly funded by signatories; may be funded by one signatory

F. Facilitator (MRGESCP Science Coordinator)
    i. Skill in translating science to communicate effectively across professional levels
    ii. Doctorate degree in an area of applied science

2. Formation Process

A. Executive Committee
    i. Recommend names of individuals that may have time to sit on the SAMC
    ii. Work with the MRGESCP Science Coordinator to invite potential individuals to apply for SAMC positions

B. Interested Individuals
    i. Interested individuals work with the Science Coordinator to complete the SAMC application package (*see Application Packages*)
    ii. If an individual is interested in being considered for more than one position, one application package must be filled out for each position

C. MRGESCP Science Coordinator
    i. Work with interested individuals to complete and submit an application package (*see Application Packages*)
    ii. Submit application packages to the EC

D. Executive Committee
    i. Review application packages
    ii. Nominate one or more EC member(s) for ex officio position (if more than one EC member expresses interest, the EC will vote on the position)
    iii. Each signatory's EC representative casts one vote per SAMC position

E. Prospective Date for SAMC Launch: 2020 – late October/early November

V. MEETING OPERATIONS

1. The SAMC will operate under a modified version of Robert's Rules of Order, including the following:
    A. SAMC meetings will be open to an audience of non-SAMC members; only SAMC members may participate in meeting deliberations. Prior to the meeting, the SAMC members may invite Ad Hoc Group leaders and outside experts to participate on specific agenda items as needed
    B. Each agenda after the first meeting will include time for non-member comment; individuals will have up to 3 minutes to speak during the non-member comment period
    C. Formal agendas will be drafted for review and approval at each meeting. Draft meeting materials will be made publically available on the Program Portal one week prior. The draft materials will be distributed to the SAMC members via email one week prior
    D. Each meeting will have formal meeting minutes, which will be used to document meeting deliberations and decisions, and communicate activities to the MRGESCP and external interested parties
    E. The finalized agendas, read aheads, and minutes will be included in the MRGESCP's Annual Administrative Record and stored on the Program Portal
2. The SAMC will strive to operate by consensus, and will deliver consensus science-based recommendations to the EC, including in their report:
    A. Scientific justification for the recommendation
    B. Recommended alternatives
3. If the SAMC cannot reach consensus during the translation of scientific results:
    A. SAMC member(s) will document the various opinions, each with justification
        i. The opinions will be provided to the EC for review and direction
        ii. The EC may direct the SAMC to use the documented opinions to inform a Science and Technical Ad Hoc Group's further actions
        iii. The EC may work with the SAMC to determine if a form of independent peer review is necessary
4. SAMC members will abide by all federal, state, tribal, and local agency rules and regulations regarding conflict of interest

VI. EVALUATION

Executive Committee

1. The MRGESCP Science Coordinator will provide an annual update
    a. SAMC's work plan status
2. Evaluation of the SAMC members

APPENDIX A: **APPLICATION PACKAGE**

The SAMC coordinates MRGESCP-related science initiatives and signatory efforts through identifying and assigning scientific tasks to Science and Technical Ad Hoc Groups; compiling the results of scientific studies, modeling, and monitoring efforts; and translating scientific findings into recommendations for best management practices in the Middle Rio Grande.

The SAMC comprises eight member positions and one ex officio position. Selected individuals serve a two-year term, with the possibility to renew. Individuals may not serve more 4 years consecutively on the SAMC. This application package is for SAMC Positions 1 – 4. The SAMC positions are as follows:

1. **Aquatic Expert: Scientist knowledgeable in aquatic ecology**
2. **Terrestrial Expert: Scientist knowledgeable in terrestrial ecology**
3. **Ecosystem Expert: Scientist knowledgeable in ecosystem function**
4. **Hydrology Expert: Scientist knowledgeable in hydrology, water operations and policy**
5. **Expertise to be determined by need**
6. **Expertise to be determined by need**
7. **Expertise to be determined by need**
8. **Expertise to be determined by need**

Ex officio: EC Advisory Member

Facilitator: MRGESCP Science Coordinator

The SAMC will meet every other month to discuss work products and conduct committee business. The time commitment for each member will vary, but is expected to be approximately 10-15 hours per month. Time will include document reviews; discussions with Program members, the MRGESCP Science Coordinator, and SAMC members; and preparing for and attending meetings.

To be considered for a position, please complete the following form and submit to the MRGESCP Science Coordinator via email at [cmurphy@west-inc.com] by close of business on MM/DD/YYYY. If you are interested in being considered for more than one position, one application package must be completed for each position.

Name: Click or tap here to enter text.

Job Title: Click or tap here to enter text.

Affiliation: Click or tap here to enter text.

Daytime Phone Number: Click or tap here to enter text.

Email Address: Click or tap here to enter text.

Position for which you are applying (choose one per application package):

Choose one per application

Specific area(s) of research/expertise: Click or tap here to enter text.

Years of experience in your respective field: Click or tap here to enter text.

Years of experience working the Middle Rio Grande: Click or tap here to enter text.

Years of experience working with the MRGESCP, and in what capacity:

Click or tap here to enter text.

Why would you like to serve on the Science and Adaptive Management Committee?

Click or tap here to enter text.

Please describe any specific experience working directly with the listed species of the Middle Rio Grande (i.e., New Mexico meadow jumping mouse, Pecos sunflower, Rio Grande silvery minnow, southwestern willow flycatcher, yellow-billed cuckoo) related to the position for which you are applying:

Click or tap here to enter text.

Where do opportunities exist for adaptive management in the Middle Rio Grande? Click or tap here to enter text.

In one sentence, describe the biggest challenge facing the Middle Rio Grande:

Click or tap here to enter text.

By signing this application, you are committing to abide by the following statement:

> *As a member of the SAMC, I agree to uphold high scientific standards, work collaboratively, and advocate for the best science possible. I understand that if selected, I would be serving in the capacity as a technical expert in a specific field, and not as a representative of a specific organization. All views expressed in SAMC meetings will be my own and not those of my organization.*

Please sign and date this application by typing in the respective boxes, attach the application, and submit via email to the MRGESCP Science Coordinator by COB on MM/DD/YYYY.

Thank you for your interest in the Middle Rio Grande Endangered Species Collaborative Program.

Click or tap here to enter text.	Click or tap to enter a date.
Type Your Name	Today's Date
Click or tap here to enter text.	Click or tap to enter a date.

APPENDIX B: SCIENCE AND TECHNICAL AD HOC GROUP FORMATION

With EC approval, the SAMC will convene and coordinate Science and Technical Ad Hoc Groups to complete assigned tasks (*See SAMC Responsibilities*)

1. The SAMC will:
    A. Identify the tasks needed to implement the Science and Adaptive Management Plan with direction from the EC
    B. Develop Science and Technical Ad Hoc Group charge (*see Charge Template below*) to complete a specific task, including:
        i. Timelines and deadlines
        ii. Deliverable(s)
        iii. Identify preliminary membership
    C. Direct the PST to draft Ad Hoc Group charges for their review
    D. Direct the PST to contact the identified Ad Hoc Group members to secure their commitment
    E. The SAMC may ask other individuals to join the group if an identified member declines

2. The Science and Technical Ad Hoc Groups will:
    A. Meet as needed to carry out their charge, with support from the PST
    B. Select a group leader
        i. Progress updates to the SAMC
        ii. Communicate issues to the SAMC immediately
    C. Complete the assigned deliverables within the specified timeline

3. Once the Ad Hoc Groups submit work to the SAMC, the SAMC will take next steps, which may include the following:
    A. Request the existing Ad Hoc Group make revisions
    B. Translate scientific results into recommendations for EC approval
    C. Document the range of SAMC opinions for areas of non-consensus
    D. Get EC approval to convene a new Science and Technical Ad Hoc Group to address subsequent steps
        i. Develop a new charge

Science and Technical Ad Hoc Group
Charge Template

Approved by Executive Committee on [*DATE*]
Approved by the Science and Adaptive Management Committee on [*DATE*]

I. Originating Committee

Only the Executive Committee and the Science and Adaptive Management Committee can create an ad hoc group. The ad hoc group reports to their originating committee, or as assigned.

II. Ad Hoc Group Charge

Detail the ad hoc group charge. Include specific tasks and the MRGESCP objectives addressed by those tasks.

III. Membership

A. Criteria for membership

Provide a list of qualifications and/or interests members should possess

B. Member List

List the proposed members of the ad hoc group here, including affiliation and job title. The total membership should take into account the expertise needed to carry out the group's charge, and the group should be kept at a manageable size in order to complete the task within the timeline detailed in this document.

IV. Tasks and Deliverables

*List the specific tasks the ad hoc group is being directed to complete to fulfill their charge, and the deliverable(s) associated with each task. Tasks can be a concrete activity (e.g., data analysis, a scope of work, a model), or be process-oriented (e.g., develop options for addressing a hypothesis for the SAMC's consideration). *Add or delete numbers for additional tasks as needed*

1. **Task One Name**
   Details of task one
   Objective of Task One
   How will this task contribute to the group's overall charge?
   Deliverable(s):
   Clearly state the expected outcome

2. **Task Two Name**
   Details of task two
   Objective of Task Two
   How will this task contribute to the group's overall charge?
   Deliverable(s):
   Clearly state the expected outcome

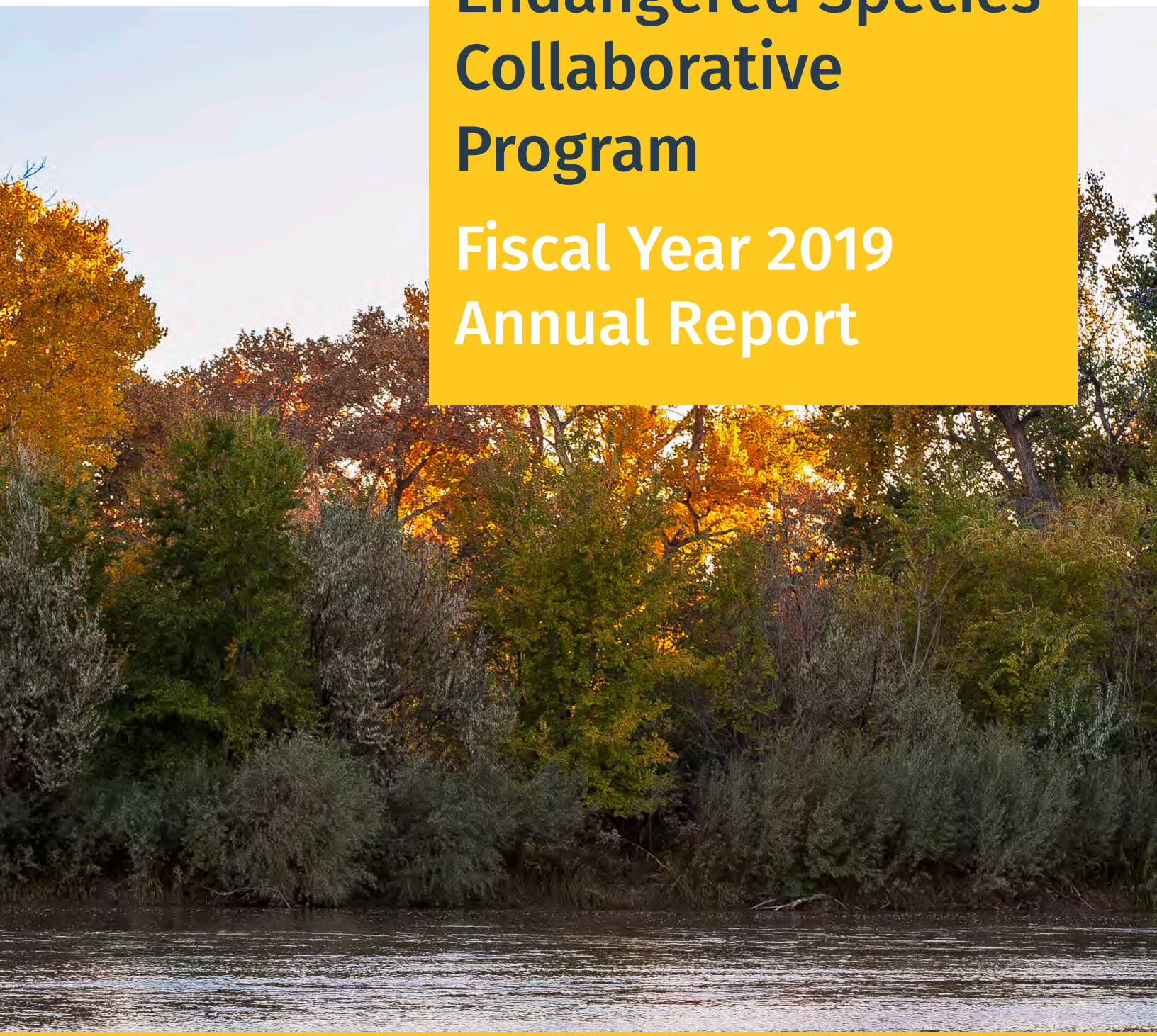
V. Timeline and Reporting Scheduling

Complete the table, noting when tasks are expected to be complete, any subtasks, and the expected deliverable(s) to be submitted to the originating committee for review. The tasks in the table should match with those listed above. Each task should include updates to the originating committee.

Task	Subtask	Deliverable	To Be Completed By
Task one	Subtask 1A	Deliverable Name	Deadline
	Subtask 1B	Deliverable Name	Deadline
Task two		Deliverable Name	Deadline

Middle Rio Grande Endangered Species Collaborative Program

Fiscal Year 2019 Annual Report



Program Website: https://webapps.usgs.gov/MRGESCP/



Photo: Scenic view at Bosque del Apache
Credit: Mike Marcus, APA

Prepared by:

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On Behalf of:

The Middle Rio Grande Endangered Species Collaborative Program

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Acronyms & Abbreviations

Acronym/Abbreviation	Definition
2016 MRG BO	Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico
ACF	Aquatic Conservation Facility
ABCWUA	Albuquerque Bernalillo County Water Utility Authority
APA	Assessment Payers Association of the Middle Rio Grande Conservancy District
ARRC	Southwest Native Aquatic Resource and Recovery Center
BEMP	Bosque Ecosystem Monitoring Program
BO	biological opinion
CoA	City of Albuquerque
CPUE	catch per unit effort
EC	Executive Committee
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
FPC	Fiscal Planning Committee
FY	fiscal year
HEC	Hydraulic Engineering Center
IDD	Isleta Diversion Dam
LLSMR	Los Lunas Silvery Minnow Refugium
MRG	Middle Rio Grande
MRGCD	Middle Rio Grande Conservancy District
MRGESCP/Program	Middle Rio Grande Endangered Species Collaborative Program
NMISC	New Mexico Interstate Stream Commission
PESU	Pecos sunflower
Reclamation	U.S. Bureau of Reclamation
RGSM	Rio Grande silvery minnow
SADD	San Acacia Diversion Dam
SWFL	Southwestern willow flycatcher
UNM	University of New Mexico
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
YBCU	yellow-billed cuckoo

Executive Summary

The Middle Rio Grande Endangered Species Collaborative Program (MRGESCP or Program) is made up of federal, state, tribal, and local signatory organizations that work together to support actions in the Middle Rio Grande (MRG) that benefit endangered and threatened species. The Program aids in the recovery of five federally listed species inhabiting the MRG: the endangered Rio Grande silvery minnow (RGSM), the endangered Southwestern willow flycatcher (SWFL), the endangered New Mexico meadow jumping mouse (NMMJM), the threatened yellow-billed cuckoo (YBCU), and the threatened Pecos sunflower (PESU). As the MRGESCP works towards its species-specific goals, it is committed to protecting the MRG's existing and future water uses.

Program signatories support the Program's mission by performing scientific, technical, and administrative activities. The signatories fund and staff scientific studies, population management efforts, water operations, and habitat restoration to the benefit of the MRG's listed species, while also participating in Program planning, administration, and technical support. In fiscal year 2019 (FY19), the Program updated its mission to focus on conducting science that benefits listed species recovery through an adaptive management process. Signatories worked throughout FY19 to support this updated mission by contributing to numerous scientific endeavors and engaging in the development of an adaptive management framework for the Program. This report summarizes the Program's FY19 activities.



Photo: Jetty jacks in the Alameda Bosque
Credit: Mike Marcus, APA

Middle Rio Grande Endangered Species Collaborative Program

Background

The Middle Rio Grande Endangered Species Collaborative Program (MRGESCP or Program) is a collaborative partnership of federal, state, tribal, and local signatory organizations that aims to protect and recover federally listed species in the Middle Rio Grande (MRG), while also preserving the area's existing and future water uses. The Program has changed gradually over the years but was first formed in response to several events: the federal listing of the endangered Rio Grande silvery minnow (*Hybognathus amarus*; RGSM) under the Endangered Species Act (ESA) in 1994, the listing of the endangered Southwestern willow flycatcher (*Empidonax traillii extimus*; SWFL) in 1995, drought in 1996, and litigation related to these events in 1999.

In 2000, stakeholder organizations that were interested in species recovery and protection of water uses in the MRG formed the Endangered Species Act Work Group. This group led to the development of the MRGESCP, which was officially established in 2002 with the signing of the Memorandum of Understanding (MOU). In 2008, Program signatories reaffirmed their commitment by signing the Memorandum of Agreement (MOA).

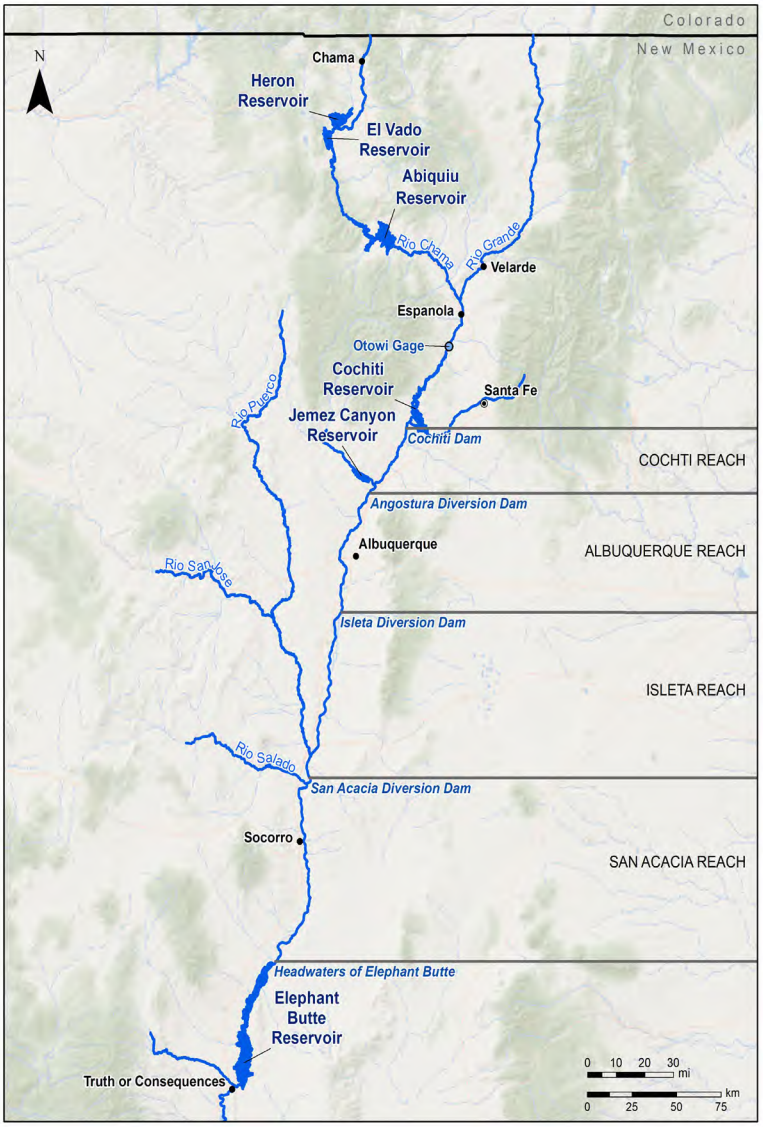


Figure 1. Map of the Program Area

The area of the Program stretches from the headwaters of the Rio Chama watershed and Rio Grande, including tributaries, downstream to the elevation of the spillway crest of Elephant Butte Reservoir at 4,450 feet above mean sea level, excluding the land area reserved for the full pool of the Elephant Butte Reservoir (Figure 1). Four reaches are delineated within the MRG and, from north to south, these are the Cochiti Reach, the Angostura (Albuquerque) Reach, the Isleta Reach, and the San Acacia Reach. Depending on their jurisdiction and authority, signatories may support activities within one or all four reaches.

FY19 Overview

Throughout FY19, the Program continued development of an adaptive management framework, which led to the adoption of an updated mission: to provide a collaborative forum to support scientific analysis and implementation of adaptive management to the benefit and recovery of the listed species pursuant to the ESA within the Program area, and to protect existing and future water uses while complying with applicable state, federal, and tribal laws, rules and regulations. Program signatories supported this mission by conducting numerous activities that benefited the MRG's listed species and contributing to the development of the MRGESCP's science and adaptive management program. Signatory activities in FY19 included scientific studies, habitat restoration, monitoring efforts, population management and augmentation, and water operations, as well as participation in Program planning, administration, and technical support.

In addition to its updated mission, the Program expanded its species of interest to include the following listed species in the MRG: the yellow-billed cuckoo (*Coccyzus americanus*; YBCU), listed as threatened in 2014; the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*; NMMJM), listed as endangered in 2014; and the Pecos sunflower (*Helianthus paradoxus;* PESU), listed as threatened in 1999. This was done to acknowledge the importance of ecosystem health in an effective science and adaptive management plan.







Photos (from left to right): Yellow-billed cuckoo | New Mexico meadow jumping mouse | Pecos sunflower
Credit: Andy Reago and Chrissy McClarren | Jennifer K. Frey, New Mexico State University | USFWS staff

Governance

Adopted in 2008, the Program's by-laws describe the governance structure, decision-making processes, and roles and responsibilities of its signatories. The by-laws have been amended over the years to accommodate Program development. Documents relating to governance, including by-laws, authorities, and charters, are maintained on the Program Portal, which can be accessed at **https://webapps.usgs.gov/MRGESCP/.**

Organizational Structure

Signatories

The following sixteen organizations were signatories of the Program's 2008 MOA in FY19:

- Albuquerque Bernalillo County Water Utility Authority (ABCWUA)
- Assessment Payers Association of the Middle Rio Grande Conservancy District (APA)
- Audubon New Mexico
- Bosque Ecosystem Monitoring Program (BEMP)
- City of Albuquerque (CoA) Open Space Division
- Middle Rio Grande Conservancy District (MRGCD)
- New Mexico Attorney General's Office
- New Mexico Department of Game and Fish
- New Mexico Interstate Stream Commission (NMISC)
- Pueblo of Isleta
- Pueblo of Sandia
- Pueblo of Santa Ana
- U.S. Army Corps of Engineers (USACE)
- U.S. Bureau of Reclamation (Reclamation)
- U.S. Fish and Wildlife Service (USFWS)
- University of New Mexico (UNM)

Representatives from these signatories, as well as other interested parties, worked collaboratively to complete the Program's FY19 activities. Program participants conduct activities through four main organizational structures: the Executive Committee (EC), the Fiscal Planning Committee (FPC), work groups, and ad hoc groups. The structures and functions of these committees and groups are outlined below.

Executive Committee

Federal Co-chair: Brent Esplin, Reclamation
Non-federal Co-chair: Jannet Jarratt, APA (October 2018 - July 2019)
John Stomp, ABCWUA (July 2019 - present)

The MRGESCP is governed by the EC, which consists of one representative from each signatory. The EC oversees all Program groups and committees and makes decisions on their actions. The EC also informs, approves, and directs the implementation of Program initiatives and acts as the face of the Program in any communication with signatory and non-signatory organizations.

Fiscal Planning Committee

The EC selects a group of signatory representatives to serve on the Fiscal Planning Committee (FPC). This committee is tasked with coordinating and seeking funding streams for Program activities and coordinating related timelines and deadlines. The FPC reports signatory funding capabilities, potential funding resources, and gaps in funding to the EC.

Work Groups

Work groups are established by the EC to address specific Program directives and activities. They do so by providing focused assistance and expertise, scientific and technical review, and coordination of Program actions. Work groups meet regularly and are made up of signatory staff and additional parties with appropriate expertise. The following work groups met during FY19:

- Adaptive Management Work Group
- Population Monitoring Work Group
- Science and Habitat Restoration Work Group

Ad Hoc Groups

As necessary, Program committees and work groups create temporary subgroups that work on specific projects or tasks. These ad hoc groups consist of signatory staff and non-signatory parties with expertise or interest in the specialized topic assignment. Ad hoc groups report to their primary committee or work group and disband once their predetermined objectives have been met.



Photo: Scenic view at the Rio Grande Nature Center
Credit: Mike Marcus, APA

Program Activities

The MRGESCP signatories continued to support the recovery of the MRG's endangered and threatened species in FY19. These organizations worked collaboratively to conduct a wide range of activities, including scientific studies, surveys and monitoring, propagation and augmentation, habitat restoration, coordination of water operations, and Program support. The results of these activities helped signatories and other resource managers in the MRG determine the impacts of different actions on listed species and adjust management actions to benefit them. The signatories were also involved in Program management throughout the fiscal year.

The following sections describe the Program's FY19 activities, which are split into six categories: Avian Species, Rio Grande Silvery Minnow, Habitat Restoration, Science Support, Water Monitoring and Studies, and Program Support.

Avian Species

Program signatories contributed to long-term efforts aimed at monitoring SWFL and YBCU populations to discover trends and distribution in the MRG. Additionally, signatories collaborated to conduct noise disturbance and telemetry studies to better understand the listed avian species. Table 1 lists the avian species-related activities that were associated with the Program in FY19.

Activity Name	Begin	End	Sponsor/Contributor Signatories
Avian Monitoring	FY03	FY19	USACE
Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Noise Disturbance Study	FY17	FY20	Reclamation; USACE
Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Surveys and Nest Monitoring at U.S. Army Corps of Engineers Restoration Sites	FY04	FY20	USACE
Southwestern Willow Flycatcher Surveys	FY95	Ongoing	Reclamation; USACE
Yellow-Billed Cuckoo Surveys	FY06	Ongoing	Reclamation
Yellow-Billed Cuckoo Telemetry Study	FY17	FY20	Reclamation; USACE

Table 1. FY19 Avian Species Activities List

Avian Monitoring

As a result of inadequate habitat, avian populations have been decreasing in the MRG. This trend has been noted in surveys sampling avian abundance and species richness relative to vegetation community and structure types within the MRG Bosque. Avian monitoring surveys have occurred in 81 transects, from Rio Rancho to La Joya Wildlife Management Area, since December 2003. 21 of these transects included areas that USACE restored starting in 2010. Surveys were conducted not only during pre-construction of the restoration sites as part of the documentation of existing conditions, but also during and after construction. Established transects within the MRG are surveyed during both the breeding and wintering seasons. Locations within each reach are surveyed and compared to previous survey data. Nest search and monitoring are also conducted. Various nest parameters, including nest success, brood parasitism, predation, abandonment, and productivity are determined for the SWFL and YBCU, as well as for raptors and songbirds.

An additional objective of the avian monitoring surveys was established in 2017 and focuses on changes in the bosque since the 1984 MRG Biological Survey. This objective includes: (a) providing a 20-plus year comparison of change in avian abundance and species richness, (b) providing a 20-plus year comparison of change in community and structure types, (c) providing a 20-plus year comparison of change in types present, given the construction of MRG restoration sites. This report will be completed in spring 2020.



Photo: Southwestern willow flycatcher perching on a branch
Credit: Scarlett Howell, USGS

Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Noise Disturbance Study

Nesting avian species can be sensitive to noise disturbance. In spite of this, SWFL and YBCU are known to nest in riparian habitat in the Rio Grande floodplain that is adjacent to active construction zones. Current protocol within the MRG is to maintain a 400 meter (1/4 mile) buffer between active nests and construction activities. However, little data exist on the distance between the nest and construction activities at which breeding birds are disturbed.

Conducted in the spring and summer of 2019, the noise disturbance study sought to determine the sensitivity of SWFL and YBCU to noise disturbance by quantifying the impact of noise on the nesting activities of a group of surrogate, non-threatened riparian obligates. The study involved the recording of actual construction noise and the broadcasting of those recordings at a series of decreasing distances from a known nest to measure any effects on the nesting birds. Non-sensitive species were used during the pilot study trials to assess any potential detrimental effects of the study on nesting birds prior to the inclusion of SWFL or YBCU. The final report for this study will be available in FY20.





Photos (from top to bottom): Nest of newly hatched Southwestern willow flycatcher chicks | 12-day-old Southwestern willow flycatcher fledglings
Credit: Darrel Ahlers, Reclamation | Dave Moore, Reclamation

Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Surveys and Nest Monitoring at U.S. Army Corps of Engineers Restoration Sites

In accordance with established survey protocols, presence and absence surveys were conducted during the 2019 breeding season at several USACE restoration sites within the Albuquerque Reach. These surveys were conducted to assess the effectiveness of restoration activities. Restoration construction began as early as 2004 at several of the locations evaluated in this study. The species use and habitat suitability of each location were evaluated in regards to both the SWFL and YBCU. Restoration sites are presently in various stages of riparian succession, each with different vegetative species compositions and structures that are associated with different habitat potential for SWFL and YBCU. Trends and results were analyzed, and recommendations for future survey work based on habitat conditions were developed.

Southwestern Willow Flycatcher Surveys

Biologists have conducted SWFL surveys and studies at sites from Bandelier National Monument to Elephant Butte Reservoir since 1995. These studies were originally designed to identify potential threats to SWFL populations and their habitats, but they currently focus on presence and absence surveys, nest monitoring, and supporting compliance with the 2016 MRG Biological Opinion (BO).

In 2019, Reclamation conducted surveys and nest monitoring at select project sites within the MRG basin. Survey results were used to determine the distribution, abundance, and productivity of SWFL breeding within the defined study area. These surveys are required in order to achieve compliance with the ESA and meet project obligations.

In accordance with established survey protocols, presence and absence surveys were conducted during the 2019 breeding season. Surveys and nest monitoring were conducted within eight sub-reaches of the MRG's four reaches (Table 2), along approximately 205 miles of the Rio Grande. Results of the 2017, 2018, and 2019 surveys are shown in Table 2.



Photo: Southwestern willow flycatcher habitat
Credit: USGS staff

Sub-reach	2017 Territories	2018 Territories	2019 Territories	2017 Pairs	2018 Pairs	2019 Pairs	2017 Nests	2018 Nests	2019 Nests
Frijoles	0	0	NS	0	0	NS	0	0	0
Belen	17	20	NS	16	17	NS	27	17	NS
Sevilleta	4	12	NS	3	7	NS	1	3	NS
San Acacia	0	0	0	0	0	0	0	0	0
Escondida	8	4	9	6	4	5	9	4	4
Bosque del Apache	16	24	24	11	21	16	16	22	7
Tiffany	0	0	0	0	0	0	0	0	0
San Marcial	257	277	293	223	240	243	298	315	280
Totals	**302**	**337**	**326**	**259**	**289**	**864**	**351**	**361**	**291**

Table 2. Summary of Southwestern willow flycatcher territories, pairs, and nests recorded between 2017 and 2019 by Middle Rio Grande sub-reach. "NS" denotes that no surveys were conducted.

Yellow-Billed Cuckoo Surveys

Biologists have conducted YBCU protocol surveys within the MRG basin since 2006. These studies are designed to track YBCU population trends and provide insight into habitat use through presence and absence surveys. Survey results are used to determine the distribution and abundance of breeding YBCU within a defined study area. Additionally, the current studies achieve ESA compliance and support requirements detailed in the 2016 MRG BO. Surveys are conducted within seven sub-reaches of three MRG reaches, along approximately 130 miles of the Rio Grande. A breakdown of YBCU detections and territories from 2016 to 2019 is presented in Table 3.

Sub-reach	2017 Detections / Territories	2018 Detections / Territories	2019 Detections / Territories
Belen	34 / 4	41 / 10	NS
Sevilleta/La Joya	12 / 4	41 / 10	NS
San Acacia	50 / 13	47 / 14	29 / 8
Escondida	44 / 11	55 / 10	50 / 11
Bosque del Apache	43 / 10	46 / 13	59 / 14
Tiffany	2 / 0	0 / 0	0
San Marcial	227 / 56	193 / 49	190 / 42
Totals	**412 / 98**	**423 / 106**	**328 / 75**

Table 3. Summary of yellow-billed cuckoo detections and territores recorded between 2017 and 2019 by Middle Rio Grande sub-reach. “NS” denotes that no surveys were conducted.





Photos (from left to right): Yellow-billed cuckoo held by hand | Yellow-billed cuckoo nestlings
Credit: Mark Dettling, USFWS | Frontenac Bird Studies

Yellow-Billed Cuckoo Telemetry Study

Along the MRG, the YBCU typically nest in large, dense patches of riparian vegetation, particularly with a cottonwood/Goodding's willow overstory. A dense understory comprised of native vegetation or, alternatively, of exotic salt cedar or Russian olive also appears to be an important requirement for territory establishment. Although salt cedar may be a component of cuckoo habitat, as the proportion of salt cedar increases, the overall habitat suitability for YBCU is believed to decrease. There is uncertainty regarding what exactly constitutes suitable YBCU breeding habitat. Reclamation personnel have been conducting surveys within the MRG since 2006. Each year, YBCU detections and territories are recorded in both suitable and unsuitable habitat. Additionally, breeding YBCU are very mobile, cover large areas, and are not vocal near nests, which makes it difficult to find nests.

This study seeks to refine the habitat preferences of breeding YBCU within the MRG by continuing a radio telemetry study initiated in 2017. The pilot study conducted in 2017 refined transmitter attachment techniques and provided preliminary habitat use data. In 2018, the study focused on the delta of Elephant Butte Reservoir and included nine YBCU that provided useful movement and habitat data. In 2019, the study focused on areas upstream of Elephant Butte Reservoir in an effort to characterize YBCU habitat in a narrower, more managed active floodplain, where habitat is potentially of lesser quality. These data will be incorporated into the next MRG YBCU habitat model, which will better inform management efforts in regards to habitat preservation and restoration. Additionally, as few nests have been monitored due to the difficulty of finding them, increased nest discovery by radio tracking could expand sample size and allow for further insight into nesting variables and limiting factors of population growth.



Photo: Scenic view of the Middle Rio Grande Bosque
Credit: Mike Marcus, APA

Rio Grande Silvery Minnow

Program signatories implemented activities that supported long-term RGSM recovery efforts. These activities included population monitoring and modeling, captive breeding programs, population augmentation, genetics monitoring, fish rescue and salvage, and several RGSM-related studies. Table 4 lists the RGSM-related activities that were associated with the Program in FY19.

Activity Name	Begin	End	Sponsor/Contributor
Age Determination of Wild-Captured Larval Rio Grande Silvery Minnow Using Lapilli Otoliths Study	FY18	FY20	ABCWUA; NMISC
Assessment and Monitoring of Rio Grande Silvery Minnow Genetics	FY03	Ongoing	Reclamation
City of Albuquerque Aquatic Conservation Facility Rio Grande Silvery Minnow Program Operations and Maintenance	FY19 FY07	FY23 Ongoing	Reclamation ABCWUA
Drain Outfall Sampling	FY15	Ongoing	MRGCD
Engineering Modeling Applications for Quantifying Habitat for the Rio Grande Silvery Minnow	FY17	FY20	Reclamation; USACE
Environmental Flow Analysis for Rio Grande Silvery Minnow	FY10	FY20	USACE
Evaluation of Using eDNA for Detecting Larval Rio Grande Silvery Minnow on the Floodplain	FY19	FY20	USACE
Integrated Rio Grande Silvery Minnow Assessment Model Development	FY18	FY20	ABCWUA; NMISC
Larval Rio Grande Silvery Minnow Otolith Validation Study	FY18	FY20	ABCWUA; NMISC
Los Lunas Silvery Minnow Refugium Operations and Maintenance	FY07	Ongoing	NMISC; Reclamation
Pueblo of Santa Ana Fish Community Surveys	FY05	Ongoing	Pueblo of Santa Ana; Reclamation; USFWS
Rio Grande Silvery Minnow High-Throughput Markers	FY18	FY20	Reclamation
Rio Grande Silvery Minnow Population Management	FY18 FY01	FY18 FY22	MRGCD; Reclamation; USFWS
Rio Grande Silvery Minnow Population Monitoring	FY93	Ongoing	Reclamation
Rio Grande Silvery Minnow Reproductive Monitoring	FY18	Ongoing	Reclamation
Rio Grande Silvery Minnow Spawning Habitat Study	FY16	FY21	ABCWUA; NMISC
San Acacia Diversion Dam Fish Passage Pilot Study	FY16	FY21	MRGCD; NMISC; Reclamation
Spawning and Larval Fish Study in the San Acacia Reach	FY19	FY19	NMISC

Table 4. FY19 Rio Grande Silvery Minnow Activities List

Age Determination of Wild-Captured Larval Rio Grande Silvery Minnow Using Lapilli Otoliths Study

A total of 63 different specimens were used to compare the growth trajectories of wild-captured larval RGSM in three reaches of the Rio Grande. Larval RGSM were collected from habitat restoration sites in the Angostura, Isleta, and San Acacia Reaches in 2017, as part of the RGSM Spawning Habitat Study. In 2019, larvae were collected from the Angostura and San Acacia Reaches. These larval fish were aged using their otoliths to determine when they hatched and how long they were on the floodplain. The aged larval RGSM could then be used to determine the environmental factors, such as flow and temperature, that impact RGSM spawning, hatching, and larval development in each MRG reach.

Otoliths from wild-captured larvae were more difficult to read than those from larvae reared for the Larval RGSM Otolith Validation Study and thus, required more time to read. Using the information learned from the Larval RGSM Otolith Validation Study, SWCA Environmental Consultants (SWCA) was able to age (in days) wild-captured larvae. Growth trajectories (i.e., standard length versus otolith age) were compared by reach. Although there were no significant reach differences, results from the study indicate that aging wild larvae is feasible. The study is expected to be published as an article in 2020.



Photo: Spawning flows for Rio Grande silvery minnows
Credit: Mike Marcus, APA

Assessment and Monitoring of Rio Grande Silvery Minnow Genetics

Reclamation contracted UNM to perform genetic monitoring of the RGSM population annually from 1999-2012, and again from 2014-2019. Since the augmentation program began in 2002, this work included the monitoring of RGSM stocks that are bred or reared in captivity, then released into the MRG. Genetic monitoring enables tracking of the genetic effects of population fluctuations due to inter-annual variability in flows and various management activities.

As part of this genetic work, changes in levels of genetic variability within the wild RGSM population were examined to determine how they potentially impacted population viability. UNM also examined the impacts of captive propagation and augmentation on RGSM wild stocks. The RGSM genetics database generated by the project was used to develop, parameterize, and verify models directed at predicting the genetic effects of captive propagation on RGSM wild stocks. These models informed captive propagation and augmentation strategies aimed at species recovery.

Genetic monitoring in 2019 included the genotyping of 134 wild and 127 wild-caught hatchery-reared RGSM collected in three occupied reaches of the MRG: the Angostura Reach, the Isleta Reach, and the San Acacia Reach. The progeny of captive stocks from the Southwestern Native Aquatic Resources and Recovery Center (ARRC) [n=197] and the CoA Aquatic Conservation Facility (ACF) [n=99] were also genotyped. Combined, these fish comprised the 2019 potential breeding population. In 2019, 553 broodstock were also genotyped and used to produce fish for release in fall 2019 from the Southwestern Native ARRC, ACF, and Los Lunas Silvery Minnow Refugium (LLSMR).

Data from genetic monitoring in 2019 indicate that genetic change in the wild RGSM population was largely determined by supplementation with captive-reared stocks. This supplementation buffers the population against potential losses of diversity due to drastic changes in population size. Over the duration of the monitoring effort, indications of genetic diversity, including heterozygosity and average number of alleles, have so far been maintained.



Photo: Rio Grande silvery minnow
Credit: Michael Porter, USACE

City of Albuquerque Aquatic Conservation Facility Rio Grande Silvery Minnow Program Operations and Maintenance

The ACF promotes the recovery of RGSM in the wild through captive propagation and augmentation. Each year, ACF staff collect naturally-spawned RGSM eggs and/or young-of-year fish from the MRG for use in the captive breeding program. In November 2018, the ACF captured 1,000 juvenile RGSM and transferred them to the LLSMR to serve as broodstock for captive spawning operations. Captive spawning produced approximately 54,054 viable RGSM eggs in 2019.

During the potential spawning season for wild RGSM (April through June 2019), the flow rate in the MRG was consistently over 3,000 cubic feet per second (cfs). This high flow rate created dangerous conditions for ACF staff and made egg monitoring and/or collection virtually impossible. This resulted in no naturally-spawned RGSM eggs being collected during the 2019 spawning season.

As it was not possible to collect RGSM eggs from the MRG, several trips were made to collect post-larval and/or juvenile fish. ACF staff, accompanied by staff from USFWS's New Mexico Fish and Wildlife Conservation Office, collected fish from the four MRG reaches. The captive fish were monitored over time for growth and development, which ensured that only RGSM were kept for the captive breeding program. After one month of observation, all remaining fish were transferred to an outdoor tank. In total, approximately 600 RGSM were collected. The dates, reaches, and approximate numbers of juvenile RGSM collected are given in Table 5.

Date	Reach	Approximate Number
June 4, 2019	Angostura	25
June 5, 2019	San Acacia	50
July 12, 2019	Isleta	200
July 17, 2019	Angostura	200
July 19, 2019	San Acacia	200
Total		**675**

Table 5. Summary of juvenile Rio Grande silvery minnow collections in 2019

In addition to collecting naturally-spawned eggs, ACF staff also conducted captive RGSM spawning. In 2019, adult RGSM (97 males and 97 females) were each injected with carp pituitary extract in order to initiate spawning. The fish were then separated into batches and placed in separate 100-gallon aquariums overnight. The next day, eggs were collected and counted volumetrically (assuming 30 eggs/milliliter [ml]). Percent viability was determined by visual examination of three samples of 100 eggs taken from each tank. A total of 117,510 eggs were produced and viability estimates ranged from 39 to 52 percent, with an overall average of 46 percent.

Captive-spawned (and occasionally naturally-spawned) young-of-year RGSM were released into the river in order to augment the wild population. During FY19, ACF staff released a total of 66,000 RGSM. The dates and locations of these releases are listed in Table 6.

Date	Reach	Approximate Number
November 15, 2018	San Acacia	18,000
November 16, 2018	Isleta	15,000
November 19, 2018	Angostura	15,000
February 14, 2019	San Acacia	6,000
February 14, 2019	Isleta	6,000
February 14, 2019	Angostura	6,000
Total		**66,000**

Table 6. Summary of Rio Grande silvery minnow releases in FY19





Photos (from left to right): Rio Grande silvery minnow at the Aquatic Research Facility | Release of Rio Grande silvery minnow into the river
Credit: ACF Staff

Drain Outfall Sampling

During the FY19 irrigation season, small volumes of water were consistently discharged from three MRGCD outfalls within the Isleta Reach of the MRG, where river channel drying is common in the summer and early fall. Much of the water discharged from the outfalls was supplied by agencies that have coordinated with MRGCD to convey this water through the MRGCD system.

The fish populations in MRGCD outfalls were sampled at monthly intervals in late summer and fall of 2018 to determine the degree to which RGSM utilize them as refugia during periods of adjacent river channel drying. These samplings will be used to inform future water management decisions, determine the most economical use of water when supplies are limited, and aid in the formation and refinement of future studies and monitoring projects.

Engineering Modeling Applications for Quantifying Habitat for the Rio Grande Silvery Minnow

Projects with the goal of creating habitat for the RGSM have been underway on the MRG since the 1990s. Though localized efforts to quantify habitat have been made, a standard method for quantifying the amount and quality of habitat that is constructed or preserved in the dynamic river system has yet to be developed.

This project used USACE's Hydraulic Engineering Center (HEC) modules to visualize, quantify, and track changes in RGSM habitat on the MRG. To utilize engineering models, a hypothesis of ideal habitat conditions for the RGSM was characterized into hydraulic parameters. Shallow depth, slower velocities, and sufficient duration of inundation are three habitat characteristics believed to be crucial for the survival of early-life stage RGSM reared on the floodplain. Version 5.0 of the HEC's River Analysis System (HEC-RAS) features the ability to perform two-dimensional hydrodynamic routing, which produces detailed channel and floodplain analysis and enables depth and velocity characteristics to be quantified. By coupling HEC-RAS 5.0 with version 4.0 of the HEC's Ecological Function Model (HEC-EFM), the duration of RGSM habitat under various flow regimes can be computed.

Environmental Flow Analysis for Rio Grande Silvery Minnow

Environmental flow criteria for floodplain inundation, which produces low-velocity habitats that support the feeding and growth of larval RGSM, provide guidance for how to manage spring runoff pulses to benefit recruitment. The objective of this study was to analyze annual RGSM recruitment in response to either routine water management or environmental flow manipulation at upstream reservoirs. Analysis of recruitment responses provides values for hydrograph parameters (e.g., magnitude, frequency, duration, timing, and rate-of-change) associated with increased RGSM recruitment rates and population indices. This information, in combination with the MRG inundation assessment and habitat restoration monitoring, will contribute to refinement of spring runoff flow parameters for more effective management of RGSM recruitment by MRG water management agencies.

Evaluation of Using eDNA for Detecting Larval Rio Grande Silvery Minnow on the Floodplain

Environmental DNA (eDNA) is a maturing technology for inventorying and monitoring aquatic species. Gut samples from predators can be used for diet analysis based on the presence of target eDNA markers. Filtered eDNA from large watershed areas may be used for detecting rare occurrences at a lower cost than traditional sampling methods (e.g., electrofishing or seining). Sampling for eDNA at downstream access points may be useful for monitoring upstream reaches that have limited access. Thus, development of reliable eDNA markers may potentially provide valuable information for RGSM studies.

The objective of this project is to develop and evaluate an eDNA tool for RGSM. The best approach is to develop two mitochondrial DNA quantitative real-time polymerase chain reaction (qPCR) markers that can be run as a multiplex qPCR on eDNA extracted from water samples. Multiplexing has been shown to be a useful countermeasure against false negatives arising from sampling errors when target DNA is rare and dilute or when water samples are carrying PCR inhibitors. This experimental design is similar to the current approach utilized by USFWS's Asian carp monitoring program.

Integrated Rio Grande Silvery Minnow Assessment Model Development

ABCWUA and NMISC contracted the Southwest Biological Science Center of the U.S. Geological Survey (USGS) to develop an integrated RGSM assessment model. The model integrates environmental and species-specific information and data to assess the status of the RGSM population in the MRG. The model will be useful in making predictions for how the RGSM population may respond to current and future management options. Species-specific information will include RGSM vital rate information, such as growth, survival, and reproductive capabilities at various ages. The model is being developed in collaboration with the MRGESCP's Population Monitoring Work Group. In 2019, background information about the RGSM and MRG was gathered to develop a draft framework for the model.



Photo: Rio Grande silvery minnow
Credit: Thomas Archdeacon, USFWS

Larval Rio Grande Silvery Minnow Otolith Validation Study

NMISC and ABCWUA contracted SWCA to conduct the Larval RGSM Otolith Validation Study. The LLSMR, the CoA BioPark, USFWS, and SWCA all took part in the design and implementation of the study. UNM also provided microscopy laboratory space for otolith readings. The purpose of this study was to validate that RGSM deposit a single daily increment on lapillar and sagittal otoliths, thereby facilitating a method for accurately estimating the age and hatch date of larval RGSM. RGSM were hatched and grown to 30 days post-hatch; then their otoliths were extracted for use in a double-blind aging method. The study indicated that larval RGSM deposited discernible daily increments on lapilli. Results from the study are important for showing that otoliths can be accurately and reliably used to age larval RGSM. This study is the first larval otolith validation for this species as well as the first study evaluating the efficacy of using otoliths to determine the daily age of wild larval RGSM. The study is expected to be published in 2020.

Los Lunas Silvery Minnow Refugium Operations and Maintenance

The LLSMR was built by NMISC with federal financial assistance and was designed for the propagation and culture of RGSM within a natural environment. The facility began operation in 2009 and is located on State of New Mexico property in the Village of Los Lunas, about 20 miles south of Albuquerque. The facility includes an outdoor refugium that has a stream, ponds, islands, and overbank areas to mimic the Rio Grande's habitats. The LLSMR also has an indoor hatchery, a quarantine building, outdoor tanks, and an office building. The facility has a permanent staff of two aquaculturists and one technician. NMISC also works with the Program's Science and Habitat Restoration Work Group and USFWS's Genetics and Captive Propagation Work Group to accomplish the goals and objectives of the LLSMR. In FY19, the facility was jointly funded by NMISC and Reclamation, and permitted by USFWS.

NMISC operates the LLSMR to propagate RGSM for augmentation into the MRG. The fish produced for augmentation support a reproducing population of RGSM in the MRG, especially in years with low population numbers. In FY19, the facility accommodated fish for a fish movement study being conducted by NMISC staff and a contractor. To support this study, four-year-old RGSM were injected with passive integrated transponder (PIT) tags and held on station for scheduled release.



Photo: Aerial view of Los Lunas Silvery Minnow Refugium
Credit: Douglas Tave, LLSMR

Pueblo of Santa Ana Fish Community Surveys

In 2019, the Pueblo of Santa Ana completed spring, summer, and fall fish community surveys with help from USFWS staff. These surveys provide management-relevant information on the RGSM, including trends in population responses to habitat restoration projects.

The Pueblo monitored eight sites in the Santa Ana stretch of the Rio Grande during all three seasons. The Rio Jemez was only accessible during the spring monitoring event, during which data was collected at six sites. There were 195 seine hauls during the spring event, 120 hauls during the summer event, and 120 hauls during the fall event. Figure 2 shows the percentage of RGSM caught in Santa Ana compared to all fish species caught in the area in 2019.

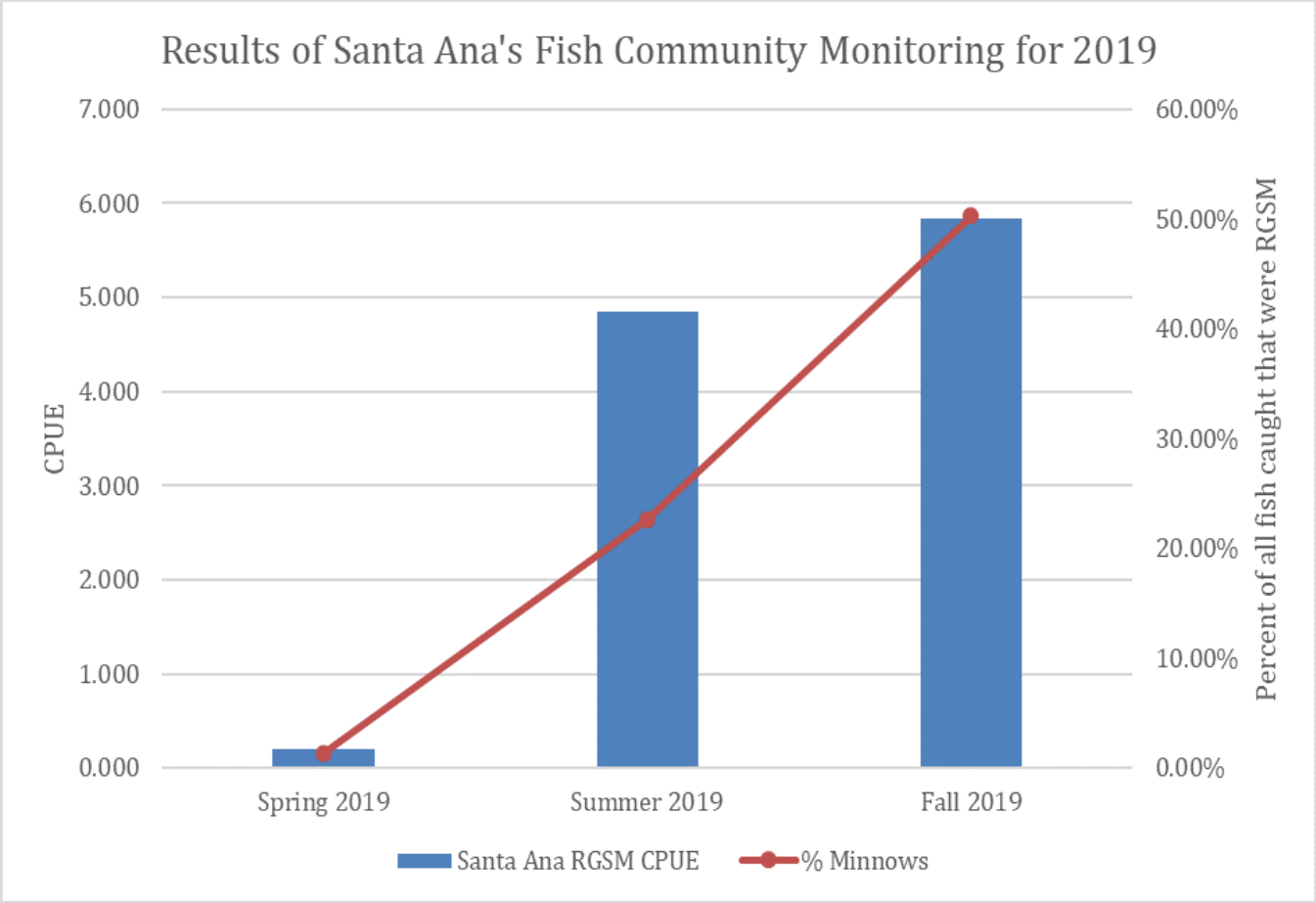


Figure 2. Catch per unit effort (CPUE) [fish/100 square meters (m2)] of Rio Grande silvery minnow captured in Santa Ana in 2019 and the percentage of Santa Ana Rio Grande silvery minnow caught compared to all fish species caught in the area.

Rio Grande Silvery Minnow High-Throughput Markers

The purpose of this project is to develop a single nucleotide polymorphism (SNP) panel, which will allow for a thorough evaluation of various genetic metrics among RGSM. The project objectives are as follows:

1. Develop a SNP panel that provides sufficient loci to monitor genetic diversity, effective population size, population structure, and relatedness within or among captive and wild populations
2. Develop sex-specific markers that will allow for genetic determination of sex
3. Provide plans, updates, and reports for review and approval, including oral presentations, draft/final reports, and a draft study plan

To date, the project has resulted in an inventory of DNA subsampled from tissues at the Museum of Southwest Biology. This DNA inventory was isolated, purified, and assessed for quality, before being prepared for DNA sequencing and genotyping. Currently, the research team is working on the final steps of the filtering process to prepare the dataset for analysis.

Additional experiments have been conducted to develop sex-specific markers for the RGSM. These experiments included many of the project components listed previously. The final SNP panel is expected to be completed and reported by September 2020.

Rio Grande Silvery Minnow Population Management

The RGSM is restricted to a portion of the Rio Grande and ranges from approximately 150 river miles from the vicinity of Bernalillo downstream to the headwaters of Elephant Butte Reservoir. The objectives of the RGSM Population Management project include the continued propagation of RGSM, the monitoring and augmentation of wild RGSM with hatchery-raised RGSM, and the rescue and transport of stranded RGSM during intermittent flow periods in the MRG.

During FY19, both MRGCD and Reclamation provided resources for fish rescue and salvage activities conducted by USFWS. River channel drying in the MRG began late in 2019. Between September 3rd and September 29th, rescue activities were conducted on 5.6 unique miles of the main channel of the MRG that were dry or intermittent. All drying occurred within the San Acacia Reach. An additional 12 miles of drying occurred at the Bosque del Apache National Wildlife Refuge, but the area was inaccessible due to a sediment plug. As a result, no fish rescue operations were performed there.

In total, 989 RGSM were rescued. Of these, 966 were young-of-year, 22 were hatchery-reared, and one was a wild adult. 138 dead RGSM were also documented during river intermittency. Although spring runoff was high in 2019, the number of young-of-year RGSM was unexpectedly low; a pattern that was also observed in river-wide fish surveys. Late season low flows, drying, and a low number of RGSM that survived 2018 are all factors that may have contributed to the low RGSM count observed during fish rescue.

Rio Grande Silvery Minnow Population Monitoring

Systematic population monitoring of the RGSM and its associated MRG fish community began in 1993 at multiple sites from Algodones to Elephant Butte Reservoir. Monitoring was refined to standardized sites prior to MRGESCP involvement in FY02. This long-term monitoring program documents the number of fish captured per unit of effort, which is used to calculate the CPUE density metric. A comparison of CPUE over time is used to describe the long-term trends and overall status of the RGSM population. This monitoring is required to continue for regulatory compliance with the 2016 MRG BO.

Population monitoring occurs up to nine months of the year, at 20 locations in the MRG. The sampling design was modified in 2017 to include a total of 30 sites during the key months of April and October. Consistent monitoring protocol is expected to yield a long-term ecological dataset that accomplishes the following:

- Determines long-term (multi-year) and short-term (seasonal) trends in MRG fish populations using statistical approaches that discern spatiotemporal differences in the abundance of native and non-native fish, with a focus on the RGSM
- Evaluates the influence of water discharge timing, magnitude, and duration on population fluctuations of both native and non-native fish species in the MRG over time and space, with a focus on the RGSM,
- Compares changes in absolute and rank abundance between the RGSM and other native and non-native fish species
- Determines site-specific sampling variation
- Examines spatial correlation of RGSM population dynamics over time



Photo: Flooded site for population monitoring
Credit: American Southwest Ichthyological Researchers, L.L.C. staff

CPUE of the RGSM in October 2019 was higher than the October 2018 estimate (Figure 3). In October 2019, a total of 209 RGSM were collected from 19 of the 20 standard long-term monitoring sites. RGSM were collected in 92 of the 333 seine hauls that yielded fish. All RGSM collected in October 2019 were unmarked and presumably naturally spawned. In addition, the RGSM collected were in two age classes, with the majority being young-of-year fish. These monitoring results indicate that spring runoff flows in 2019 resulted in successful RGSM spawning and recruitment.

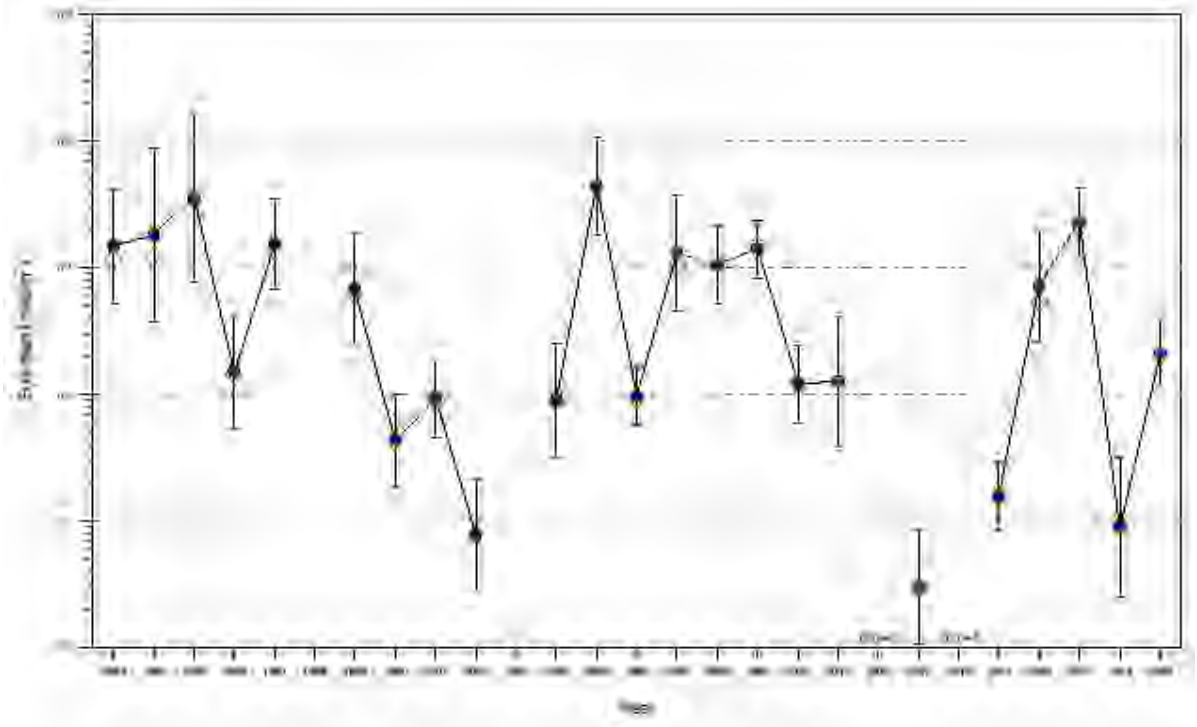


Figure 3. October Rio Grande silvery minnow density estimates (E(x)) [fish/100 square meters (m2)] for 1993-2019. Solid circles indicate estimates, hollow circles represent simple estimates using methods of moments and bars mark 95 percent intervals.

Rio Grande Silvery Minnow Reproductive Monitoring

Systematic reproductive monitoring of the RGSM has been conducted annually since 2001, with the goal of providing insight into the key environmental factors that affect the spatiotemporal spawning patterns of the RGSM. Results assist managers in developing successful strategies for species recovery. The primary objectives of the RGSM Reproductive Monitoring Program are to characterize the timing, duration, and magnitude of RGSM spawning in the Angostura, Isleta, and San Acacia Reaches of the MRG. Additional objectives include characterization of reach-specific spawning patterns, assessment of linkages between egg passage rates and seasonal flows, and examination of the effects that flow and temperature have on spawning.

The 2019 study was a continuation of the long-term monitoring effort in the lower portion of the San Acacia Reach (San Marcial), just upstream of Elephant Butte Reservoir. Two additional sites in the Angostura and Isleta Reaches were also sampled from 2017 to 2019. RGSM eggs were collected from all three sampling sites in 2019.

Long-term spawning patterns and trends were based solely on eggs collected at San Marcial. Modeling of daily egg presence-absence data from 2003 to 2019 revealed that the daily probability of collecting eggs was highest when river flows increased substantially across consecutive days and declined as water temperature increased. Daily egg passage rates were highest in 2011 and lowest in 2004. There was a steady decline in passage rates from 2011 to 2013, followed by an increase in 2014. Passage rates declined again from 2015 to 2016 but increased slightly in 2017. The passage rate in 2019 was significantly lower than the 2017 rate.

Ecological models revealed that changes in the occurrence and passage rate of eggs were moderately predicted by differences in seasonal river flows over time. Out of 160 models considered, scientists found that three models, which represented high flows during spring, were most informative in explaining why some years had lower egg passage rates than others. In summary, egg occurrence probabilities were higher during years with reduced and truncated spring flows, and egg passage rates were lower during years with elevated and extended spring flows.

Each year, some portion of RGSM eggs remain upstream. This occurrence is likely related to prolonged and elevated spring flows, which result in overbank flooding in vegetated areas, formation of inundated habitats in the river channel, and creation of shoreline and island backwaters. As the successful growth and survival of RGSM, from the egg through the early larval phases, requires about one month, the long-term persistence of inundated habitats is essential. The future conservation status and recovery of the RGSM appears strongly dependent on consistent seasonal flow and habitat conditions.

Rio Grande Silvery Minnow Spawning Habitat Study

ABCWUA and NMISC collaborated on a study to investigate the occurrence of inundated floodplain habitat and use of this habitat by RGSM larvae and adults in both restored and unrestored sites in the Angostura, Isleta, and San Acacia Reaches. Monitoring began in FY16 and is ongoing. The objective of the study is to determine when and how long adult and larval RGSM use floodplain habitats in the spring, as well as to examine the utilization of floodplain habitat restoration sites. In 2019, larval fish were collected from two sites in the Angostura Reach and six sites in the San Acacia Reach. RGSM from these collections supported two supplemental studies: the Larval RGSM Otolith Validation Study and the Age Determination of Wild-Captured Larval RGSM Using Lapilli Otoliths Study

San Acacia Diversion Dam Fish Passage Pilot Study

NMISC, MRGCD, and Reclamation are evaluating a number of options to enhance river connectivity at the San Acacia Diversion Dam (SADD) for the purpose of allowing fish to navigate from downstream to upstream. NMISC continued to collect hydraulics information at the gates of the diversion structure and the downstream rock ramp. Fish are also being PIT tagged and tracked in the vicinity of the dam to determine if they have the ability to move through the dam at its current configuration. A long-term fish passage is being considered that may incorporate in-channel and off-channel structures to accommodate a greater range of river flows. Additionally, Reclamation began conducting environmental compliance of alternatives.

Spawning and Larval Fish Study in the San Acacia Reach

NMISC and its contractors have been conducting fisheries studies on constructed and natural floodplain habitats for over 10 years. In FY19, NMISC and ABCWUA contracted SWCA to conduct the 2019 RGSM Spawning and Nursery Habitat on Restored Floodplain Sites in the MRG Study. This study was conducted in the 4th year of a collaborative project that investigates MRG floodplain use by RGSM of all life stages. Floodplain habitat restoration is one of the critical components for avoiding jeopardy and improving the status of the RGSM, as directed in the 2016 MRG BO.

The purpose of this study was to identify key habitat features utilized by RGSM in floodplain sites within the San Acacia and Angostura Reaches. Life cycle monitoring for RGSM at these sites was conducted using fyke nets to capture adults and dip nets to capture larvae. A total of eight sites were sampled using both methods (Figure 4).



Figure 4. Map of all San Acacia sites sampled during 2019

Fyke nets captured a total of 994 fish, representing 13 species. The two most abundant species were RGSM and Red Shiner (*Cyprinella lutrensis*). Of the 471 RGSM captured using fyke nets, 197 did not have a visible implant elastomer (VIE) tag and 274 had VIE tags. The majority of smaller RGSM (≤ 60 millimeters [mm] standard length) had a VIE tag. Conversely, the majority of RGSM that were greater than 60 mm standard length did not have a VIE tag. The majority of RGSM were adults and 23 percent were females.



Photo: Rio Grande silvery minnow with standard length of 59 millimeters and weight of 3.5 grams
Credit: SWCA staff

A total of 1,693 dip net samples were conducted throughout the study, capturing approximately 3,944 unknown larvae. In addition, 47 dip net samples were conducted under targeted non-random sampling, resulting in an additional 390 larvae for a total of 4,334 unknown larvae. The capture of RGSM gravid females and nuptial males over several years of monitoring provides evidence that RGSM are likely spawning on floodplain habitat when available.

Data collected under this study will help identify important factors that contribute to the presence of larval RGSM within floodplain habitat. This information will be used to evaluate and adjust sampling and analysis methods for floodplain monitoring, to demonstrate the life history of RGSM, to inform the water management of the MRG, to adaptively manage the species to meet the requirements set forth in the 2016 MRG BO, and to support the MRGESCP.





Photos (from left to right): Fyke net set-up for adult Rio Grande silvery minnow sampling at the Paseo del Norte southwest site | Inundation at the Paseo del Norte southwest site
Credit: Kate Mendoza, ABCWUA

Habitat Restoration

Program signatories supported habitat restoration activities in the MRG that provided sustainable habitat features for spawning and larval RGSM, SWFL, and YBCU. These activities included the identification of top locations for new habitat restoration sites and the evaluation of current sites. Table 7 lists the habitat restoration-related activities that were associated with the Program in FY19.

Activity Name	Begin	End	Sponsor/Contributor
Bosque and Riverine Restoration Project and Fish Passage at Isleta Diversion Dam	FY17	Ongoing	MRGCD; Pueblo of Isleta; Reclamation; USFWS
Evaluation of Sediment Dynamics in Habitat Restoration Features of the Albuquerque Reach	FY11	FY20	USACE
Development of a Habitat Restoration Geo-Database for the Middle Rio Grande	FY18	FY20	NMISC
Development of the Habitat Restoration Monitoring Plan for the Isleta and San Acacia Reaches	FY18	FY20	NMISC; Reclamation
Identifying Restoration Priorities for Threatened Tamarisk-Dominated Habitat to Benefit Future Habitat for the Southwestern Willow Flycatcher	FY18	FY20	USACE
Los Lunas Habitat Restoration Project Monitoring	FY00	FY20	Reclamation; USACE
Lower Reaches Habitat Restoration Project Monitoring	FY18	Ongoing	NMISC; Reclamation
New Mexico State Forestry Exotic Species Removal	FY19	Ongoing	ABCWUA; BEMP

Table 7. FY19 Habitat Restoration Activities List

Bosque and Riverine Restoration Project and Fish Passage at Isleta Diversion Dam

The Pueblo of Isleta continued to develop the Pueblo's Bosque and Riverine Implementation Report, which identifies specific treatments for the 2,000-acre Isleta Bosque. The project is intended to result in bosque and riverine improvements along Isleta's eight-mile stretch of the bosque. The project will include exotic species removal, fuels reduction, revegetation with native plants, wildlife habitat improvement, and jetty jack removal. Environmental assessments of the areas of interest are underway. In collaboration with Reclamation and MRGCD, the Pueblo of Isleta will also make modifications to the Isleta Diversion Dam (IDD), such as alteration of the dam's irrigation infrastructure for sediment management and production of a fish passage structure. Full implementation is scheduled for spring 2020.

The decline in RGSM populations has been attributed to several factors, including decreased and interrupted stream flow caused by impoundments and permanent water diversion structures. The IDD is one of three diversion dams dividing the remaining RGSM population, and building a fish passage structure at the dam will provide connectivity between the Isleta and Angostura Reaches of the MRG. The resulting bosque and riparian restoration due to the structure will enhance current habitat and provide new habitat for listed species.

In 2019, the Pueblo of Isleta matched grants funding fuels reduction and invasive plant species removal and control. Partners for these efforts include MRGCD, the Natural Resources Conservation Service, the New Mexico Environmental Quality Incentives Program, the New Mexico Water Trust Board, the New Mexico Environment Department's Isleta Island Removal Project, and the Bureau of Indian Affairs' Invasive Species Program.





Photos: Fuels reduction projects in the bosque
Credit: Mike Marcus, APA

Evaluation of Sediment Dynamics in Habitat Restoration Features of the Albuquerque Reach

Ecosystem restoration projects conducted by USACE on the MRG have focused on removing non-native vegetation, encouraging listed species habitat, and promoting main channel to floodplain connection. Surveying for these projects includes assessing morphological adjustments and sediment aggradation and erosion for a variety of hydrological features, such as high-flow channels and embayments, terraced or scalloped bank lines, and oxbows installed at various USACE project sites within the Albuquerque Reach. Surveys were conducted using current survey methods and practices, and utilizing local monuments to provide consistent controls for the sites. Reports were generated for surveys conducted from 2011-2018 to document changes observed at the sites.

The objective of this monitoring is to collect data on morphological changes of features at habitat restoration sites in order to assess how these features are functioning. Through repeated channel surveys and establishment of photo points, the changes over time of various habitat restoration features are tracked. The resultant information from this project helps biologists and design engineers understand how habitat restoration features function relative to their design intent and determine the hydrological conditions that initiate their inundation. Additionally, it helps project sponsors understand the types of operation and maintenance activities they may need to conduct to ensure the longevity of a feature. Finally, understanding hydrological inundation provides insight into potential conditions for RGSM spawning and recruitment, as well as for vegetation growth that is essential for establishment of SWFL habitat.

The morphological changes that occur due to sedimentation of the habitat restoration features were evaluated using repeated surveys conducted both parallel and perpendicular to the flow. The deposition of sediment, which can reduce the effective inundation, was then assessed. Initial results for all 17 sites indicated a general pattern of deposition in all overbanking feature types (e.g., high-flow channels, bank terraces, and interconnected swales). The greatest morphological change was observed at the entrances and exits of high-flow channels. Observation of the sites after the 2019 snowmelt runoff indicated that overbanking flows bring in sediment and also invigorate native riparian vegetation. Based on an initial assessment of the field surveys, a combination of feature types may best promote habitat for listed species. For example, large bank terracing promotes ample vegetation growth along the Rio Grande, while inland swales, connected via backflow channels, provide spawning habitat throughout the riparian zone.

Overall, evaluation of habitat restoration sites on the MRG revealed that habitat restoration projects have successfully encouraged more native riparian growth, created habitat development, and increased the river's connection with its floodplain. These projects benefit the local community in other ways as well, including as tools for recreation and teaching. Increased use and appreciation of the MRG Bosque benefits future generations of listed species and humans alike.



Photo: Los Lunas habitat restoration site
Credit: Mike Marcus, APA

Development of a Habitat Restoration Geo-Database for the Middle Rio Grande

NMISC is working with GeoSystems Analysis (GSA) to assemble and integrate a geo-database for the existing habitat restoration projects in the MRG. These projects include those constructed by Program signatories for ESA purposes, as well as those constructed by other agencies and stakeholders engaged in restoration of the bosque. The geo-database will be available on the MRGESCP Portal (**https://webapps.usgs.gov/MRGESCP/**).

Development of the Habitat Restoration Monitoring Plan for the Isleta and San Acacia Reaches

NMISC is working to improve habitat conditions for federally threatened and endangered species along the MRG. Since 2013, NMISC has focused its attention on segments of the Isleta and San Acacia Reaches, with an emphasis on expansion of off-channel nursery habitat for RGSM. In regulated river systems, like the MRG, most habitat restoration projects require focused and coordinated monitoring and adaptive management strategies to ensure that project objectives are achieved and sites function as intended.

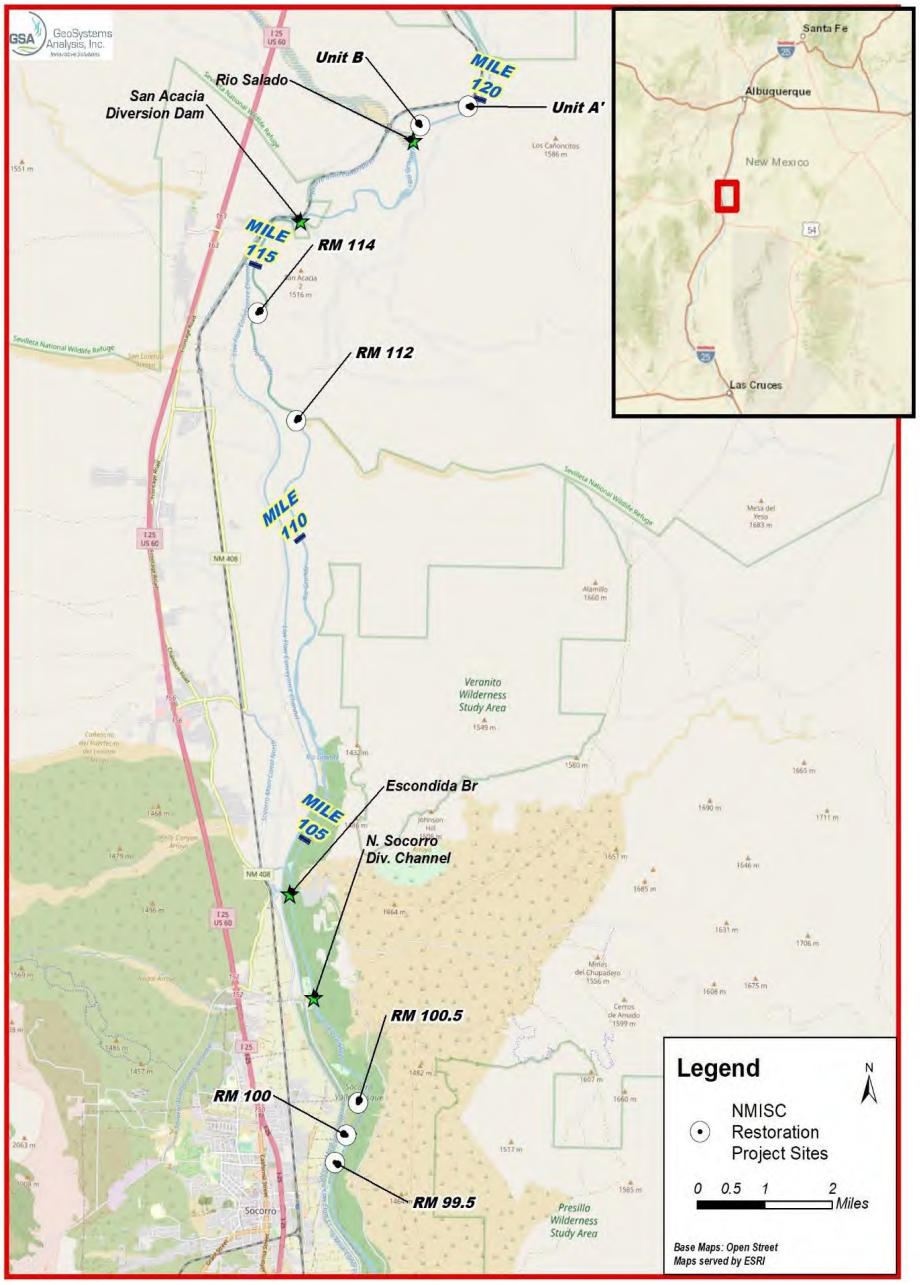


Figure 5. NMISC restoration project sites

In FY19, GSA prepared an operational framework for implementing a project- scale monitoring and adaptive management program at five restoration project sites recently designed and constructed by NMISC and Reclamation. The monitoring framework and methodologies presented in the plan could be applied to additional project sites with similar objectives and used to support reach-scale habitat restoration and adaptive management efforts.

Given the RGSM's short life span (generally ≤ 2 years), water managers and restoration practitioners are suggested to implement projects that improve reproductive conditions to mitigate the impacts of multi-year droughts. Accordingly, NMISC restoration efforts focus on designing and constructing projects that improve the probability of annual floodplain inundation under relatively low to moderate discharge levels (i.e. 800-2000 cfs).

In FY19, GSA was contracted to identify and prioritize locations and design restoration projects to increase areal extent and spatial distribution of off-channel spawning and rearing habitat for the RGSM under low to moderate river discharges. Detailed restoration designs were developed for seven project sites, including two sites upstream and five sites downstream of the SADD (Figure 5).

Restoration design criteria were guided by existing studies addressing off-channel spawning and rearing habitat attributes associated with RGSM. As with any adaptive management program, the objective of the monitoring plan was to evaluate whether the restoration design concepts would yield the desired results and importantly, to use the monitoring results to improve future restoration design efforts.

Identifying Restoration Priorities for Threatened Tamarisk-Dominated Habitat to Benefit Future Habitat for the Southwestern Willow Flycatcher

The goal of this study is to provide site-specific verification and final priority rankings for the top 15 of the 103 tamarisk-dominated SWFL restoration sites previously identified by the Program in 2015. The project features the ground truthing of several sites in order to verify the continued appropriateness of restoration goals. Ground truthing incorporates examination of site access opportunities, validation of the vegetation community, and verification of continued nearness to SWFL nesting sites. The validation techniques also feature analysis of hydrology and stage-discharge relationships, floodplain connection, and groundwater dynamics. The final priority rankings of sites were presented to the Program's Science and Habitat Restoration Work Group. A report prioritizing the site rankings will be finalized in spring 2020.



Photo: Tamarisk with flowers
Credit: Eric Coombs, Oregon Department of Agriculture

Los Lunas Habitat Restoration Project Monitoring

Historically, the Los Lunas Habitat Restoration Project fulfilled requirements for one of eight sub-reaches in which habitat restoration was to be conducted in accordance with USFWS's June 2001 BO. Following a fire in April 2000, the Los Lunas restoration site was selected as the first 2003 MRG BO restoration area. Reclamation and USACE acted as joint lead federal agencies on the 40-acre project, and MRGCD was the primary non-federal cooperator. The project was the first habitat restoration project funded by the MRGESCP.

The primary objective of the project was to improve habitat conditions for the RGSM and SWFL. The design goals were to generate inundation of the project area at flows of ≥ 2,500 cfs. For flows below 2,500 cfs, a variety of substrate elevations were integrated into the project design to allow for the inundation of certain regions at lower river stages. This included features such as a network of variable depth side and transverse channels designed to aid in minnow egg retention and provide shallow water/low-velocity rearing habitat. In addition, the increased inundation frequency would begin the process of post-fire regeneration of high-value terrestrial habitats in portions within and adjacent to the restoration area to support the recovery of the SWFL. The project was completed in 2002 and monitoring of the site began in 2003.



Photo: Los Lunas habitat restoration site
Credit: Mike Marcus, APA

This ongoing monitoring activity observed the availability and effectiveness of restored habitat, including the physical elements related to habitat characteristics (e.g., hydrology, geomorphology, and vegetation) and the presence of RGSM and SWFL.

The objectives of the annual monitoring efforts were to:

- Determine the success of restoration at the Los Lunas restoration site in establishing a productive cottonwood/willow riparian community, as well to characterize factors that may have influenced the outcome
- Assess SWFL and YBCU habitat suitability/sustainability and identify those variables which contribute to the development of quality habitat
- Establish a potential timeframe in which a restored site develops into suitable SWFL and YBCU habitat under local environmental conditions
- Provide data for the adaptive management of future restoration efforts in the MRG

FY19 concluded with a summary of the past 20-plus years of monitoring and recommendations to the Program for where best to focus future monitoring efforts.

Lower Reaches Habitat Restoration Project Monitoring

Effectiveness monitoring of the Lower Reaches Habitat Restoration Project was completed in Spring 2019 at eight sites located along a 20-mile segment of the San Acacia Reach of the MRG, between the SADD (near river mile [RM] 116) and Brown Arroyo (RM 94). Five of the eight projects were designed by NMISC, while the other three were designed by Reclamation (Table 8). Reclamation's Socorro Field Division constructed all eight project sites, with final completion in winter 2019.

Project Name	Acres	Designed by	General Design Features
RM 114	1.7	NMISC	Two backwater channels, inundation initiated at approximately 800 cfs
RM 112	1.5	NMISC	One backwater channel, inundation initiated at approximately 800 cfs
RM 104.5 (Escondida East)	3.2	Reclamation	One backwater channel, inundation initiated at approximately 800 cfs
RM 103 (Escondida West)	10.5	Reclamation	Four backwater channels and one high-flow channel, inundation initiated at approximately 300 cfs
RM 100.5	8.2	NMISC	Two backwater channels, inundation initiated at approximately 800 cfs
RM 100	1.4	NMISC	One backwater channel, inundation initiated at approximately 800 cfs
RM 99.5	3.5	NMISC	Two backwater channels, inundation initiated at approximately 800 cfs
RM 94 (Rhodes)	17.2	Reclamation	Eleven embayments and one high-flow channel, inundation initiated at approximately 300 cfs

Table 8. Restoration Project Sites

The lower reaches monitoring effort represents a collaborative effort between NMISC and Reclamation to standardize monitoring procedures, so that similar physical and biological response variables across restoration project sites can be compared and evaluated. While some restoration design details differed between agency projects, the overarching project objectives for all eight projects were similar: to physically lower elevated floodplain terraces, so they could become inundated during low to moderate river discharges (≤ 800 cfs) and to provide physical conditions conducive to spawning and rearing for the RGSM.

Monitoring was implemented at all eight restoration project sites between March 14 and June 7, 2019. Activities included:

- Mapping inundation extent at approximately 800 cfs and 2,000 cfs
- Measuring inundation depth, velocity and water temperature
- Evaluating presence of isolated pools of water (i.e., not draining back to the river channel) and potential-to-strand RGSM
- Mapping the presence and distribution of New Mexico State listed noxious weeds

The monitoring was implemented primarily by the Save Our Bosque Task Force with technical support from GSA. The relationship between the monitoring actions implemented and restoration project objectives, as well as step-by-step descriptions of monitoring procedures, was included in NMISC's Monitoring and Adaptive Management Plan for NMISC Habitat Restoration Projects in the San Acacia Reach of the MRG. The results of the 2019 monitoring season can be found on the Program Portal (**https://webapps.usgs.gov/MRGESCP/**).

New Mexico State Forestry Exotic Species Removal

The CoA Open Space Division, in collaboration with New Mexico State Forestry (NMSF), conducted three separate exotic species removal projects. These projects were performed in part by NMSF's inmate work camp over the course of 40 days. The work included the operation and maintenance of previously constructed habitat restoration features with adherence to various agency jurisdictions and mandates.

The first of the three projects is located on the west bank of the Rio Grande, north of Central Avenue and within the Rio Grande Valley State Park Bosque. This project encompassed USACE's Ecosystem Revitalization Project at Route 66 and, in its second phase, entailed the treatment of 8.7 acres of exotic plant species and the removal of "dead and down" debris to include USACE's high-flow channel project area. The project was completed to maintain habitat and river-to-floodplain connectivity for the RGSM and SWFL.

The second of the three projects was the treatment and/or removal of exotic plant species for ABCWUA's San-Juan Chama Mitigation Project at the Paseo del Norte southeast habitat restoration site. This project is located on the east bank of the Rio Grande, approximately one mile south of Paseo del Norte, within the bosque. A total of six acres of exotic plant species were treated and/or removed, and the area was revegetated with native riparian vegetation, including Rio Grande cottonwood poles, Goodding's black willow poles, and coyote willows.

The third exotic species removal project was a collaborative project between CoA's Open Space Division, NMSF, Bosque School/BEMP, and Albuquerque Fire Rescue, which entailed the removal of "dead and down" vegetation. The goal of the project was to ultimately reduce the risk of catastrophic wildfire near a highly populated area and to treat and/or remove exotic plant species on approximately two acres. The project is located on the west bank of the Rio Grande, approximately half a mile south of Montano, within the bosque. A future phase of the project that features the construction of swales in order to benefit Bosque ecosystem health and SWFL habitat is currently being explored.



Photo: Rio Grande cottonwood
Credit: Mike Marcus, APA

Science Support

MRGESCP signatories funded and implemented various scientific studies and projects that benefited the RGSM, SWFL, YBCU, and other plant and animal species in the MRG. These FY19 activities included site and species monitoring, sediment studies, routine construction, an inundation assessment, and development of a mobile bed discharge gage. Table 8 lists the science support-related activities that were associated with the Program in FY19.

Activity Name	Begin	End	Sponsor/ Contributor
2012 Middle Rio Grande Inundation Assessment	FY19	FY20	USACE
Assessment and Quantification of Sediment and Discharge at Arroyo de los Piños	FY17	FY19	Reclamation; USACE
Bosque School Bosque Ecosystem Monitoring Program Site Monitoring	FY03	Ongoing	MRGCD; USACE
Changes in Terrestrial Soil Loss in the Middle Rio Grande Basin to 2100	FY19	FY19	USACE
Development and Application of a HEC-RAS, Mobile Bed, Sediment Transport Model of the Middle Rio Grande	FY17	FY19	USACE
Development of a Mobile Bed Discharge Gage	FY17	FY19	USACE
Effects of the Las Conchas Fire on Water Quality and Fish Assemblages in the Middle Rio Grande	FY16	FY19	USACE
Flume/Weir Construction Throughout the Middle Rio Grande Conservancy District		Ongoing	MRGCD
Monitoring Climate Change in the Middle Rio Grande	FY12	FY20	USACE
Middle Rio Grande Bedload Sediment Measurement	FY19	FY20	Reclamation; USACE
Middle Rio Grande Suspended Sediment Measurement at San Acacia	FY16	FY19	Reclamation; USACE
Middle Rio Grande Tributary Precipitation Induced Geomorphology	FY15	FY19	USACE
Rio Grande Sediment Gages: Rio Puerco, San Acacia, San Marcial	FY10	FY19	Reclamation; USACE
Tamarisk Leaf Beetle Distribution, Genetic Variation, Defoliation, and Mortality Impacts on Tamarisk Habitat in the Middle Rio Grande	FY12	FY19	USACE
Tamarisk Leaf Beetle Species and Habitat Analysis With Management Implications for the Middle Rio Grande	FY17	FY19	USACE

Table 8. FY19 Science Support Activities List

2012 Middle Rio Grande Inundation Assessment

Shallow depth, slower velocities, and sufficient duration of inundation are three habitat characteristics believed to be crucial for the survival of the early-life stage RGSM reared on the floodplain. Version 5.0 of the Hydraulic Engineering Center's River Analysis System (HEC-RAS) features the ability to conduct one-dimensional hydraulic modeling to generate water surfaces of rivers. This system was paired with a digital elevation model and aerial photography (for quality control) to estimate areas of inundation for the MRG. The purpose of this project is to update the 1992 and 2002 MRG analysis, which estimated areas of inundation at particular discharges throughout the MRG. The data was then used as a quantification of habitat for the RGSM in MRGESCP's population viability analysis model, which utilizes 2012 geometry to estimate areas of inundation per mile from Cochiti to San Marcial.

Assessment and Quantification of Sediment and Discharge at Arroyo de los Piños

USACE has partnered with Reclamation and others to better understand tributary sediment loading at Arroyo de los Piños, a tributary of the MRG. The MRG is a dynamic, complex river system, and its observed form is influenced by the flow and sediment transported from the Upper Rio Grande and MRG tributaries. Arroyo de los Piños is one of several ephemeral tributaries on the east side of the MRG, between San Acacia and San Antonio. Lateral input of sediment into the Rio Grande from ephemeral channels is poorly quantified. Measuring sediment discharge is difficult in a desert setting, as these channels flow only a few times a year and often for just a few hours at a time. Even so, ephemeral channels are the only source of sediment for much of the Rio Grande south of Albuquerque, where no perennial river feeds the Rio Grande until Texas.

The Arroyo de los Piños sediment monitoring station was built to address this knowledge gap. The station represents one of only a few locations worldwide where continuous sediment flux measurements are collected. The monitoring station's first year of data indicated that sediment was being transported at globally high rates, with bedload fluxes of up to 16 kilograms per second-meter (kg/s-m). More intriguing was the grain size distribution of the transported sediment. At low flows, sand-sized particles made up the majority of the sediment in transport. As water discharge increased, larger, gravel-sized particles became entrained and began making their way downstream.

The grain size distribution of sediment input is crucial for understanding the habitat availability for RGSM populations. Large floods along arroyos can produce low-velocity zones of debris and gravel within the Rio Grande that are ideal RGSM habitat. These areas persist until snow-driven spring runoff events are large enough to efficiently move the larger gravel and cobbles deposited by arroyos. Although 2018 rainfall runoff events in the Arroyo de los Piños caused the Rio Grande to shift its course to the west side, the snowmelt runoff in 2019 provided enough energy from the river to redistribute the sediment downstream. This created a diversity of low bar formations further downstream that dynamically changed with the 2019 spring snowmelt runoff. Through better understanding of sediment delivery from arroyos to the Rio Grande and of how that sediment is subsequently redistributed over time, there can be greater insight into how RGSM habitat forms and changes spatially and temporally.





Photos: Arroyo de los Piños sediment monitoring station
Credit: Kyle Stark, New Mexico Institute of Mining and Technology

Bosque School Bosque Ecosystem Monitoring Program Site Monitoring

BEMP is a collaborative ecological monitoring and education program in partnership with UNM, the Bosque School, and the Sevilleta Long Term Ecological Research Program. In FY19, monitoring of the riparian corridor with New Mexico students, educational outreach, and other BEMP activities were funded, in part, by USACE, MRGCD, and the CoA Open Space Division.

BEMP conducts regular and systematic monitoring of habitats on the historic floodplain with the help of volunteers and K-12 and UNM students, while promoting education, awareness, and stewardship of the bosque. BEMP has collected long-term data for 20-plus years at a total of 33 research sites along 350 miles of the Rio Grande (Figure 6). Data include weather data, shallow groundwater table depth, monthly precipitation, surface arthropod activity, and forest production measurements (e.g., leaf litter biomass, tree diameter, growth rates, and plant distribution). BEMP shares its long-term data collection with Program signatories and other land and natural resource managers on an open access site (https://github.com/BEMPscience/bempdata), promotes public outreach, and furthers the preservation of habitat for listed species.

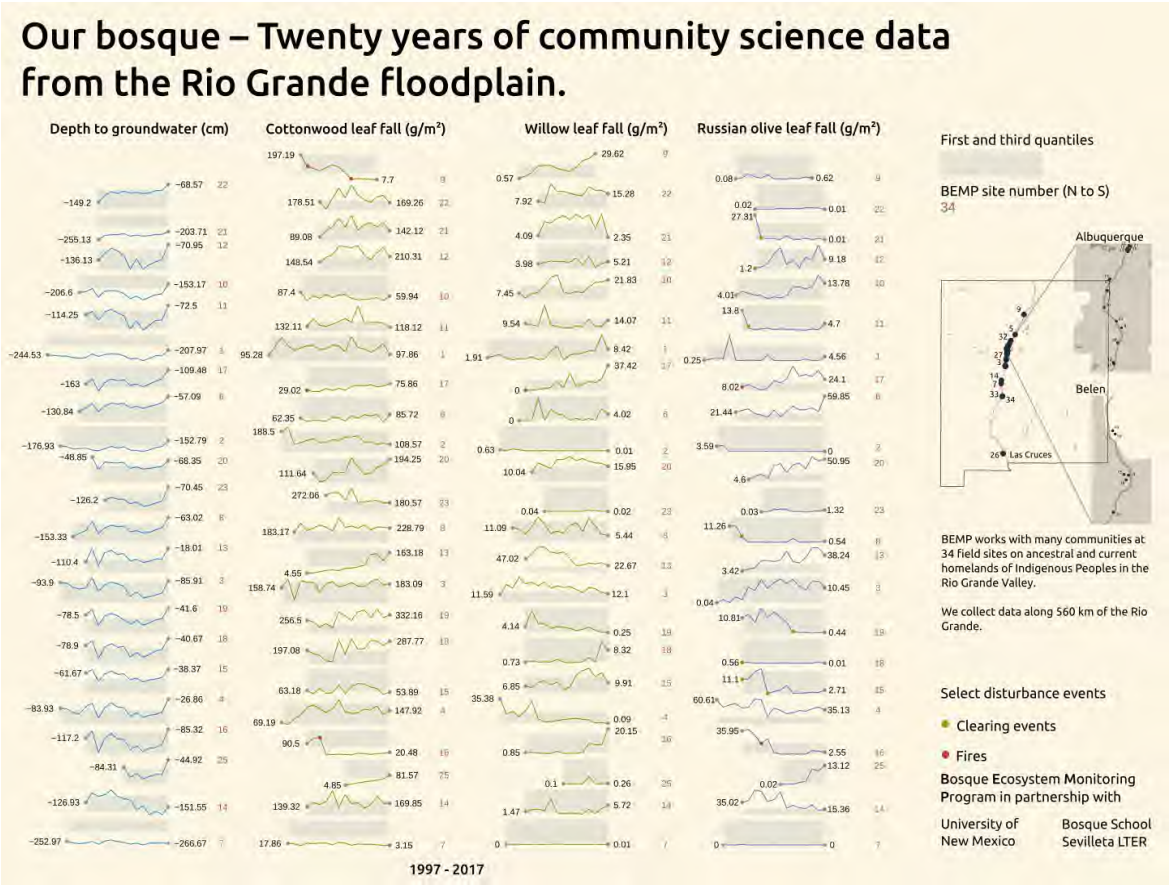


Figure 6. Data from 1997-2017 BEMP sites on the Rio Grande floodplain. Site data is organized from top (most northern site) to bottom (most southern site).

Changes in Terrestrial Soil Loss in the Middle Rio Grande Basin to 2100

Riverine sediment in the MRG is essential for the creation of habitat for fish and native plant species, such as willows and cottonwoods. Sediment in riverine systems originates from both terrestrial (e.g., soil erosion and overland transport) and in-channel sources, and is responsive to changes in land use (e.g., infrastructure development), land cover, and climate. This project explored how projected changes in climate and land use may affect terrestrial sediment supply in the MRG, below Cochiti Reservoir, in the 21st century. Historic watershed soil loss rates were modeled using the revised universal soil loss equation (RUSLE) forced with observed precipitation rates and historic land use/land cover (LULC) data from the USGS LandCarbon study. The RUSLE model was then forced with localized constructed analogs (LOCA)-modeled precipitation data and LandCarbon LULC data for two 21st century epochs in order to assess changes in future terrestrial sediment supply rates within the basin.

Development and Application of a HEC-RAS, Mobile Bed, Sediment Transport Model of the Middle Rio Grande

Considering how sediment moves through the MRG is important for planning and engineering because it influences a range of concerns, including flood risk reduction and river rehabilitation. Additionally, a sediment imbalance may impair the riverine and riparian ecosystems that are vital to listed species. USACE recently completed the development and application of a one-dimensional sediment transport model (HEC-RAS) to evaluate potential future geomorphic and sedimentation trends in MRG reaches. The model was developed with continuity of parameters between Cochiti Dam and Elephant Butte Reservoir in order to provide consistency across diversion dams that have historically segregated modeling reaches and to reset modeling boundary conditions. The simulated results provide insight into the potential future magnitude and gradation of sediment transported in the MRG as well as spatial and temporal changes in channel bed elevation and stored sediment volumes. Some key interpretations of the results that may impact listed species habitat include:

- Bed lowering/channel widening occurs in response to expected decrease in sediment storage from Cochiti to Angostura, from Isleta to Bernardo, and in the downstream portion of the San Acacia Reach
- Bed raising/channel narrowing occurs in response to expected increase in sediment storage in other MRG reaches
- MRG morphology is influenced by tributary sediment loading; hydrologic sequences, such as extended drought; and anthropogenic influences, such as diversion dams or reservoir pool levels

The model is useful for evaluating reach and longer time-scale scenarios, and for supplying boundary conditions with more detailed temporal and spatial scale modeling of flood risk, sedimentation, and habitat improvement projects. For example, one current application of the model is providing boundary conditions around the IDD in order to investigate potential solutions for problems with sedimentation and the RGSM passage.

Development of a Mobile Bed Discharge Gage

The USGS tested the initial prototype Mobile Bed Discharge (MoBeD) gage designed by USACE. The goal of the MoBed platform is autonomous capture of physical system measurements to quantify channel evolution, geomorphology, and discharge estimations. Many ecosystems are difficult or cost prohibitive to monitor with traditional gaging. MoBed seeks to fill gaps in current data collection at static locations and via drone for post-flood automated high water mark delineation. Field operation of the device will also be explored, but was not conducted in FY19. Review of the device included technical comments on its design, programming, and operation, in context of operation at the Arroyo de los Piños study site.

Primary lessons learned from prototype development will be incorporated into version 2 of MoBeD. The first job is to simplify the device. Draft specifications for the revision are based on a new hardware foundation providing better modularity and durability, while increasing sensor and processing capacity. The primary photogrammetric camera array is new and has the potential for dramatically increasing image quality and response time. In version 1 of MoBeD, video cameras used for velocity measurement were 'borrowed' from the structure from motion (SfM) array due to a four-camera capacity when using one camera multiplexer. Version 2 has a dedicated SfM array with two additional cameras to record velocity or track a staff gage independently.

The MoBed gage project was presented at the Sedimentation and Hydrologic Modeling Conference. Possible deployment opportunities arose from the presentation, and initial discussions are underway for a flume test in cooperation with the Engineer Research and Development Center (ERDC) and the U.S. Department of Agriculture's Agricultural Research Service. The USGS also expressed interest in testing the MoBed gage on the Delaware River experimental watershed. As part of the prototype gage testing, specific attention is being given to evaluating how MoBed may effectively supplement the USGS instrumentation catalog. Deployment is planned on the Arroyo de los Piños upon completion of field hardening.



Photo: Middle Rio Grande drain levee
Credit: Mike Marcus, APA



Photo: Smoke cloud over Las Conchas
Credit: Mike Marcus, APA

Effects of the Las Conchas Fire on Water Quality and Fish Assemblages in the Middle Rio Grande

This study evaluated the effects of wildfire on downstream water quality and fish assemblages in large arid-land rivers. Through use of data from a high-frequency water quality monitoring network in the MRG, the dissolved oxygen (DO) was analyzed at five sites following the Las Conchas fire in 2011. DO is an important characteristic for determining the quality of a river or stream. DO measurements decrease, or sag, when a pollutant is present. As organic matter enters the river, it requires oxygen to decompose. This increased oxygen demand causes DO to sag and recover downstream of the pollutant. In the first three years after the 2011 fire, numerous DO sag events were documented at least 50 kilometers downstream. Periodic sags were also observed throughout 2018.

Long-term fish community surveys in the MRG were used to assess the response of fish assemblages at two sites closest to the wildfire. Despite poor water quality conditions, indicated by low DO, minnow species at both sites were resilient, with the exception of the longnose dace and fathead minnow at the upstream site. Following a major flood in September 2013, total fish density, richness, and diversity were negatively impacted at the upstream site. Native species, as well as the greater fish community, were unaffected by the flood at the downstream site. The variability in the fish community response was attributed to differences in spatial factors related to the burn scar, site-specific physical characteristics, and species-specific traits.

As wildfire timing, frequency, and severity have increased across Western United States over the last several decades, it is critical for water and resource managers to be aware of potential impacts to water quality and biota in arid-land catchments that are susceptible to wildfire.

Flume/Weir Construction Throughout the Middle Rio Grande Conservancy District

MRGCD installs new flow measurement and control structures at its facilities every year. In 2019, MRGCD installed three flumes for flow measurement, four weirs for water level control, and an automatic gate for water control and measurement. These structures aid MRGCD in providing more reliable water deliveries to irrigators and making informed water management decisions. Water measurement and flow control are tools that allow MRGCD to operate more efficiently. Increased efficiencies within the MRGCD system, including greater measurement precision, allow for more flexibility in water management, which could potentially benefit RGSM.

Monitoring Climate Change in the Middle Rio Grande

Most model projections of future climate in the Rio Grande basin are characterized by persistent drought. Recent drought has highlighted the vulnerability of regional water supplies to persistent drought and the potential impacts of drought on habitat and species conservation efforts. This project helps decision-makers understand and plan for climate change impacts to listed species and critical habitat by creating and maintaining an ongoing summary and analysis of the current trends in climate and the resulting hydrologic changes in the Rio Grande basin above Elephant Butte Reservoir. In addition, this project supports the following regional climate change planning efforts:

- Climate change projects, including the Rio Grande-New Mexico Basin Study and Drought Framework Planning Study, by Reclamation and MRGCD
- The Extreme Weather Events, Critical Thresholds, and Climate Preparedness Study by the City of Las Cruces and Southwest Climate Science Center
- Climate Research Symposium and Adaptation Round Tables by Los Alamos National Laboratory
- Rio Grande basin representation on the South Central Climate Science Center Rio Grande Coordinating Call and Southern Rockies Landscape Conservation Cooperative
- Information sharing with federal agencies through the Watershed Futures Initiative

Middle Rio Grande Bedload Sediment Measurement

The geomorphology of the Rio Grande is influenced by sediment transported in suspension, near the river bed. The quantity and type of sediment transported by the river changes with distance from the bed, with the assumption that higher fluxes occur near the bed. The majority of sediment data collected on the Rio Grande is used to measure the suspended sediment. There is a lack of physical sediment measurements of the MRG's bedload. This project makes use of sound technology (sonar and acoustic) to collect repeated sand dune movements and estimate bedload transportation in the MRG using the integrated section surface difference over time version 2 (ISSDOTv2) technique, developed by USACE's ERDC. The objective of this research is to collect data on bedload movement and compare the ISSDOTv2 technique with the semi-empirical bedload estimation technique currently used on the MRG. This information, coupled with suspended sediment information already collected on the MRG, provides information on how sediment moves through the system. As information on sediment transport is important for understanding how RGSM habitat develops and adjusts, this project helps provide insight into sediment transport mechanisms on the MRG.

Sediment data collection was conducted around the Albuquerque and San Acacia USGS gaging stations during the spring snowmelt runoff in June 2019. Data collection was a joint effort between USACE, USGS, and Reclamation. The effort involved typical sediment data collections on the MRG from established USGS gaging stations using physical samples of suspended sediment and bed material. The collected samples were processed to obtain sediment gradations and suspended sediment concentrations, then used with the semi-empirical modified Einstein procedure to estimate bedload. In addition, an acoustic Doppler current profiler (ADCP) and multi-beam sonar were both used to make multiple swaths of the bed. Both ADCP and sonar data are being processed to evaluate bedload movement, with the sonar data specifically being used to evaluate the ISSDOTv2 software.

Middle Rio Grande Suspended Sediment Measurement at San Acacia

The suspended sediment measurement at San Acacia is part of the larger MRG Bedload Sediment Measurement Study described previously. Sediment gages on the Rio Grande provide daily information with regard to changes in the quantity and gradation of suspended sediment. To better understand the temporal transport of suspended sediment in the MRG, active acoustics were installed at the San Acacia USGS gage. Acoustical research work on other rivers has revealed a more in-depth understanding of the timing, magnitude, and duration of sediment loads in those systems than was impossible with previously collected datasets. This data collection effort will aid in the understanding of sediment movement on the Rio Grande and how USACE project activities affect listed species' environments. The information on sediment flux also helps support operational and strategic decision making.

Three different acoustical instruments were installed at the San Acacia USGS gage in 2016/2017. This collaborative effort between Reclamation, USGS, USACE, and the University of Mississippi resulted in the collection of data between 2016 and 2019. An initial evaluation of this data shows that the suspended sediment load may be underrepresented when using a daily suspended sediment value. From the collected acoustic information, it was observed that more sand-sized particles are moved during the spring snowmelt runoff than at other time periods, with a continuous discharge threshold of around 1,500 cfs needed to mobilize the sand particles. Fine particles tend to dominate during the rest of the year and are also dominant on the rising and falling limb of the spring snowmelt runoff. Monsoon flows showed more variability, with data indicating higher suspended sediment concentrations in January than in February.

Middle Rio Grande Tributary Precipitation Induced Geomorphology

In 2019, there was a catchment-wide, high-resolution, precipitation-driven geomorphic change analysis of several MRG tributaries. Development of a sediment transport rating table was a key goal of this project. Catchment and sub-catchment volume changes can be correlated to rainfall distributions by depth, direction, and intensity. This project has three key requirements:

Requirement 1: High-resolution photogrammetric data, collected at high temporal frequency

Civil Air Patrol data collection flights are regularly scheduled for the full Arroyo de los Piños watershed and include catchment-wide geomorphic difference analysis. The FY19 flight data was compared with FY17 flight data at high spatial resolution.

Requirement 2: Regional radar at high spatial and temporal resolution, illustrating depth and intensity

Extraction of National Weather Service products was extensively investigated. Many MRG catchments have times of concentration that are less than one hour. When building a hydrology model that accurately represents the physical system, the time step of the primary input should be less than the entire model runtime. Several critical steps were made toward accomplishing this task. Semi-automated batch scripts were configured in order to retrieve raw data from National Oceanic and Atmospheric Administration servers, to process raw data into various analysis and reporting formats, and to convert raw data to the Data Storage System for use in the HEC's Hydrologic Modeling System (HEC-HMS).

Requirement 3: A calibrated gage network

Several storm events occurred in the drainage that were correlated to FY19-FY17 volume difference grids. At Arroyo de los Piños, New Mexico Tech (NMT) installed several rain gages in the watershed. The USGS was employed to review the precipitation instrumentation installation and data management plan. Guidance provided by the USGS increased confidence in rainfall depth measurements collected at Arroyo de los Piños for long-term rain gage and radar correlation analysis. Discussions are underway to conduct gage/radar correlation analysis with NMT, the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), and the Southern Sandoval County Flood Control Authority (SSCAFCA) to determine the impacts of the precipitation accounting method on HEC-HMS results

The volume and frequency of sediment entering the MRG drives channel geomorphology, sandbar bar formation, and vertical and lateral movement. Geomorphic changes drive the distribution and re-distribution of riverine species. Refining understanding of sediment response to specific precipitation frequencies will allow for better forecasting of restoration site operations and maintenance.



Photo: Middle Rio Grande
Credit: Mike Marcus, APA

Rio Grande Sediment Gages: Rio Puerco, San Acacia, San Marcial

The overall goal of this data collection effort was to provide information by which to assess the movement of sediment in the Rio Grande and to evaluate the secondary influences that sediment has on the geomorphology of the Rio Grande. The geomorphology of the Rio Grande within the Middle Valley has been affected by flood control and irrigation projects, which have influenced the amount and type of sediment supplied to the Rio Grande. Influences, such as dams, channel rectification measures, and sediment delivery from contributing drainage areas, have an effect on the geomorphology of the Rio Grande. Accurate sediment gage data are critical for understanding how much sediment moves through the Rio Grande, what type of sediment is moving, and when that sediment is moving. This project supported data collection at three essential gages: the Rio Puerco gage, the San Acacia gage, and the San Marcial gage.

Tamarisk Leaf Beetle Distribution, Genetic Variation, Defoliation, and Mortality Impacts on Tamarisk Habitat in the Middle Rio Grande

Tamarisk leaf beetle monitoring results revealed spread of the beetle, which has resulted in tamarisk defoliation in the Rio Grande watershed. The spread of the tamarisk leaf beetle from the north (*Diorhabda carinulata*) and the potential spread of another tamarisk leaf beetle species from Texas (*Diorhabda elongata*) will ultimately affect riparian forests in Central and Southern New Mexico. The *Diorhabda carinulata* has already spread further south, and the *Diorhabda elongata* is expected to continue expanding into New Mexico watersheds. These areas are critical habitat for the endangered SWFL and are important to many other riparian breeding birds and herpetofauna.

From 2012 through 2019, tamarisk leaf beetle surveys and tamarisk habitat evaluations have been conducted throughout the Rio Grande watershed. Over an eight-year period, tamarisk leaf beetle distribution and phenology (e.g., defoliation, mortality, and flowering) have been tracked. The survey methods for monitoring the tamarisk leaf beetle are based on those established by the Tamarisk Coalition, with some modifications. Field datasheets were compiled and entered into a database, the spatial data for beetle numbers present at each sampling location were used to create a geographic information system (GIS) map, and findings identifying what beetle species are present in New Mexico watersheds were used to coordinate and compile tamarisk leaf beetle monitoring datasets with the Tamarisk Coalition. Genetic analysis of tamarisk leaf beetle species within the watershed was also completed, and four species were identified: the Northern tamarisk leaf beetle (*Diorhabda carinulata*), the Subtropical tamarisk leaf beetle (*Diorhabda sublineata*), the Mediterranean tamarisk leaf beetle (*Diorhabda elongata*), and the larger tamarisk leaf beetle (*Diorhabda carinata*). Through genetic analysis, tamarisk leaf beetle hybridization among the identified species was also identified.

Tamarisk Leaf Beetle Species and Habitat Analysis With Management Implications for the Middle Rio Grande

The introduction and proliferation of the tamarisk leaf beetle for the biological control of tamarisk, starting in 2001, has initiated landscape-scale compositional shifts in riparian vegetation communities and altered habitat conditions. Tamarisk leaf beetle populations in the MRG have increased from 2015 through 2019, with overall effects on tamarisk-dominated habitat for riparian species. This increase is mainly due the presence of the Northern tamarisk leaf beetle (*Diorhabda carinulata*), which arrived in 2012, and the Subtropical tamarisk leaf beetle (*Diorhabda sublineata*), which ranged into New Mexico from Texas in 2015. The biocontrol of tamarisk may result in a reduction of habitat and the subsequent population decline of the SWFL and YBCU. Moreover, reductions in tamarisk vegetative cover may result in increased Russian olive abundance, which brings additional management problems.

In 2017, this study was initiated to analyze tamarisk leaf beetle-related changes to tamarisk-dominated habitat, to examine specific locations in the study area over time using remote sensing, and to field monitor vegetative and avian communities. In 2017, vegetation data was collected at 30 selected locations; in 2018, avian population data was collected; and in both 2017 and 2018, tamarisk leaf beetle data was collected. Data was collected in order to understand baseline conditions, study the ongoing effects of tamarisk leaf beetle use, and provide a reference for post-treatment patterns and dynamics in regards to vegetation composition and structure and associated habitat conditions. This study documented ecosystem responses to alterations in riparian habitat structure and plant communities due to tamarisk leaf beetle use over time, and also recorded any possible changes to avian species richness and density. The ongoing monitoring of riparian systems altered by the tamarisk leaf beetle is critical for understanding the possible management implications for plant and avian communities, especially the SWFL population.



Photo: Tamarisk leaf beetle
Credit: Daniel Bean, Colorado Department of Agriculture

Water Monitoring and Studies

Program signatories aided in several activities related to water monitoring and studies, including data collection, water releases, and hydrologic monitoring in the MRG. Table 9 lists the water monitoring and studies-related activities that were associated with the Program in FY19.

Activity Name	Begin	End	Sponsor/ Contributor
Collaborative Aerial Data Collection and Analysis	FY15	FY19	USACE
High-Frequency Water Temperature Data Collection Within the Inundated Floodplain of the Middle Rio Grande During the 2019 Snowmelt Pulse	FY19	FY20	USACE
Middle Rio Grande Groundwater Monitoring	FY07	FY20	USACE
Minnow Action Team	FY12	Ongoing	All MRGESCP signatories
Multi-Agency High Flow Collector Application Used for Monitoring the 2019 Rio Grande Runoff	FY17	FY19	Reclamation; USACE
Rio Grande Nature Center High Flow Channel Gage Monitoring	FY10	Ongoing	USACE
Socorro South Distribution Hub	FY16	FY19	MRGCD
Water Quality Monitoring of Aquatic Refugia in the Middle Rio Grande	FY16	FY19	MRGCD; USACE; USFWS

Table 9. FY19 Water Monitoring and Studies Activities List

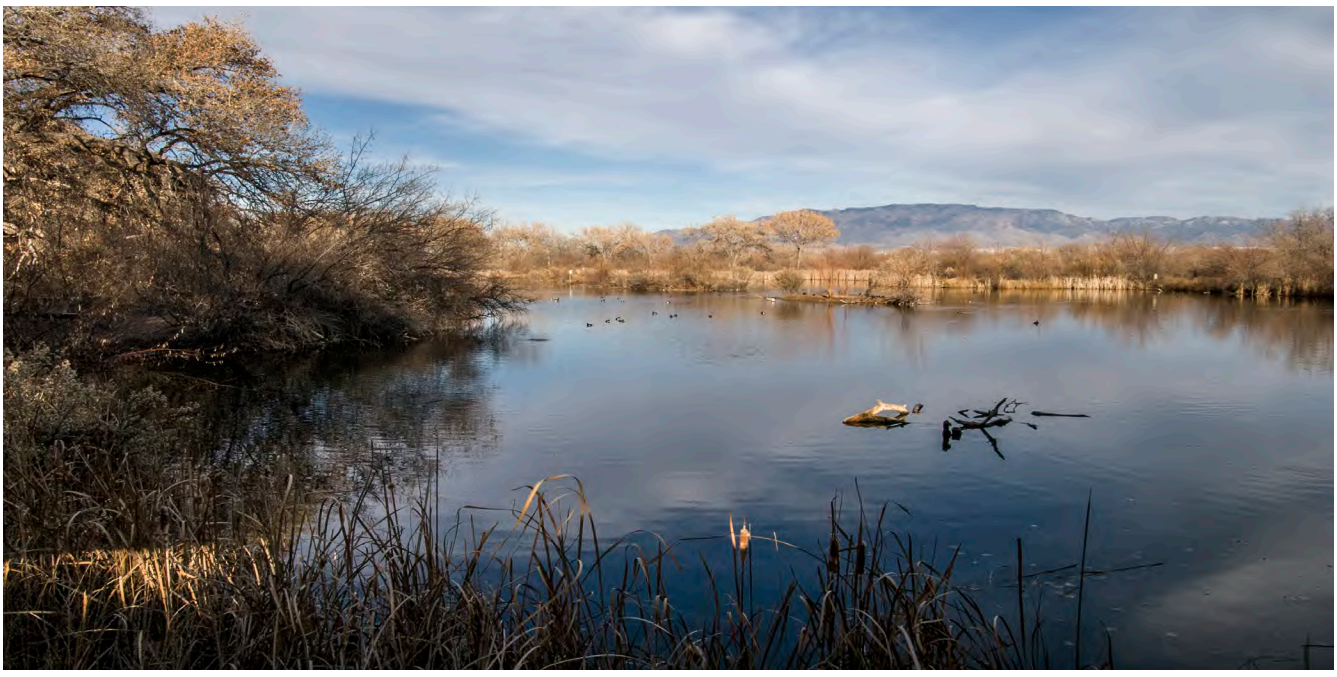


Photo: Middle Rio Grande
Credit: Mike Marcus, APA

Collaborative Aerial Data Collection and Analysis

Movement of sediment in the American Southwest tends to be initiated by flash flood events due to monsoons. These events are short-term and occur under monsoonal weather conditions, which makes them difficult to accurately monitor using common terrain mapping technologies, such as aerial light detection and ranging (LiDAR). The major impediments to using these methods are the short notice to activate flight missions and the inability to rapidly develop maps. This project develops tools to facilitate the rapid production of sediment-related measurements.

USACE collaborated with UNM's GIScience for Environmental Management Lab, the U.S. Air Force Civil Air Patrol, and the U.S. Bureau of Land Management to implement the sensor array and conduct aerial data collection. The Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) and Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA) also collaborated on arroyo data collection and ground control for aerial flights. In 2019, this project conducted several flights along the MRG. Information gathered during these flights will be used to extend in-flight computational capacity and reliability for ongoing geomorphic and vegetation analysis.

Collecting high-resolution orthoimagery and terrain data at the reach scale after precipitation events provides a critical geomorphic snapshot for the calibration of hydraulic, sediment, and vegetation models. The geomorphic snapshots are correlated to precipitation frequency and volume for event-based habitat monitoring. These models provide the foundation for Rio Grande tributary and main stem restoration efforts and efficient listed species protections measures.

High-Frequency Water Temperature Data Collection Within the Inundated Floodplain of the Middle Rio Grande During the 2019 Snowmelt Pulse

Inundated floodplains provide spawning and nursery habitat for the RGSM, which improve the reproductive success and recruitment of the species. However, the thermal regime within this habitat type has not been well studied, despite the observed effects of water temperature on growth, development, and survival of RGSM eggs and larvae. The May to July 2019 hydrologic forecast for the Rio Grande at the Otowi gage was 143 percent of the 30-year median. Given this unique hydrologic condition, USACE documented the thermal regime of the MRG floodplain using 12 randomly selected, spatially distributed, and high-frequency measurements at two sites that experienced widespread (>15 acres) and sustained (May-July) inundation. High-frequency measurements of air temperature at each site and water temperature from the nearby mainstem were also collected. In addition, water depth, velocity, specific conductance, dissolved oxygen, turbidity, pH, and estimated canopy cover were collected at each location during routine site visits. All temperature records were validated using previously developed methods. The data and associated report will be provided in FY20.

Middle Rio Grande Groundwater Monitoring

Data from MRG groundwater monitoring will provide invaluable information regarding how long designed groundwater depths are sustained following repeated flood inundation. Moist surface soils are not only important for establishment and growth of riparian-wetland plant species but also for organic soil development, nutrient cycling, invertebrate diversity, and other ecological processes. Long-term monitoring will help determine if depth thresholds are exceeded after restoration features become repeatedly inundated. In addition, monitoring of groundwater levels is needed to evaluate if and to what degree soil moisture retention improves with time as restoration features become repeatedly inundated. These data are invaluable for evaluating the effects of different soil moisture availabilities on vegetation growth attributes of constructed willow restoration features. This information is particularly important for guiding future designs for SWFL restoration projects. Additionally, the data collected can also be used to evaluate the differences in primary biological productivity between restoration features with and without direct river connections. The final report, to be completed in spring of 2020, will include a review of existing groundwater wells to determine if any of them can be retired from the monitoring network and excluded from the development of a groundwater database.

Minnow Action Team

The Minnow Action Team (MAT) began in 2012 as an ad hoc work group that aimed to bring adaptive management to MRG water and species activities. The MAT was formed after 2012 reports revealed low RGSM numbers due to prolonged drought. MAT meetings continue to take place each spring. During these meetings, resource managers and scientists coordinate information to make management decisions with the goal of benefitting listed species.

The MAT assists water and resource management entities with the annual coordination of, evaluation of, and recommendations for water operations and species management that aid in meeting the 2016 MRG BO and RGSM recovery goals. The MAT does this by assimilating hydrologic, biological, and ecological information on an annual basis, which informs the group's recommendations for reducing threats to listed species and enhancing the spawning, recruitment, and survival of RGSM.



Photo: Middle Rio Grande
Credit: Mike Marcus, APA

Multi-Agency High Flow Collector Application Used for Monitoring the 2019 Rio Grande Runoff

Like many areas in the arid Southwest, the MRG Valley, from Cochiti Lake through Albuquerque, downstream to Elephant Butte Lake, has seen drought for approximately a decade. This has impacted environmentally-sensitive species, agriculture, and water delivery to Rio Grande Compact partners downstream. Fortunately, the winter of 2018-2019 saw above average snowpacks in the Upper Rio Grande watershed, resulting in higher than average runoff levels.

In 2019, high-flow runoff provided an opportunity to carry out a multi-agency collaborative effort, led by USACE, with the objective of monitoring and documenting the effects of high-flow runoff on levee integrity, floodplain inundation, overbanking extents, and fish spawning habitat. To accomplish this, the Environmental Systems Research Institute's Collector for ArcGIS mobile application was implemented in the first coordinated multi-agency undertaking of its kind. USACE partnered with MRGCD and Reclamation to submit photographs and georeferenced observations. ArcGIS Online mapping enabled participants to share near real-time monitoring with all participating agencies. This effort was especially effective in identifying seepage points in the levees, thereby mitigating risks of levee failure, and in identifying whether habitat restoration sites were inundating at design flows.



Photo: Rio Grande backwater channel
Credit: Mike Marcus, APA

Rio Grande Nature Center High Flow Channel Gage Monitoring

The Rio Grande Nature Center Habitat Restoration Project was designed to restore an ephemeral side channel of the Rio Grande, thereby reconnecting the floodplain of the bosque to the river and reestablishing native habitat. The objective of this monitoring study is to collect data on stream flow through the channel during spring runoff. This information helps biologists understand if and how long flow conditions in the channel are suitable for RGSM spawning and recruitment. The amount and duration of flows also affect growth of native shrub species, which provide essential SWFL habitat.



Photo: Scenic view at the Rio Grande Nature Center
Credit: Mike Marcus, APA

Socorro South Distribution Hub

The Socorro Main South Distribution Hub uses two check structures in the Socorro Riverside Drain to supply water to a pump station. In turn, this pump station provides water for three separate discharge locations. Two of the three locations discharge into the MRGCD conveyance system; this enables MRGCD to access drain water for delivery to irrigators. The third discharge location is through the levee, which allows existing infrastructure to discharge the pumped water into the river channel and augment flows for listed species.

The Socorro Hub gives MRGCD access to the water from the Socorro Riverside Drain in order to effectively minimize the amount of water diverted directly from the Rio Grande. In addition, the pump station is used to augment flows in the river channel for the benefit of the RGSM below the SADD.

Water Quality Monitoring of Aquatic Refugia in the Middle Rio Grande

River intermittency, or the drying of stretches of the river so there is not continuous flow, will continue to become more common because of climate change, especially in the American Southwest. On the MRG, significant river intermittency is now considered normal and will likely become more frequent and widespread given water scarcity predictions.

Aquatic MRG wildlife experiences habitat loss as drying occurs along stretches of the river. Remaining habitat for aquatic wildlife, such as irrigation outfalls, areas below irrigation outfalls, and isolated pools, may provide temporary refuge during periods of river intermittency. These spaces are known as aquatic refugia, and may become increasingly important as drying trends continue in the Rio Grande basin. Water quality factors of aquatic refugia, including pH, nutrient content, temperature, and dissolved oxygen, have been identified as potential inhibitors of use of these critical spaces by listed species, such as the RGSM. Continuous and discrete measurements of water quality within aquatic refugia have provided insight into factors that may influence fish survival and, more specifically, survival of the endangered RGSM. Moreover, the evaluation of these aquatic refugia has led to a greater understanding of stream fish ecology and of future challenges facing the MRG. The results of this work may also be used to inform management decisions.



Photo: Middle Rio Grande edge habitat with algae growth
Credit: Mike Marcus, APA

Program Support

MRGESCP signatories provide support for the Program and its activities. This support is vital for accomplishing the Program's mission and goals, which benefit the MRG's listed species. The signatories provide administrative assistance and aid in the funding, planning, coordination, and staffing of Program activities. Table 10 lists the Program support-related activities that occurred in FY19.

Activity Name	Begin	End	Sponsor/ Contributor
MRGESCP Portal and Database Management System	FY07 FY18	FY18 FY20	ABCWUA USACE
MRGESCP Program and Science Support Contract	FY16	FY21	Reclamation
U.S. Fish and Wildlife Service Management and Support	FY02	FY22	Reclamation; USFWS

Table 10. FY19 Program Support Activities List

MRGESCP Portal and Database Management System

The Program Portal is a database management system that also functions as the Program's website and meeting calendar. It is regularly maintained and updated, and stores and facilitates access to scientific data, reports, and papers relating to species of interest and critical habitat in the MRG. The Portal also functions as the document repository for the Program's administrative record of meetings and activities. Stored information and data is available for use by Program members and the public. The Program Portal can be found at **https://webapps.usgs.gov/MRGESCP/**.

MRGESCP Program and Science Support Contract

In FY19, Reclamation continued to contract Western EcoSystems Technology, Inc. (WEST, Inc.) to provide third-party program and science support services for the MRGESCP. The Program Support Team (PST) includes a Program Manager, a Science Coordinator, and support staff. The PST is responsible for facilitating the achievement of Program goals and initiatives by providing meeting administration, technical and scientific support, signatory correspondence, activity planning and coordination, Program outreach, and dissemination of Program-related information to relevant parties. The PST's science coordination services include assistance with scientific activities, as well as coordination with Program scientists and technical experts to develop plans, processes, and other work products in support of the MRGESCP.

The support services of the PST aid in the implementation of Program activities that progress the Program's mission and goals. Improvement of coordination and communication around Program efforts by the PST enables the Program to make better informed recommendations for the MRG and its listed species.

U.S. Fish and Wildlife Service Management and Support

In FY19, Reclamation continued to provide funding to USFWS for the hiring of personnel tasked with supporting MRGESCP management activities and facilitating ESA compliance. Specific ESA compliance tasks of USFWS personnel include facilitating Section 7 consultations for the Program's federal partners and managing Section 10 permits for other Program signatories.

As a signatory, USFWS also independently provides Program management and on-the-ground support for activities that advanced the recovery of listed species. These efforts aim to minimize the adverse effects that actions in the MRG have on federally listed species, as well as on their proposed and designated critical habitat.



Photo: Rio Grande cottonwoods in the Middle Rio Grande
Credit: Mike Marcus, APA



Middle Rio Grande Endangered Species Collaborative Program

FY19 Annual Report



FISCAL PLANNING COMMITTEE MEETINGS

November 19, 2019

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

Long-Term, High Frequency, Water Quality Monitoring in the Middle Rio Grande [presentation]

Fiscal Year 2018 Annual Report Avian Monitoring Write-Up

Avian Monitoring Fiscal Planning Committee Update

Unfunded Water Quality Stations [spreadsheet]

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Fiscal Planning Committee (FPC)
Meeting Agenda

November 19, 2019
2:00-3:00 pm
WEST Office, 8500 Menaul Blvd. NE, Suite A-200 *NOTE NEW SUITE #
Albuquerque, NM 87110

Conference Call-in Information
Phone Number: *(712) 451-0011*
Passcode: *141544#*

2:00 – 2:10	**Welcome** • Introductions • Agenda Review • ***Decision***: Approve meeting agenda	*Julie Dickey, Program Support Team (PST)*
2:10 – 2:50	**Funding** • Opportunities • Timelines ➢ Rio Grande gage monitoring ➢ Avian surveys/monitoring	*FPC Group Discussion*
2:50 – 3:00	**Meeting Review** • Action Items • Next Steps	*J. Dickey, PST*
3:00	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Fiscal Planning Committee (FPC)
Meeting Minutes

November 19, 2019 2:00pm-3:30pm
WEST Office, 8500 Menaul Blvd NE Suite A-200
Albuquerque, NM 87110

Conference Call-In Information
Phone Number: (712) 451-0011
Passcode: 141544#

Decisions:

- The meeting agenda for 11/20/2019 was approved.

Actions:

WHO	ACTION ITEM	BY WHEN
Program Support Team (PST)	The presentations will be sent out to all FPC members.	ASAP
PST	Draft letters of support for U.S. Army Corps of Engineers (USACE)	ASAP

Next Meeting: TBD

Meeting Notes

Welcome, Introductions, Agenda Review
Julie Dickey, PST, opened the meeting with introductions and review of the draft agenda.

- ✓ **Decision:** Agenda for 11/19/19 was approved

Funding
The group discussed the USACE's budget cuts and activities that will be unfunded for the Fiscal Year 2020 (FY20) and potentially beyond. These include the Rio Grande gage monitoring and avian monitoring surveys that Lynette Giesen and Justin Reale, USACE, will cover for the group. Questions arose as to where additional funding could be found and whether attending signatory representatives had interest in continuing any of the projects.

Rio Grande gage monitoring
Justin R. presented to the group on *Long-Term, High Frequency, Water Quality Monitoring in the MRG* (see presentation). The presentation was to inform FPC attendees about the water monitoring

efforts that have been ongoing since 2006 and are aimed at assessing temporal and spatial water quality trends in the MRG.

One group member requested more information on the uses of the data. Justin explained that the data are used to assess baseline in conditions and disturbances but also to support planning, monitoring, and assessment by MRGESCP signatories for water management and restoration projects for the listed species. Further, gathering this data helps assess baseline water quality for the Rio Grande silvery minnow (RGSM), allows researchers to value effects of drought and water managements actions on water quality and ecosystem processes along the MRG, and is used as a resources for baseline studies on thermal regime and reproductive phenology, metabolic regime, and refugia. It is also used for Clean Water Act compliance related to storm water permit compliance.

Current statues for 2020
Upstream and downstream of Cochiti will be funded through Upper Rio Grande Water Operations Model (URGWOM) operations. The unfunded gages are the Alameda, Rio Bravo, Isleta Diversion, Isleta Reach, and San Acacia Reach. Alameda has the most continuous record for the past 13 years. No gages exist at the Isleta or San Acacia Reaches. There has been small focus studies with sensors but no long-term gages.

Some gages have long-term records, but in 2009 there were budget cuts and data were not collected. The same situation is occurring for FY20. It is important to continuously collect data as they are important to gather baseline information and capture the next disturbance.

An FPC participant requested information on the man power required for the monitoring effort. In response, Justin R. stated that there is no set schedule, but that collection occurs every four to five weeks at a minimum for sites that require more maintenance such as extreme drought and monsoon seasons. During winter base flows, data may be collected once every two months.

A group member requested information on where the money goes and how the monitoring program contract is structured. Justin R. replied that URGWOM funds the data collection for all of the sites through a cooperative agreement with the University of New Mexico (UNM). In 2013, grants were used to sole source to UNM and were administered by the USACE. Additionally, URGWOM has funded U.S. Fish and Wildlife (USFWS), Bosque Ecosystem Monitoring Program, and U.S. Geological Survey to complete monitoring at sites at various times. For the past five years, USACE has funded UNM for one USACE employee and one student to complete the work. Some of the contracts include man power, while others include instruments, data reporting, and publishing a final record. Currently, UNM has the instruments paid for by URGWOM that could be used under a contract with UNM to continue work. It could be beneficial to fund only the data collection alone for the gages, which would cost less, but eventually the gages would need to be replaced (about every five years).

Justin R. answered a group member's question of when current data collection efforts will stop by say that some data collection ended in August, while other efforts would continue through September 30, 2020. UNM is currently continuing some raw data collection efforts without funding, but by spring 2020 may not have the man power to do so.

Justin R. suggested that the MRGESCP signatory's using this data should be interested in seeing these efforts continue. He suggested that letters of support from USFWS or others that benefit from the data collection efforts could be helpful for signatories to ask for funding from decision-makers. This work is listed in the Interim Long-Term Plan, which suggests that the EC has requested that USACE continue funding it. URGWOM can provide some support, but very little funding, if any.

Monika Hobbs, Albuquerque Bernalillo County Water Utility Authority (ABCWUA), suggested that it could be of interest to the ABCWUA and will ask around and let Justin R. and David VanHorn, UNM, know. Anne Marken, Middle Rio Grande Conservancy District (MRGCD) will look into the MRGCD funding BEMP to continue some work.

Avian surveys/monitoring

Lynette G. discussed the USACE-funded avian surveys and monitoring. The work includes several aspects of surveys and monitoring, including song birds studies, raptor surveys, and southwestern willow flycatcher (SWFL) and yellow-billed cuckoo (YBCU) surveys and monitoring. USACE will no longer fund these projects, although Hawks Aloft will have enough money for two people to do work this year, but it becomes the their data, and they will only complete surveys in the Albuquerque area.

The U.S. Bureau of Reclamation (Reclamation) has begun working to find opportunities to fund SWFL and YBCU surveys, including the possibility of funding through APHIS. Reclamation is working with USFWS to determine the survey frequency needed, and they are discussing rotating survey periods at each site to get samples at least every five years so that every site gets covered. Related to the 2016 MRG BO, no funding was set aside this year for SWFL and YBCU surveys.

Chuck Hayes, New Mexico Department of Game and Fish (NMDGF), stated that NMDGF funded some surveying and monitoring work in 2009, but the focus has shifted to funding other work.

One group member asked how much money we are looking at trying to find. Lynette G. indicated that there is not a good number for each sector: song birds, raptors, and SWFL/YBCU, because much of the work was done in-house by USACE. She estimated that approximately $250,000 may cover all three, but that the in-house percentage of that is unknown at this time. The estimated cost would include data collection, write-ups, and reporting. She indicated that the sites for song birds and SWFL had been cut down to just surveying/monitoring approximately 12 restoration sites, but that in-house labor was completing another six sites.

The FPC members agreed that it could be helpful to send letters of support to USACE's offices to support continued funding of the USACE's work in the MRG, and to non-Federal agency decision-makers to find some funding. Much of the Federal funding would require a non-Federal match of 25 percent or more. The letter should include the entire list of the un-funded activities from the USACE, with particular attention to the impact of having gaps in data collection. Two letters were suggested: one general, and one specific to funding into 2020 and 2021.

- **Action Item**: The PST will draft letters of support

Meeting Review
Julie D. reviewed the action items and announced that the presentation would be sent to the group with the meeting follow up.

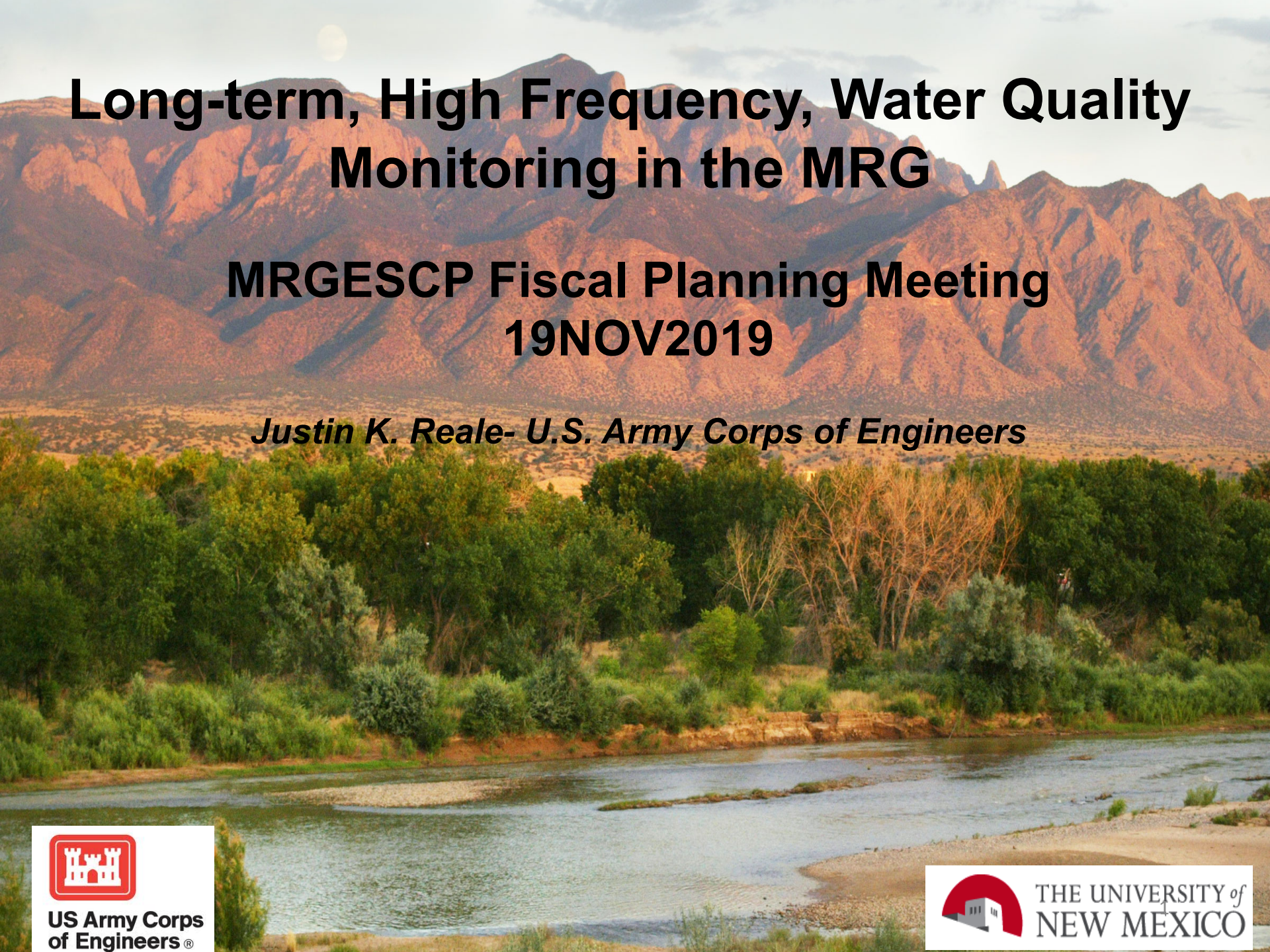
Meeting Participants

Participant	Organization
Amy Erickson	Audubon New Mexico
Anne Marken	Middle Rio Grande Conservancy District
Chuck Hayes	New Mexico Department of Game and Fish
Debbie Lee	Program Support Team
Grace Haggerty	New Mexico Interstate Stream Commission
Jim Wilber	U.S. Bureau of Reclamation
Julie Dickey	Program Support Team
Justin Reale	U.S. Army Corps of Engineers
Kiara Takacs	Program Support Team
Lynette Giesen	U.S. Army Corps of Engineers
Monika Hobbs	Albuquerque Bernalillo County Water Utility Authority

Long-term, High Frequency, Water Quality Monitoring in the MRG

MRGESCP Fiscal Planning Meeting
19NOV2019

Justin K. Reale- U.S. Army Corps of Engineers



US Army Corps of Engineers®

THE UNIVERSITY of NEW MEXICO

Previous Water Quality Studies in the MRG

WATER-QUALITY ASSESSMENT OF THE RIO GRANDE VALLEY STUDY UNIT, COLORADO, NEW MEXICO, AND TEXAS--ANALYSIS OF SELECTED NUTRIENT, SUSPENDED-SEDIMENT, AND PESTICIDE DATA

By S.K. Anderholm, M.J. Radell, and S.F. Richey

WATER-QUALITY ASSESSMENT OF THE RIO GRANDE VALLEY, COLORADO, NEW MEXICO, AND TEXAS--
Summary and analysis of water-quality data for the basic-fixed-site network, 1993-95

By Denis F. Healy

Nutrient and organic carbon trends and patterns in the upper Rio Grande, 1975–1999

Howard D. Passell[a,*], Clifford N. Dahm[b], Edward J. Bedrick[c]

Science of the Total Environment
An International Journal for Scientific Research into the Environment and its Relationship with Humankind

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NITROGEN SOURCES AND SINKS WITHIN THE MIDDLE RIO GRANDE, NEW MEXICO[1]

Gretchen P. Oelsner, Paul D. Brooks, and James F. Hogan[2]

JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION

AMERICAN WATER RESOURCES ASSOCIATION

USACE - Continuous Water Quality Monitoring Network for the Middle Rio Grande

History: 2006 – Present

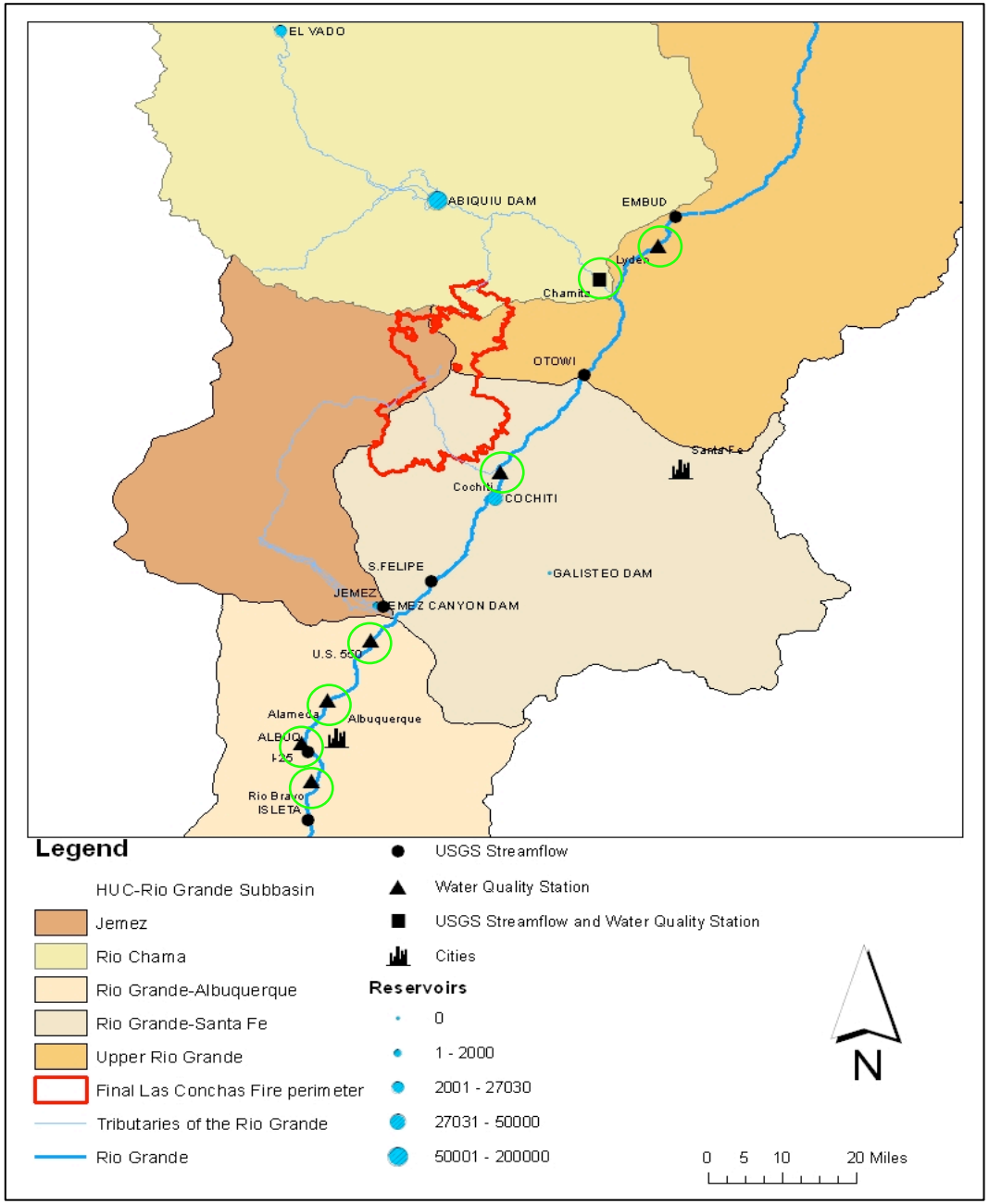
Goals: Assess temporal and spatial water quality trends in the Middle Rio Grande (MRG)

Methods: Continuous water quality collection in the Abq. reach of the MRG since 2006,three sites added above Cochiti Reservoir in 2012.

Primary Investigators: David Van Horn (UNM), Justin Reale (USACE), Clifford Dahm (UNM emeritus).



Locations and Methods

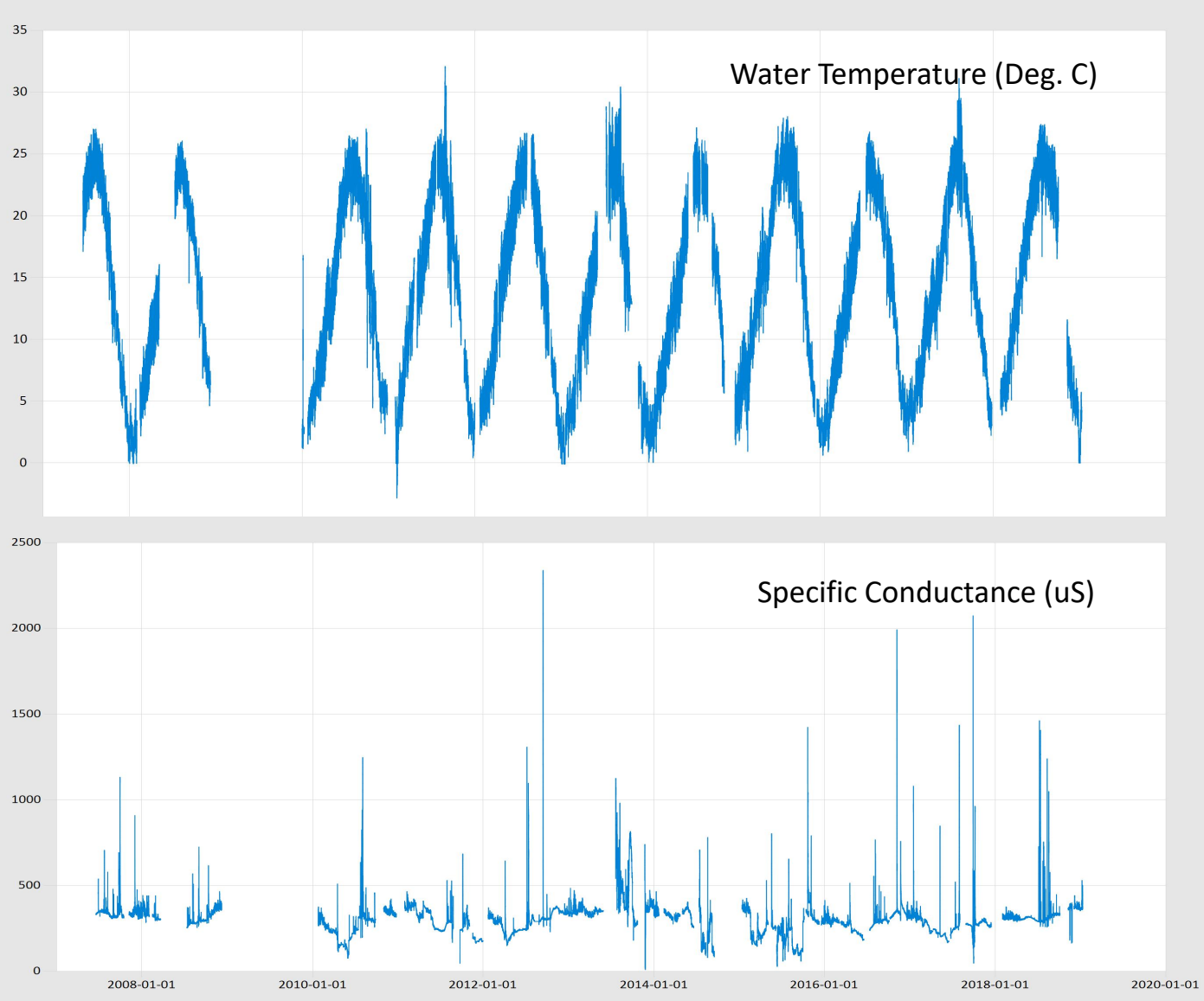




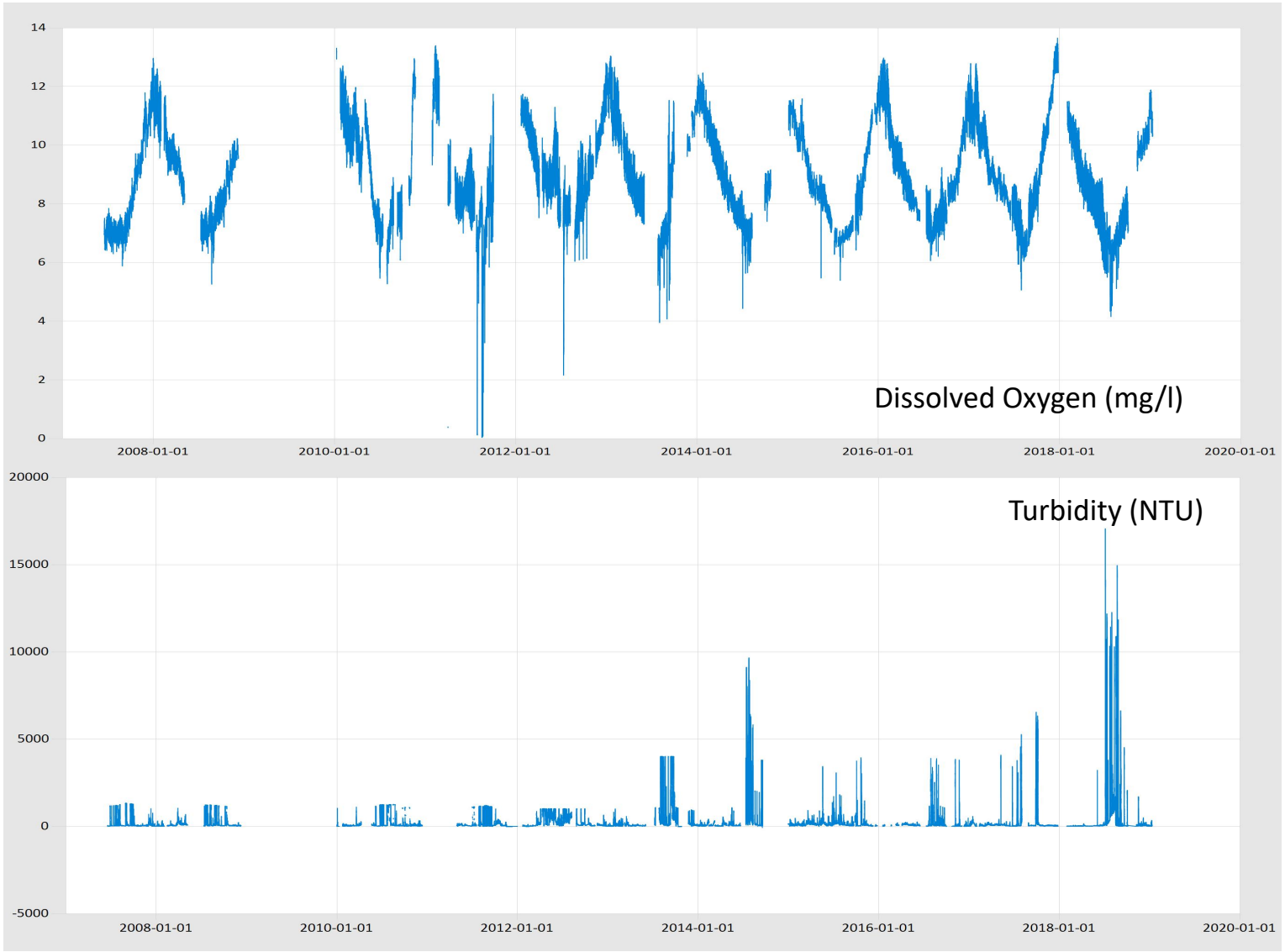




Data – Bernalillo 550



Data – Bernalillo 550



How are these data used?

1. Assess baseline water quality conditions of the MRG and refugia
    - Physical
    - Chemical
    - Biological
    - In-stream ecosystem processes

2. Evaluate the effects of disturbances on baseline conditions
    - Drought
    - Wildfire
    - Stormwater
    - Flooding

Temperature

Dissolved oxygen

Refugia

salinity

Primary Productivity

Turbidity

pH

Ecosystem Respiration

Baseline



Disturbance

Wildfire

?

Drought

Stormwater

Flooding

Baseline Studies

Thermal Regime and Reproductive Phenology

Reale, J.K., Segura, M.V., Stomp. J. In preparation. High-frequency water temperature data collection within the inundated floodplain of the Middle Rio Grande during the 2019 snowmelt pulse. Submitted to MRGESCP.

Reale, J.K. 2014. Continuous water temperature monitoring on the Middle Rio Grande during the 2014 snowmelt pulse. Submitted to MRGESCP.

Valdez, R.A., Haggerty, G.M., Richard, K. and Klobucar, D., 2019. Managed spring runoff to improve nursery floodplain habitat for endangered Rio Grande silvery minnow. *Ecohydrology*, *12*(7), p.e2134.

Archdeacon, T.P., Diver, T.A., Betrand, N.G., Wilson, W.D., Knight, W., Uliabarri, M., Lusk, J., Reale, J.K. In preparation. Effects of stocking season on survival and reproduction of hatchery-reared Rio Grande Sivery Minnow. TBD.

Metabolic Regime

Shafer, B., Van Horn, D.J., Reale, J.K., Gonzalez-Pinzón, R., Bixby, R., Stone, M.C. In preparation. Seasonal and interannual variability in stream metabolism along an aridland river. TBD.

Shafer, B., Van Horn, D.J., Reale, J.K., Gonzalez-Pinzón, R., Bixby, R., Stone, M.C. In preparation. The impacts of large-scale climate patterns and localized disturbance events on whole stream metabolism in an aridland river. TBD.

Refugia

Van Horn, D.J., Reale, J.K., Archdeacon T.P. Submitted. Water quality in three potential aquatic refugia in an arid-land river: Assessing suitability to sustain populations of an endangered fish species. Environmental Biology of Fishes.

Disturbance Studies

Wildfire

Dahm, C. N., Candelaria-Ley, R., Reale, C. S., Reale, J. K., and Van Horn, D. J. 2015. Extreme water quality degradation following a catastrophic forest fire. Freshwater Biology. 60: 2584-2599.

Reale, J. K., Van Horn, D. J., Condon, K.E., and Dahm, C. N. 2015. The effects of catastrophic wildfire on water quality along the river continuum. Freshwater Science. 34:1426-1442

Reale, J.K., Van Horn, D.J., Archdeacon T.P., Gonzales, E.J, Dudley, R.K., Turner, T.F., Dahm, C.N. In revision. Effects of a catastrophic wildfire on downstream fish assemblages in an aridland river. Hydrobiologia.

Stormwater

Regier, P., Gonzalez-Pinzón, R., Reale, J.K., Van Horn, D., Khandelwal, A., Nichols, J. Submitted. Impacts of urban stormwater runoff on downstream water quality in the Rio Grande. Science of the Total Environment.

Flooding

Reale, J.K., Van Horn, D.J., Archdeacon T.P., Gonzales, E.J, Dudley, R.K., Turner, T.F., Dahm, C.N. In revision. Effects of a catastrophic wildfire on downstream fish assemblages in an aridland river. Hydrobiologia.

Shafer, B., Van Horn, D.J., Reale, J.K., Gonzalez-Pinzón, R., Bixby, R., Stone, M.C. In preparation. The impacts of large-scale climate patterns and localized disturbance events on whole stream metabolism in an aridland river. TBD.

Drought

Van Horn, D.J., Reale, J.K., Archdeacon T.P. Submitted. Water quality in three potential aquatic refugia in an arid-land river: Assessing suitability to sustain populations of an endangered fish species. Environmental Biology of Fishes.

How are these data used?

1. Assess baseline water quality conditions of the MRG and refugia
   - Physical
   - Chemical
   - Biological
   - In-stream ecosystem processes

2. Evaluate the effects of disturbances on baseline conditions
   - Drought
   - Wildfire
   - Stormwater
   - Flooding

3. Support planning, monitoring, and assessment by signatories for non- MRGESCP projects
   - Water management and deviations
   - Restoration and sediment mobilization projects
   - Environmental compliance

4. The Clean Water Act
   - Stormwater permit compliance (NPDES 402)
   - Monitoring, assessment, and standards by NMED SWQB

Current Status of the Network

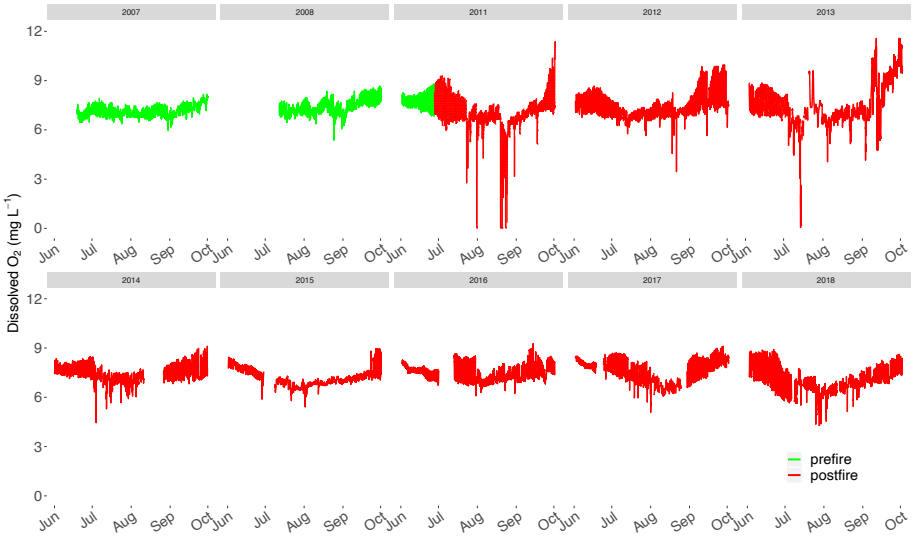
Station	FY20 Cooperator
Upstream Cochiti Dam	USACE (Operations)
Downstream of Cochiti Dam	USACE (URGWOM)
Bernalillo	USACE (Operations)
Alameda*	unfunded
Rio Bravo	unfunded
Isleta Diversion	unfunded
Isleta reach**	unfunded
San Acacia reach**	unfunded

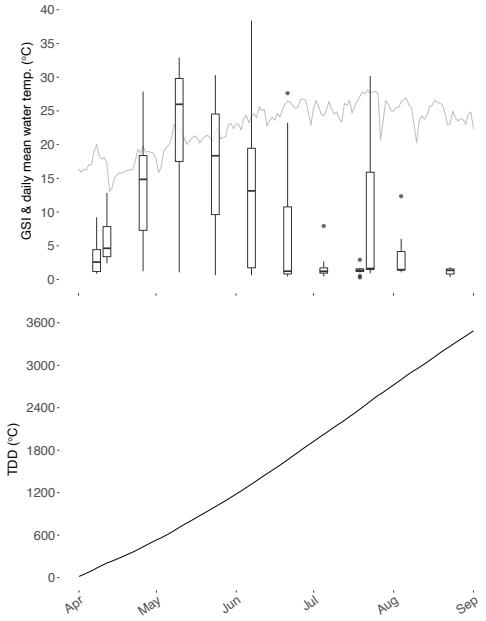
* Temperature sensor funded by USACE MRGESCP

** Lacks baseline data

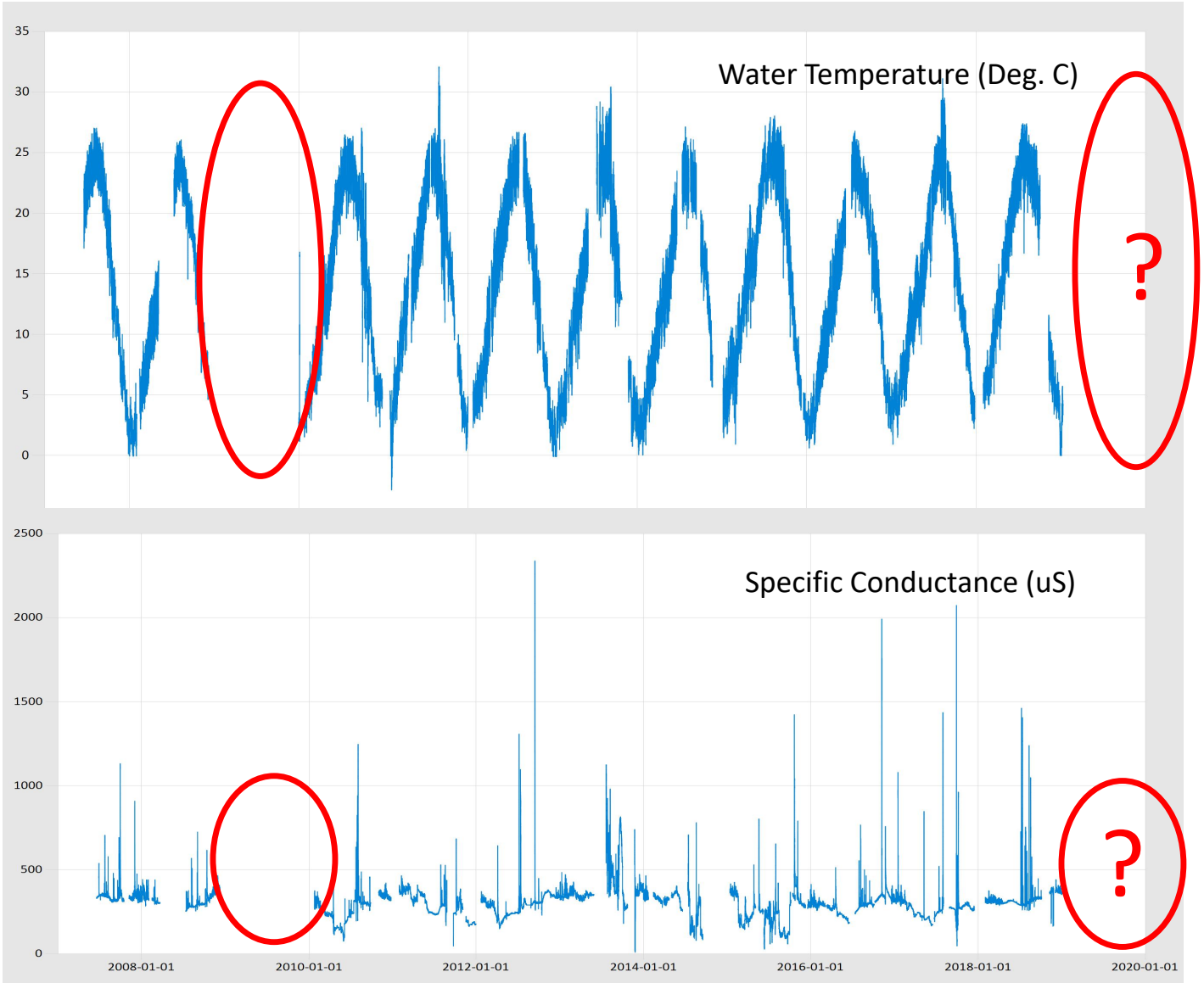
Future Data Collection and Studies

- Effects of climate change on baseline water quality and in-stream ecosystem processes
- Landscape-scale disturbance and recovery
- MRGESCP planning, monitoring, and assessment
- Thermal regime and reproductive phenology of RGSM
- Isleta and San Acacia reaches are unknowns





Water Year 2020



Primary Investigator Contact Info

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Justin Reale, Biologist, Environmental Engineering Section, U.S. Army Corps of Engineers, justin.k.reale@usace.army.mil, 505.342.3138

Acknowledgements

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AMAFCA
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Patrick Chavez

UNM
Clifford Dahm
Ricardo González-Pinzón
Peter Reiger
Aashish Sanjay
Justin Nichols
Betsy Summers
Roxanne Candelaria-Ley
Alex Clark Grady Ball
Lydia Zeglin
Becky Bixby

Pueblo of Isleta
Ruben Lucero
Cody Walker

MRGCD
David Gensler
Mat Martinez

FY18 Annual Report Write-Up

Name of Project: Avian Monitoring

Avian Monitoring

With decreasing avian populations resulting from inadequate habitat, surveys sampling avian abundance and species richness relative to vegetation community and structure (C/S) types within the MRG bosque have occurred since December 2013. In FY18, established transects within the MRG were surveyed during both the breeding and wintering seasons. Nest searches were completed using parameters for raptors and songbirds, as well as the SWFL and YBCU, which included nest success, brood parasitism, predation, abandonment, and productivity. Nest monitoring was also conducted.

An additional objective established in 2017 focuses on changes in the bosque since the 1984 Middle Rio Grande Biological Survey. Changes include: (a) providing a 20-plus year comparison of change in avian abundance and species richness; (b) providing a 20-plus year comparison of change in C/S types; and (c) types present 20-plus years ago versus changes based upon construction of the MRG restoration sites. These will be included in the final report in 2019.

The results of this study contribute to baseline population data, monitoring of population trends, and the determination of the current distribution of SWFL in the region. Additionally, this project aids in tracking avian activity and assists in determining safe and usable avian habitat within the MRG.

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Avian Monitoring

As part of long-term avian monitoring efforts, U.S. Army Corps of Engineers (USACE) funded the completion of surveys sampling avian abundance and species richness relative to vegetation community and structure types in the Middle Rio Grande bosque. Over the past several years, USACE contractors have surveyed eighty-five transects from Rio Rancho, NM to La Joya Wildlife Area, NM three times monthly during both the breeding and wintering seasons.

USACE is not able to fund the monitoring efforts during FY20, and the Middle Rio Grande Endangered Species Collaborative Program (MRGESCP) has indicated an interest in seeing this work continue. The Fiscal Planning Committee was tasked with seeking potential funding sources to continue this long-term monitoring effort.

- **Avian Songbird Survey** - 85 transects from Rio Rancho to La Joya Wildlife Area.
- **Raptor Nest Searches and Monitoring** - Ground survey for stick nests between Bernalillo Bridge and Los Lunas Bridge (USACE will conduct raptor surveys in-house next to their restoration sites only)
- **SWFL and YBCU Surveys** - Following USFWS protocol (USACE will conduct sampling in-house at 10 USACE restoration sites only)

The following is the write-up provided for the MRGESCP's FY18 Annual Report.

Avian Monitoring

With decreasing avian populations resulting from inadequate habitat, surveys sampling avian abundance and species richness relative to vegetation community and structure (C/S) types within the MRG bosque have occurred since December 2013. In FY18, established transects within the MRG were surveyed during both the breeding and wintering seasons. Nest searches were completed using parameters for raptors and songbirds, as well as the SWFL and YBCU, which included nest success, brood parasitism, predation, abandonment, and productivity. Nest monitoring was also conducted.

An additional objective established in 2017 focuses on changes in the bosque since the 1984 Middle Rio Grande Biological Survey. Changes include: (a) providing a 20-plus year comparison of change in avian abundance and species richness; (b) providing a 20-plus year comparison of change in C/S types; and (c) types present 20-plus years ago versus changes based upon construction of the MRG restoration sites. These will be included in the final report in 2019.

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Station	Lat /long	Status	Operator	FY19 Cooperator	FY20 Cooperator	Parameters	Date of installation
Rio Grande at ABCWUA diversion (formerly at Alameda Bridge)	35°11'35.61, 106°38'36.00	Active	UNM & USACE	USACE (URGWOM)	unfunded	pH, dissolved oxygen, temperature, turbidity, salinity	6/2/2006
Rio Grande downstream of Rio Bravo Bridge	35° 1'38.15", 106°40'21.61"	Active	UNM & USACE	USACE (URGWOM)	unfunded	pH, dissolved oxygen, temperature, turbidity, salinity	6/2/2006
Rio Grande at Isleta Diversion (formerly at I-25)	34°54'20.39", 106°41'6.64"	Active	UNM & USACE	USACE (URGWOM)	unfunded	pH, dissolved oxygen, temperature, turbidity, salinity	6/2/2006
Rio Grande (Isleta reach)	TBD	NA	NA	NA	unfunded	NA	Episodic studies
Rio Grande (San Acacia reach)	TBD	NA	NA	NA	unfunded	NA	Episodic studies

April 1, 2020

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

Science and Habitat Restoration Work Group Project Descriptions

U.S. Army Corps of Engineers Fiscal Year 2021 Unfunded Activities

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Fiscal Planning Committee (FPC)
Meeting Agenda

Date & Time: April 1, 2020; 1:00-3:30pm
Location: Zoom Meeting

Zoom Call-in Information
Link: https://west-inc.zoom.us/j/8983593120
Call-In: +1-669-900-6833
Meeting ID: 898-359-3120
One-Touch Dial: 669-900-6833,,8983593120#

1:00 – 1:10	**Welcome** • Introductions • Agenda Review • ***Decision***: Approve meeting agenda	*Julie Dickey, Program Support Team (PST)*
1:10 – 1:25	**Review Charter Amendment** • Addition of co-chairs • ***Decision***: Selection of a Non-Federal and a Federal Co-Chair	*J. Dickey, PST*
1:25 – 2:15	**FY2021 Unfunded Activities** • Proposed activities for FY21 • Review U.S. Army Corps of Engineers (USACE) unfunded activities list • ***Read Aheads***: o Project descriptions o USACE activities list	*FPC Group Discussion*
2:15 – 2:30	**Break**	
2:30 – 3:20	**FY2021 Unfunded Activities (*continued*)**	*FPC Group Discussion*
3:20 – 3:30	**Meeting Review** • Action Items • Next Steps	*J. Dickey, PST*
3:30	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Fiscal Planning Committee (FPC)
Meeting Notes

Date & Time: April 1, 2020; 1:00-3:30pm
Location: Zoom Meeting

Decisions:

- ✓ Approval of April 1, 2020 FPC meeting agenda
- ✓ Grace Haggerty, New Mexico Interstate Stream Commission (NMISC), and Lynette Giesen, U.S. Army Corps of Engineers (USACE), were elected as the FPC Non-Federal Co-Chair and Federal Co-Chair, respectively

Action Items:

WHO	ACTION ITEM	BY WHEN
Program Support Team (PST)	Review Grace H.'s suggested revisions to the FPC charter, and discuss them with the Executive Committee (EC) co-chairs to determine next steps	April 2, 2020
PST & Avian Small Group	Add in a section for how the project descriptions apply to different regulatory obligations, authorities, and/or missions	April 2, 2020
PST	Research how a membership fee/pooled funds approach could work to pay for future Program Portal operations, maintenance, and development	May 1, 2020
Grace H.	Research how New Mexico State uses pooled funds in the case of the San Juan River Recovery Implementation Program to pay for administrative costs	May 1, 2020
PST	Research how other Programs manage pooled funds/membership fees to cover administrative costs	May 1, 2020
Lynette Giesen	Check Dave Moore's availability to hold a Zoom Brown Bag in April/May	ASAP
PST	Schedule a Zoom Brown Bag for Dave Moore's work	ASAP
PST	Provide the FPC with a document that provides more detail about the status of USACE's FY21 unfunded projects	April 8, 2020
All Signatories	Review USACE's FY21 unfunded projects list for funding opportunities, and contact Lynette G. (lynette.m.giesen@usace.army.mil) for more information	April 8 – May 1, 2020
MRGESCP	Determine potential avenues of funding for USACE's projects list	ASAP

Next Meeting: TBD

Meeting Summary

Welcome, Introductions, Agenda Review

- The PST opened the meeting and reviewed the agenda.

✓ **Decision**: The FPC approved the meeting agenda

Review Charter Amendment

Addition of co-chairs

- The FPC charter amendment specifies the election of two co-chairs to serve as committee leaders for a one-year term with no more than two consecutive one-year terms.
- Grace H., NMISC, sent some suggested edits to charter. She wants to discuss the advantages and disadvantages of having co-chairs.
    - The missing piece in the amendment is the responsibilities of the co-chairs.
    - The benefit of a federal co-chair, in particular, is that they could help navigate the ins and outs of federal contracting and budgeting.
    - The co-chair can benefit meeting participation.
        - Participation is decided by the EC based on the FPC meeting agenda.
        - There has been low participation in FPC meetings.
        - It may help to make the meeting more formal and establish dates within a quarter.
        - The co-chairs can help disseminate information to the EC.
    - Lynette G., USACE, is willing to be the federal co-chair but does not know how much longer she will be available.
    - The group elected Grace H. as Non-Federal Co-Chair and Lynette G. as Federal Co-Chair.
    - Ashlee Rudolph, U.S. Bureau of Reclamation (Reclamation), will figure out the primary FPC person from Reclamation.
        - Ashlee R. or Brian Hobbs are more appropriate than Jim Wilber.
        - Brian H. has accepted a position as a grants manager for U.S. Fish and Wildlife Service.
- Grace H.'s suggested charter revisions
    - Add an organizational chart.
    - The FPC should be a work group instead of a committee.
        - A work group address specific issues and a committee does not appear to do much.
        - The By-Laws Committee and EC decided that standing groups will be "committees" and ad hoc groups with a specific charge will be "work groups."

➢ **Action Item**: The PST will discuss Grace Haggerty's suggested FPC charter revisions with the EC co-chairs

✓ **Decision**: Grace Haggerty and Lynette Giesen were elected as the FPC's Non-Federal and Federal Co-Chairs, respectively

FY2021 Unfunded Activities
Proposed activities
Review USACE unfunded activities list

- Avian Work Group Project Descriptions
    - The Avian Work Group will meet to develop scopes of work (SOWs) and estimate costs.
    - The projects need more development to know who will want to fund them. Their funding organizations may determine how the SOW is written.
    - How did the SOWs become a priority?
        - The work groups developed conceptual ecological models, identified uncertainties, and developed projects to address them. The prioritization process for the uncertainties is still being worked through.
    - More work needs to be done before finding funding. Project descriptions will go back to the Avian Work Group.
    - In April, all project descriptions need to be submitted to signatories, specifically Reclamation, to get funding placeholders for the upcoming year.
        - The PST will be submitting the projects and their cost estimates to Reclamation and other organizations.
        - Reclamation is unlikely to fund anything that does not meet Biological Opinion (BO) commitments.
            - While prioritizing these projects, link them to organization requirements to make them more relevant to funding organizations.
        - Referencing the 2016 BO in a SOW could prevent USACE from funding a project.
            - Use a different format depending on the organization a SOW is sent to.

➢ **Action Item**: The PST will add an item to the Avian Work Group meeting agenda to address adding in a section for how project descriptions apply to different regulatory obligations, authorities, and/or missions

- USACE unfunded activities list
    - Bosque Ecosystem Monitoring Program (BEMP)
        - Funded through FY21, has 12 months from October to find funding.
        - BEMP has some funding from other signatories but is looking for more.
        - A larger conversation needs to happen with Kim Eichhorst, BEMP, to understand the full situation.
    - Program Portal
        - Funded through January 2021.
        - There needs to be ongoing funding for annual maintenance and operations.
        - $10,000 per year is the approximate cost but there will be no additional development.
        - There should be minimal work that needs to be done by the PST after past documents and datasets get uploaded.

- The Program needs to prioritize what is completed before funding ends.
- Could there be a membership fee that covers Portal costs?
    - There needs to be an account holder, either WEST or a signatory.
    - It could be a fiscal nightmare; each signatory would need to have an independent contract with the account holder.
    - Do other programs have a membership fee?
        - The San Juan Recovery Implementation Program (RIP) pools money from members.

- **Action Item**: Grace Haggerty will research how New Mexico State uses pooled funds in the San Juan RIP to cover administrative costs
- **Action Item**: The PST will research how membership fees/pooled funds can be used to fund the Program Portal
- **Action Item**: The PST will research how other programs manage membership fees/pooled funds to cover administrative costs

- Avian Monitoring
    - Large-scale monitoring ended in winter 2019.
    - Raptor nest monitoring will be funded through 2020.
    - Gale is completing some surveys but is not paid by USACE; that data may not be shared with Program signatories.
    - Southwestern willow flycatcher (SWFL) and yellow-billed cuckoo surveying will end at USACE restoration sites within four years.
- Multi-Agency Study for Identifying Restoration Priorities for Threatened Tamarisk Dominated Habitat to Benefit Future Habitat for SWFL
    - This will result in a list of areas ripe for restoration.
    - USACE can only do the study, not the implementation.
    - A report will be out by April.
- Multi-Agency Los Lunas Habitat Restoration Project
    - One of the first projects the Program funded.
    - David Moore is managing the project and recommends that the site not be abandoned. Monitoring should continue.
    - Dave M. wants to give brown bag; he submitted a draft report to USACE, and the report will be finalized in April.

- **Action Item**: Lynette Giesen will check David Moore's availability for a Zoom brown bag in April/May
- **Action Item**: The PST will schedule a Zoom brown bag for David Moore

- Habitat Restoration Site Surveying
    - The Hydraulics and Hydrology group is surveying USACE's created structures and monitoring changes during high flows to determine maintenance activities that can be funded by a local sponsor.
    - GeoSystems Analysis (GSA) and TetraTech are looking at vegetative differences at sites.
    - There will be summary reports through 2019.

- USACE Unfunded Projects Summary
    - The ending of these projects will result in the loss of a large knowledge base that will affect the work of other signatories.
    - USACE is stopping avian monitoring, tamarisk leaf beetle monitoring, sediment transport studies, large-scale climate change monitoring, water quality monitoring, and multi-agency projects.
    - Some of these studies cross into water management. Are they getting picked up by other funding sources?
        - The HEC-RAS model was funded by USACE, MRGESCP, Upper Rio Grande Water Operations Model (URGWOM), and Water Ops.
        - Other sediment projects are focused on sediment transportation and how it affects restoration features or species habitat.
        - The HEC-RAS model is largely complete and available.
        - URGWOM has taken a huge hit but will be funded in 2021. It has dropped everything that is "nice to know" instead of "need to know."

➢ **Action Item**: Signatories will review USACE's list of FY21 unfunded projects for funding opportunities and contact Lynette Giesen for more information

Potential Funding Resources

- Sustainable Rivers Program
    - The program proactively improves environmental health by changing reservoir operations to benefit natural communities.
    - Seems to be focused on environmental flows, which would involve Cochiti.
        - Cochiti has the most restrictive authorizing language of any U.S. reservoir.
        - Altering Cochiti operations to establish environmental flows will take Congressional authorization, which won't be considered unless the Rio Grande Compact and Pueblos affected by the change reach agreement.
- Continuing Authorities Program – Section 1135
    - Requires a local sponsor to send a letter to USACE stating that a federal structure has impacted an ecosystem along a floodway and they would like to study how to improve that.
    - The local sponsor pays for half the cost of the study.
    - Cost share for construction is 75% federal, 25% non-federal.
    - The funding limit is 10 million total.
- Continuing Authorities Program – Aquatic Ecosystem Restoration - Section 206
    - Requires no link to federal action.
    - Cost share not as good; 65% federal, 35% non-federal for construction, 50-50 cost share for study.
- Reclamation's Science and Technology Program
    - Requires a strong technical proposal, usually engineering-focused.
    - The WaterSmart Grant may be more appropriate for the level of the proposals the Program can produce.

USACE Unfunded Projects (Continued)

- Further Information on Groundwater Monitoring

        - USACE has 65 wells; a large portion have transducers and others have data manually collected.
        - The contract is ending in April.
        - All sites are in the Albuquerque Reach.
        - The wells have produced a 15-year data set that can be useful.
        - Every BEMP site also has a groundwater well; some have close to 10 years of data.
        - The groundwater data can be put on the Portal. Todd Caplan, GSA, will likely finish a compilation report in August.
- The PST will send out a detailed list of projects.
        - It would be helpful to add the dates that projects were funded and the reaches they happened in.

- **Action Item**: The PST will provide the FPC with a document that gives more detail about USACE's unfunded FY21 projects
- **Action Item**: The MRGESCP will determine potential avenues of funding for USACE's project list

Meeting Participants

Participant	Organization
Ashlee Rudolph	U.S. Bureau of Reclamation
Debbie Lee	Program Support Team
Grace Haggerty	New Mexico Interstate Stream Commission
Julie Dickey	Program Support Team
Kate Mendoza	Albuquerque-Bernalillo County Water Utility Authority
Lynette Giesen	U.S. Army Corps of Engineers
Michelle Tuineau	Program Support Team

Project Description for
Soil Moisture Holding Capacity Study

I. Background

Native riparian vegetation thrives in conditions with moist soils, low salt content, shallow depths to groundwater, and opportunities for seasonal overbank flows. When these conditions are not met, less desirable, non-native vegetation may be established and potentially outcompete native vegetation. A better understanding of the bosque's soil moisture holding capacity would enable managers to take steps to increase the likelihood of native vegetation establishment and survival. A study of soil moisture holding capacity and topsoil health will provide valuable information to management, and especially restoration efforts, in the Middle Rio Grande bosque.

II. Objective

To design and implement a study to examine possible methods to increase soil moisture holding capacity with the end goal of increasing success of native vegetation establishment at habitat restoration sites. This could include evaluating soil improvements, microbial composition, and other potential amendments.

III. Conservation Benefit

The results of this study would inform future habitat restoration and increase the potential success of ecosystem restoration.

IV. Relationship to Panel Recommendations

This project idea is related to the following panel recommendations:

- Caplan (2018) SWFL critical uncertainty #1: What site selection and prioritization procedures contribute to the successful restoration of SWFL breeding habitats along the MRG?

V. Compliance Required?

If this study is carried out in the bosque, the researcher may need to secure Clean Water Act permits.

Project Description for
Evaluation of Yellow-billed Cuckoo Prey and Associated Host Plants

I. Background

Habitat restoration work for the southwestern willow flycatcher (SWFL) and YBCU in the Middle Rio Grande (MRG) mainly focuses on planting vegetation related to the nesting site. The YBCU's food intake needs are great, as juveniles grow rapidly and fledge in seven days. Their main food source is large insects, such as caterpillars, dragonflies, and cicadas. To our knowledge, little work has been done to cross-reference the vegetation needs of the YBCU prey base with plants suitable for habitat restoration projects in the MRG. Having a reference of such plants would inform future restoration planning, and allow restoration managers to plan for the food base needed to support YBCU populations.

II. Objective

Complete a literature search and research project identifying the prey base of YBCU and the host plants needed to support those prey, and evaluating whether those plants are suitable for inclusion in habitat restoration projects in the MRG.

III. Conservation Benefit

The results of this research project would facilitate the inclusion of YBCU prey host plants, suitable for the MRG, in habitat restoration projects. This would improve the prey base for the YBCU and contribute to greater nest success, thus improving the value of the habitat restoration site.

IV. Relationship to Panel Recommendations

This project idea is related to the following panel recommendations:

- Caplan (2018) YBCU critical uncertainty #1: Which abiotic and biotic variables predict suitable YBCU habitats in the MRG across multiple spatial and temporal scales?

V. Compliance Required?

No permits would be required to carry out this project.

Project Description for
An Analysis of Overbank Flow and Its Relationship with Southwestern Willow Flycatcher (SWFL) and Yellow-billed Cuckoo (YBCU) Territory Selection

I. Background

Restoration projects have created native riparian habitat, yet few of these sites in the Middle Rio Grande (MRG) support breeding populations of SWFLs. The magnitude, frequency, and duration of flooding and overbank flow strongly influence the structure and function of riparian habitat and the invertebrate communities that provide abundant food resources for SWFL and YBCU. SWFLs, in particular, often place their nests in vegetation hanging over standing water. Although data on hydrological conditions along the MRG exist, no studies have analyzed response of riparian vegetation or SWFL and YBCU territory selection to quantitative data on river flow regimes within the MRG. Results of this study would inform adaptive water management to optimize the creation and maintenance of flycatcher and cuckoo habitat, and would help prioritize locations for habitat restoration with the highest probability of success.

II. Objective

The design and implementation of a research project exploring a potential correlation between overbanking and SWFL and YBCU territory selection. This would entail using existing data of overbank flows and SWFL and YBCU survey data to determine if there was an observed increase in territory selection in an overbanked area during the year of overbanking, and in successive years. This project would also include an analysis of vegetation types before and after flooding events, and whether the vegetation was more suitable for SWFL and YBCU habitat.

III. Conservation Benefit

The results of this project would help predict SWFL and YBCU territory selection, and could be used to inform future restoration projects site selection and development.

IV. Relationship to Panel Recommendations

This project idea is related to the following panel recommendations:

- Caplan (2018) SWFL critical uncertainty #1: What site selection and prioritization procedures contribute to the successful restoration of SWFL breeding habitats along the MRG?
- Caplan (2018) YBCU critical uncertainty #1: Which abiotic and biotic variables predict suitable YBCU habitats in the MRG across multiple spatial and temporal scales?

V. Compliance Required?

No permits would be required to carry out this project.

Project Description for
An Evaluation of Aerial Imagery and Southwestern Willow Flycatcher (SWFL) and Yellow-billed Cuckoo (YBCU) Habitat

I. Background

Understanding the best locations to conduct habitat restoration for SWFL and YBCU in the Middle Rio Grande (MRG) would be a valuable approach to the management and conservation of these species. This could be accomplished by developing a GIS-based, habitat restoration suitability model for SWFL and YBCU. The foundation of this model would include using past survey and nest data of occupied SWFL and YBCU locations, and subsequently overlaying these layers with existing aerial imagery, vegetation maps, and habitat maps. This type of landscape-scale analysis would help determine the influence of patch size, edge effects, and adjacent land uses on SWFL and YBCU habitat uses. Habitat suitability model results would better inform habitat restoration site locations that provide the best opportunity for breeding activities.

II. Objective

An evaluation of aerial imagery of the MRG overlaid with occupied habitat for SWFL and YBCU in order to determine:

(1) any overlap in habitat characteristics for the two species, and
(2) any edge effects.

This would be include an analysis using existing aerial imagery, habitat maps, and vegetation maps. This project would not include collecting new data or imagery.

III. Conservation Benefit

The results of this project would inform habitat restoration efforts to maximize ability to attract both SWFL and YBCUs. It would also inform habitat restoration project siting based on adjacent and nearby land uses that would be beneficial to either or both species.

IV. Relationship to Panel Recommendations

This project description is related to the following panel recommendations:

- Caplan (2018) YBCU critical uncertainty #3: How similar are the YBCU and SWFL in their breeding habitat requirements in the MRG?
- Caplan (2018) YBCU critical uncertainty #1: Which abiotic and biotic variables predict suitable YBCU habitats in the MRG across multiple spatial and temporal scales?
- Caplan (2018) SWFL critical uncertainty #1: What site selection and prioritization procedures contribute to the successful restoration of SWFL breeding habitats along the MRG?

V. Compliance Required?

No permits would be required to carry out this study.

1. Bosque Ecological Monitoring Program (BEMP)
2. Middle Rio Grande Endangered Species Collaborative Program Portal and Database
3. Avian monitoring in the Middle Rio Grande (MRG)
4. Multi-Agency study for Identifying Restoration Priorities for Threatened Tamarisk Dominated Habitat to Benefit Future Habitat for SWFL
5. Multi-Agency Los Lunas Habitat Restoration Project
6. Habitat restoration site surveying
7. SWFL surveys on the Rio Grande in the Albuquerque metro area
8. Tamarisk leaf beetle monitoring
9. Multi-Agency Assessment and Quantification of Sediment and Discharge at Arroyo de los Piños
10. Changes in Terrestrial Soil Loss in the Middle Rio Grande Basin to 2100
11. Development and Application of a HEC-RAS, Mobile-bed, Sediment Transport Model of the Middle Rio Grande
12. MRG groundwater monitoring
13. Multi-Agency Engineering Modeling Applications for Quantifying Habitat for the Rio Grande Silvery Minnow
14. Multi-Agency Environmental Flow Analysis of Hydrograph and Population Parameters for Rio Grande Silvery Minnow Recruitment
15. Evaluating the Grain Size of Bedload Transported from Arroyos into the Rio Grande
16. Evaluation of Sediment Dynamics in Habitat Restoration Features of the Albuquerque Reach
17. Monitoring Climate Change in the MRG
18. Water quality monitoring of aquatic refugia in the MRG
19. Multi-Agency continuous water temperature monitoring of the MRG Basin
20. YBCU Noise and Telemetry Study

POPULATION MONITORING WORK GROUP MEETINGS

November 6, 2019

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

- *Overview of Flow, Habitat, and Rio Grande Silvery Minnow Abundance [presentation]*
- *Summary Overview of Flow, Habitat, and Rio Grande Silvery Minnow Abundance [presentation]*
- *Steps Towards an Integrated Population Modelling of Rio Grande Silvery Minnow [presentation]*
- *Rio Grande Silvery Minnow Model Survey*
- *Rio Grande Silvery Minnow Sampling Methods: Population Monitoring (PM) and Population Estimation (PE) [presentation]*

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)

Wednesday, November 6, 2019 9:00 AM – 4:00 PM
U.S. Fish and Wildlife Service
2105 Osuna Rd NE, Albuquerque, NM

Call-In Information:
712-451-0011; Passcode 141544#

Meeting Agenda

9:00 – 9:10	**Welcome, Introductions, and Agenda Review** ➢ **Decision**: Approval of November PMWG meeting agenda	*Rich Valdez and Joel Lusk, Work Group Co-Chairs*
9:10 – 9:20	**Review of September PMWG Meeting Minutes** • Action Items review ➢ **Decision**: Approval of September PMWG meeting minutes	*PMWG Co-Chairs*
9:20 – 10:10	**Presentation: RGSM Population Monitoring & Population Estimation Studies** • Discussion	*Rob Dudley, ASIR*
10:10 – 10:40	**Stakeholder Needs for Model** • Questionnaire and member feedback	*Rich Valdez*
10:40 – 10:55	**Break**	
10:55 – 12:20	**Rio Grande Silvery Minnow Model** • Review of model approach and structure • Current progress on the model	*Charles Yackulic*
12:20 – 1:40	**Lunch** *(on own)*	
1:40 – 3:00	**Group Discussion of Model** • Data collection needs to address hypotheses and management questions	*PMWG Co-Chairs*
3:00 – 3:15	**Break**	

3:15 – 3:45	**Overview of Flow, Habitat, and RGSM Abundance**	*Rich Valdez*
3:45 – 4:00	**Work Group Name**	*PMWG Co-Chairs*

- **Decision**: Keep or change the work group name

4:00 **Next Steps and Adjourn**

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
Meeting Minutes

November 6, 2019 9:00am-4:00pm
Location: U.S. Fish and Wildlife Services
2105 Osuna Rd NE, Albuquerque, NM

Decisions:

- The November 6th meeting agenda was approved.
- The September 4th meeting minutes were approved.

Action Items:

WHO	ACTION ITEM	BY WHEN
Program Support Team (PST)	The PST will email all presentations given at the November 11th meeting to the PMWG members.	ASAP
PST	The PST will share all documents referenced in Rich Valdez's (SWCA) presentation with the PMWG members.	ASAP
PST	The PST will share the habitat data summary produced by Santa Ana Pueblo with the PMWG members.	ASAP
PST	The PST will share the responses to the survey received thus far with the PMWG members.	ASAP
All	The PST and the PWMG signatories will continue to solicit responses to the survey.	January 2020

Next Meeting: TBD

Meeting Notes

Welcome, Introductions, and Agenda Review

Rich Valdez, SWCA and the PMWG Co-chair, and Debbie Lee, PST, opened the meeting and reviewed the agenda.

- **Decision:** The November 6, 2019 PMWG meeting agenda was approved.

Review of September PMWG Meeting Minutes

The work group discussed the status of the American Southwest Ichtyological Researchers (ASIR) contract and their ability to engage with the Program. ASIR is now able to engage with the Program, but will reserve their limited time to working in the background on data needs and requests from the Program.

The group briefly discussed the model survey distributed to the Program, including the continued need for participation in the survey.

- **Decision:** The September 4th meeting minutes were approved.
- **Decision:** The model survey would remain available to the Program.

Presentation: Rio Grande Silvery Minnow (RGSM) Population Monitoring & Population Estimation Studies by Rob Dudley, ASIR

The presentation discussed methodology used by ASIR during the Population Monitoring and Population Estimation efforts.

During the presentation, Rob D. responded as follows to questions and comments from the work group:

RGSM Life History and Sampling Sites

- One work group member noted that variability in flow was minimal during October.
- It was asked if ASIR found any evidence of spawning outside of the spring.
    - Rob D. replied that there was not enough information to be certain. They have caught eggs up until mid-June, but rarely see early-stage larvae in July and never in August, so we suspect spawning does not persist far beyond the spring.
- The group discussed dry sites, and replacement sites for when dry sites were encountered.
    - In 2019 ASIR did not encounter any dry sites during the population monitoring, but in 2018, there were about 9, including sites that were observed as dry on more than one occasion.
- Shoreline pools and runs are different from other pools and runs, as it is possible to seine into a feature.
- Sampling is done a bit differently during high flows and low flows. During high flows, ASIR typically samples the inside bend of the river as it is calmer, safer, and more efficient. They generally do not go over waist-deep because of safety concerns and sampling challenges, except occasionally in runs.

Population Estimation Methods

- Sampling was conducted annually in November, with flow varying between years.
- Disturbance of the habitat and fish was minimized during sampling by keeping the technicians on the periphery of the area during the October GPS mapping. Sampling areas were then flagged with bamboo posts or flags at the site, and ASIR's sampling team would move laterally and quickly to the site. They could not be 100% sure of the percentage of the fish that moved outside the sampling area, but they regularly caught large fish (i.e., catfish and carp) which gave them confidence in the efficiency of the method.
- The sampling device was sealed by a lead skirt on the bottom to reduce the amount of fish escape once the PVC equipment hit the water. The PVC pipes were hollow, so they filled with water and rapidly descended.
- ASIR did not notice a difference between the lengths of the RGSM that were caught in the seine versus the closed sampling device. There was no evidence of a whole cohort of fishing missing, or something similar.
- Dip netting was not as productive in catching fish as the other methods, which was assumed to be attributed to the turbidity of the river.
- Fish lengths were not always recorded in the population estimation work. It depended on the terms of the contract for that year.
- Gary White, ASIR, ran all of the statistics, including the Huggins-type model. Fish lengths were not a part of these analyses.

- There was not a uniform p-hat on all samples because p-hat was established early on when there was enough fish but was not calculated for passes with very few fish.
- ASIR documented all the species caught during this effort. The behavior of the RGSM was noted to be quite different than that of other taxa, with the closest being red shiner.
- ASIR is now contracted to document individual fish lengths in the population monitoring work. Fish are separated into age categories based on length. Though it is difficult to distinguish age based on fish lengths because fish size can vary within an age class depending on the year and growing conditions.
- The catch per unit effort (CPUE) averages presented were from the 20 sites, not the averages of 20 times the number of samples in each site.
- One signatory asked if more information could be gleaned from the confidence intervals around CPUE in "bad" years.
    - This was determined to be a difficult question to answer, and one that was beyond the purview of ASIR as they are not a part of the regulatory decision-making process. ASIR suggested that perhaps genetics could provide additional information, but overall, they were unable to provide an answer to the regulatory challenge of interpreting large confidence intervals in "bad" years.
- Overall, the population monitoring and population estimation trends between years are typically consistent with the exception for the low flow years, when it can be difficult to get a good estimate.
- It was noted that in 2011, low flow conditions resulted in a reduction in habitat availability. By comparison, 2008 and 2009 provided better runoff conditions. It was noted as rare to see high flows in October, which generally has the most stable conditions.
- Funding for the population estimation work ran out in 2011, which is why the work only ran for 4 years.

Occupancy Methods

- Occupancy is defined at the scale of 200m, and is determined using the same 20 sites as sampled during population monitoring.
- It was noted that occupancy is sensitive to the number of sites, and if you wished to tighten the variance on the estimates, there would be a need to include more sites.
- ASIR designed the occupancy work to try to determine what the sampling variance might be across days. It was not designed with the intent of determining occupancy.
- It was noted that the occupancy sampling may be most valuable in "bad" years, with little added benefit in "good" years.

Stakeholder Needs for Model

Rich V. reminded the PMWG members that a survey had been developed and distributed to the Program to determine stakeholder needs for the model being developed by Charles Yackulic, USGS. There have been some responses, but he encouraged PMWG members to discuss the survey with their Executive Committee and ask them to complete it.

- **Action Item:** The PMWG co-chairs will start drafting a report that documents the progress made from this model.

Presentation: Steps towards an integrated population modeling of Rio Grande Silvery Minnow

Charles Y. provided an update on the model he has been developing for RGSM, under contract with NM Interstate Stream Commission. During his presentation, Charles responded to questions and comments from the work group members:

Spatial scale:

- When discussing "movement," that refers to movement between ten-mile segments of the river. At that scale, there is at least one monitoring site in each segment.
- The spatial scale picked will affect the predictions of the model. Charles is still determining if the data available will support finer resolution estimates.
- Charles has not looked at how the ten-mile segments correspond with geomorphic features.
- It is possible to have the model run for a certain area, and not for the whole MRG in order to reduce computation problems. But it is a complex exercise.

Drying data:

- Charles is using the drying data to explore whether some fish were moving before drying events. This would contribute to our understanding of salvage data, and how it would relate to the fish population number in a reach.
    - One member suggested he also look at predation and food availability related to drying events. This may limit recolonization of those areas by fish.
    - Rob D. noted that ASIR has not noticed a rapid recolonization of dry areas.

Data availability and capacity:

- There is a lack of data on estimates of larval survival. There are estimates of egg survival from laboratory studies.
- Whether Charles will be able to incorporate time in the movement analyses will depend on the data capabilities.
- Charles noted a need to understand sampling variability. If you can determine how much of the variability is due to the sampling process, you can adjust and prevent falsely concluding there is density dependence.

Group Discussion of the Model

The PMWG then discussed the model being developed by Charles. He noted that there are a lot of parameters in the model, and in order to be able to perform simpler analyses, he has to determine what the reasonable ranges for the parameters are. He still has to take a harder look at the mark-recapture data. The model will be documented in R code for visibility and transparency.

During the conversation, PMWG members asked questions:

- Question: Will the model inform management decisions given limited water and limited flexibility?
    - Answer: It will be eventually possible. Charles anticipates being able to manipulate the model in the future to answer management questions. He is also looking to add management costs in order to estimate how changes in management (and management costs) result in changes in the population. There may be different versions of the model to accomplish this.
- Question: Will the model take into account only the constraints of the system today, or will it "think outside the box"?
    - Answer: This will depend on what folks want. The management constraints can always change in reality. Ideally, stakeholders would be coming up with management options and alternatives that could influence this. Or, the group may

just want to explore possibilities, even without an expected policy change. Ideally, there would be a tool where people could run alternatives and scenarios themselves and see the outcome.

- Question: Is the model taking into account genetics?
  - Answer: Not at this point.
- Question: Is mark-recapture a feasible way to look at abundance for RGSM?
  - Answer: It would involve really intensively sampling one area during a year when there are a lot of fish. There are trade-offs with PIT tags: while they can offer better data, they have higher mortality than VIE tags. One possibility is to break up a study area into different sections and study movement between using differently colored VIE-tagged fish. You could tailor this study to answer very specific questions (for example, upstream and downstream of a diversion dam).
- Question: What are some options for reducing uncertainty?
  - Answer: First, Charles would want to look at the existing data to see if there is more to be gleaned from it. Then, specifically design studies to fill in gaps in order to reduce uncertainties.
    - BACI (before, after, control, impact) designed studies might help better the impact of restoration work.
    - One possibility is to compare years where there was not a lot of restoration work with years where there were, over similar flows. The Albuquerque area might be a good site for such a study.

Presentation: Overview of Flow, Habitat, and RGSM Abundance

Rich gave a presentation, "Overview of Flow, Habitat, and RGSM Abundance," which included a compilation related studies and their models, parameters, results, and conclusions. The group had an in-depth discussion about mesohabitats and the characteristics of the mesohabitats.

Next Steps:

- Next meeting date: TBD

The PST will coordinate with Charles on potential next meeting dates.

Meeting Participants

Trevor Birt, N.M. Interstate Stream Commission
Dave Campbell, U.S. Fish & Wildlife Service
Rob Dudley, American Southwest Ichthyological Researchers
Lynette Giesen, U.S. Army Corps of Engineers
Grace Haggerty, N.M. Interstate Stream Commission
Mo Hobbs, Albuquerque-Bernalillo County Water Utility Authority
Shay Howlin, Western EcoSystems Technology
Debbie Lee, Western EcoSystems Technology
Anne Marken, Middle Rio Grande Conservancy District
Michael Porter, U.S. Army Corps of Engineers
Kiara Takacs, Western EcoSystems Technology
Ashley Tanner, Western EcoSystems Technology
Clint Smith, U.S. Fish & Wildlife Service
Rich Valdez, SWCA
Ara Winter, Bosque Ecosystem Monitoring Program
Charles Yackulic, U.S. Geological Survey

Preliminary – Subject to Revision

Overview of Flow, Habitat, and RGSM Abundance

Rich Valdez

Population Monitoring Workgroup Meeting

Albuquerque, NM

November 6, 2019

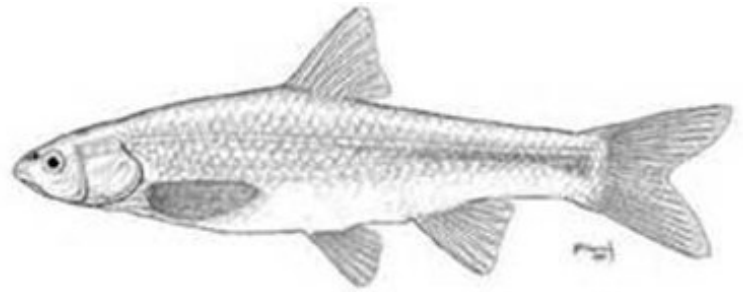
The Issue:

The abundance parameter is vital to an integrated model.

There is a need to quantify total RGSM abundance as related to habitat and flow

- Abundance is defined as total number of individuals in the population (not CPUE)

Purpose for this Overview



- To assimilate and review relevant literature.
- To initiate a conversation of the PMWG.
- To reconcile the relationship of flow, habitat, and RGSM abundance.

Key Documents—Flow, Habitat, and RGSM Abundance

1. Bovee, K.D., T.J. Waddle, and J.M. Spears. 2008. Streamflow and endangered species habitat in the lower Isleta reach of the Middle Rio Grande. US Geological Survey, Open-File Report 2008-1323.

2. Dudley, R.K., G.C. White, S.P. Platania, and D.A. Helfrich. 2011, 2012. Rio Grande silvery minnow population estimation program results from October 2010 (2011). Final Report. American Southwest Ichthyological Researchers, L.L.C., Albuquerque, NM.

3. Miller, P.S. 2012. A RAMAS-Based Population Viability Model for the Rio Grande silvery minnow (*Hybognathus amarus*). Final Report, Middle Rio Grande Endangered Species Act Collaborative Program, Conservation Breeding Specialist Group (SSC/IUCN), Apple Valley, MN.

4. Tetra Tech, Inc. 2014. Ecohydrological relationships along the Middle Rio Grande of New Mexico for the endangered Rio Grande silvery minnow. Final Report, Contract WP912PP-08-D-0009-0-20, Task Order 20, Task 5. U.S. Army Corps of Engineers, Albuquerque District, Albuquerque, NM.

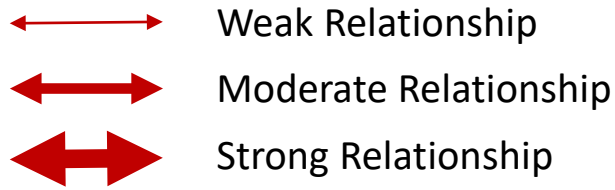
5. Braun, C.L., D.K. Pearson, M.D. Porter, and J.B. Moring. 2015. Physical characteristics and fish assemblage composition at site and mesohabitat scales over a range of streamflows in the Middle Rio Grande, New Mexico, Winter 2011–12, Summer 2012. U.S. Geological Survey, Investigations Report 2015–5025. U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service, Albuquerque, NM.

6. U.S. Fish and Wildlife Service. 2016. Appendix A: Analytical framework for evaluating the proposed water management and maintenance actions on Rio Grande silvery minnow, southwestern willow flycatcher, and yellow-billed cuckoo and their critical habitats. Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico, Consultation Number 02ENNM00-2013-F-0033, U.S. Fish and Wildlife Service, Albuquerque, NM.

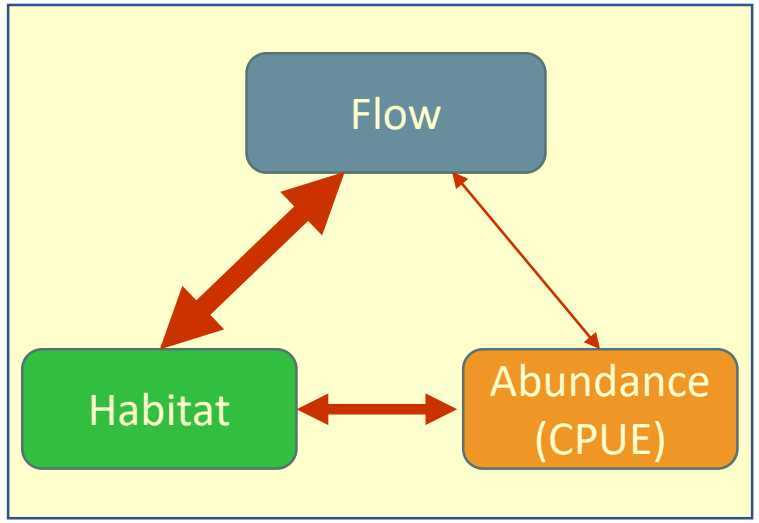
7. Yang, Y., K. LaForge, and P. Julien. 2018. Middle Rio Grande—Isleta Reach: Isleta Diversion Dam to Rio Puerco, hydraulic modeling and silvery minnow habitat analysis, 1918-2016. Draft Report, August 2018, Prepared for: U.S. Bureau of Reclamation, Colorado State University, Engineering Research Center, Department of Civil Engineering, Fort Collins, CO.

8. Budy, P., and T.E. Walsworth. 2019. Review of the “Analytical framework for evaluating the proposed water management and maintenance actions on Rio Grande silvery minnow, southwestern willow flycatcher, and yellow-billed cuckoo and their critical habitats” with recommendations for future analytical considerations. USGS Cooperative Fish and Wildlife Research Unit, Utah State University, Logan, UT.

Summary of Key Documents Principal Variables:

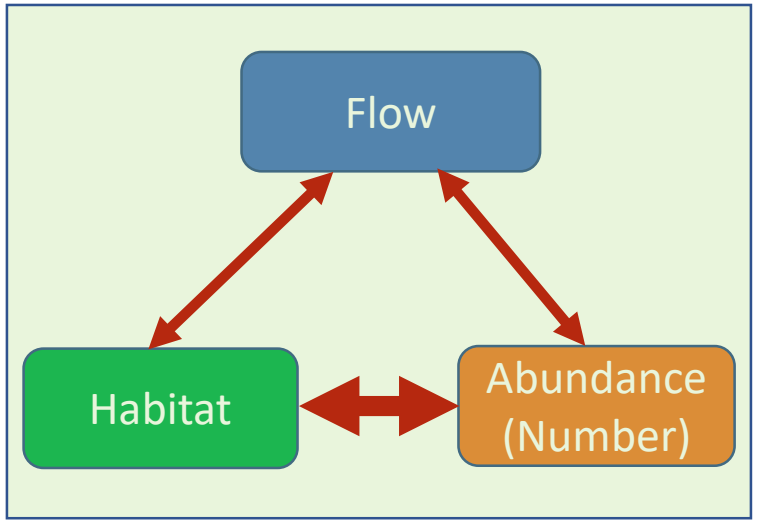


Strong Relationship: Flow to Habitat



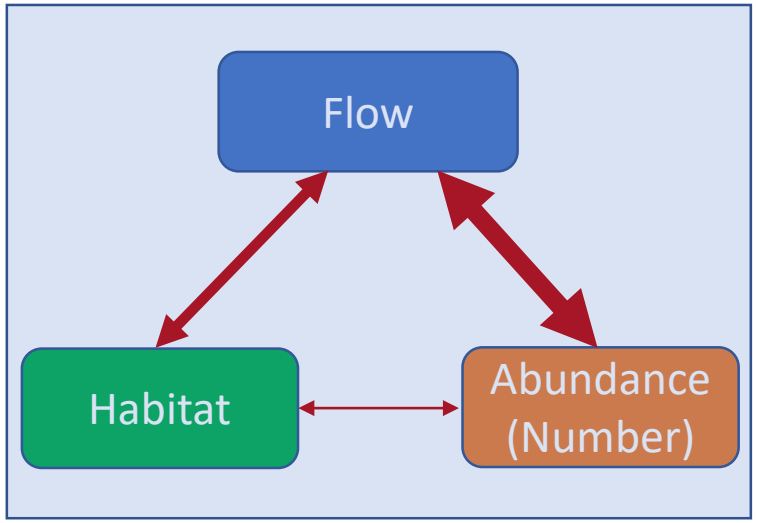
- Bovee et al. (2008)
- Tetra Tech (2014)
- Braun et al. (2015)
- Yang et al. (2018)

Strong Relationship: Habitat to Abundance



- Dudley et al. (2011, 2012)
- Miller (2012)

Strong Relationship: Flow to Abundance



- USFWS (2016)
- Budy and Walsworth (2019)

1a – Bovee

Bovee et al. (2008)

- Objectives:
  - Evaluate effects of different operational modes of the Bernardo siphon on habitat for *H. amarus* and *E. t. extimus* in this section of river.
  - Increase operational flexibility and improve irrigation delivery efficiency to the Socorro main canal at San Acacia Dam.
  - The “Bernardo Siphon” has been proposed to intercept up to 150 cfs from the Lower San Juan Riverside Drain on the east side of the Rio Grande and transport it under the river into a drainage canal on the west side.
- Used a two-dimensional hydraulic simulation model (PHABSIM) to simulate hydraulic conditions for a range of discharges at three study sites in the Rio Grande between the proposed siphon location and San Acacia Dam.

1b – Bovee



Figure 2. San Acacia diversion dam and diversion headworks. Photograph by Paul Tashjian accessed from http://www.fws.gov/southwest/bhg/images/san1.htm, November 2007

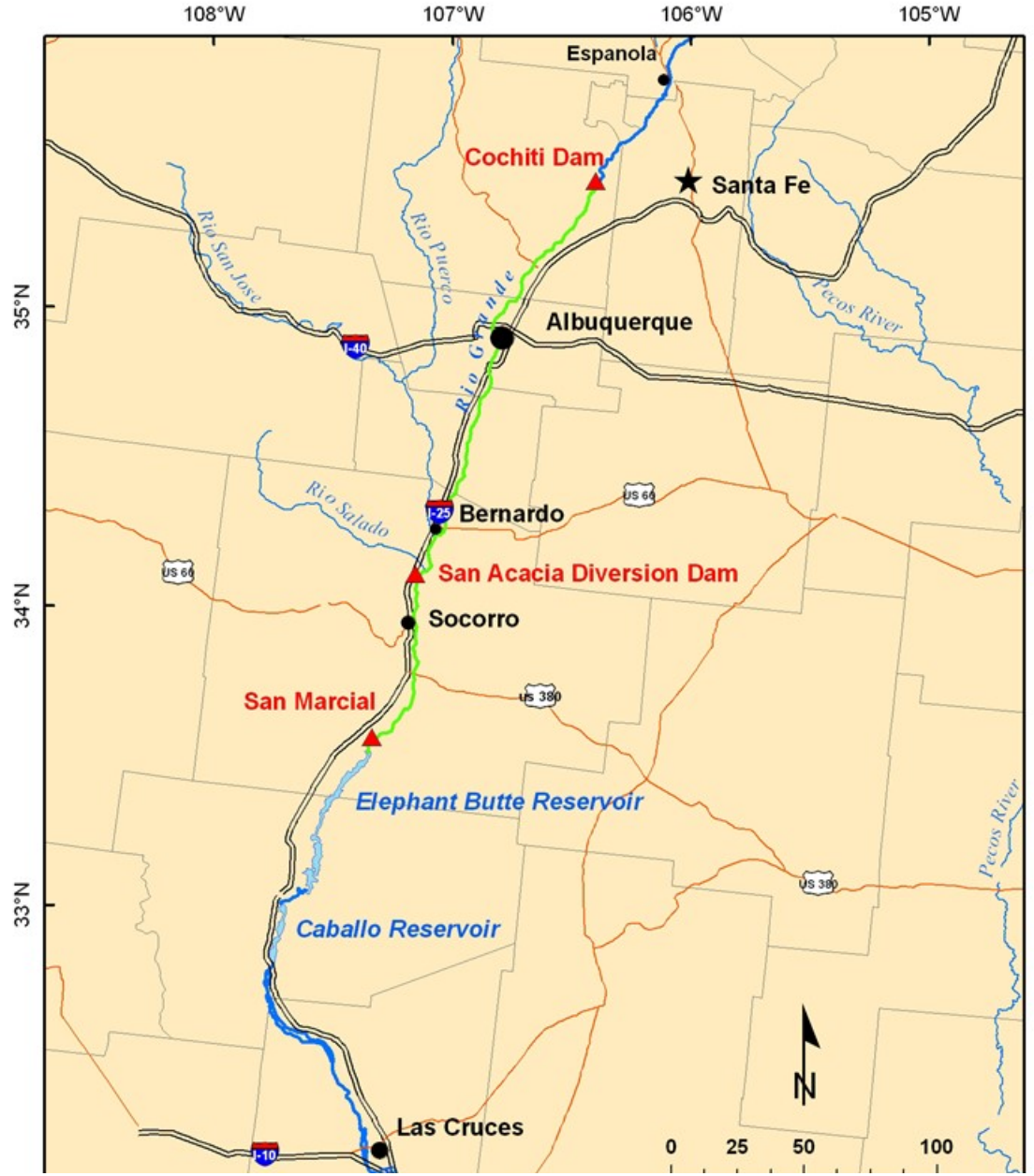


Figure 1. Map showing the New Mexico portion of the Rio Grande, the location of the San Acacia diversion dam, and the approximate extent of the critical habitat designation for *H. amarus* (in green).

1c – Bovee

Suitable habitat characteristics were defined for H. amarus by consensus of a panel of experts (i.e., Delphi).

These criteria were also used by Tetra Tech (2014), Braun et al. (2015), and Yang et al. (2018).

Table 2. Summary of habitat suitability criteria for the Rio Grande silvery minnow, with justification for deviations from criteria in the U. S. Fish and Wildlife Service recovery plan (1999).

	Criteria source		
Criteria type	Technical advisory group June 2007	Recovery plan 1999	Technical advisory group (final) November, 2007
Adult depth range	• 10 cm, no upper limit	• 50 cm, no lower limit given	5 cm [a]–50 cm [b]
Juvenile depth range	• 5 cm, no upper limit	• 50 cm, no lower limit given	5 cm [a]–50 cm [b]
Adult velocity range	0–60 cm/s	0–40 cm/s	1 cm/s [c]–40 cm/s [d]
Juvenile velocity range	0–30 cm/s	0–40 cm/s	1 cm/s [c]–30 cm/s [e]

Justification for modifications:

[a] Minimum depth set at 5 cm for potential habitat use at shallower depths consistent with feeding biology .

[b] Maximum depth changed to 0.5 m for consistency with recovery plan.

[c] Minimum velocity set at 1 cm/s to differentiate flowing water from stagnant pools.

[d] Maximum velocity for adults reduced for consistency with recovery plan.

[e] Maximum velocity for juveniles reduced from recovery plan to reflect sustained swimming performance of post-larval fish.

1d – Bovee

Habitat criteria are used to define suitable areas of the river channel, but are not linked to RGSM abundance.

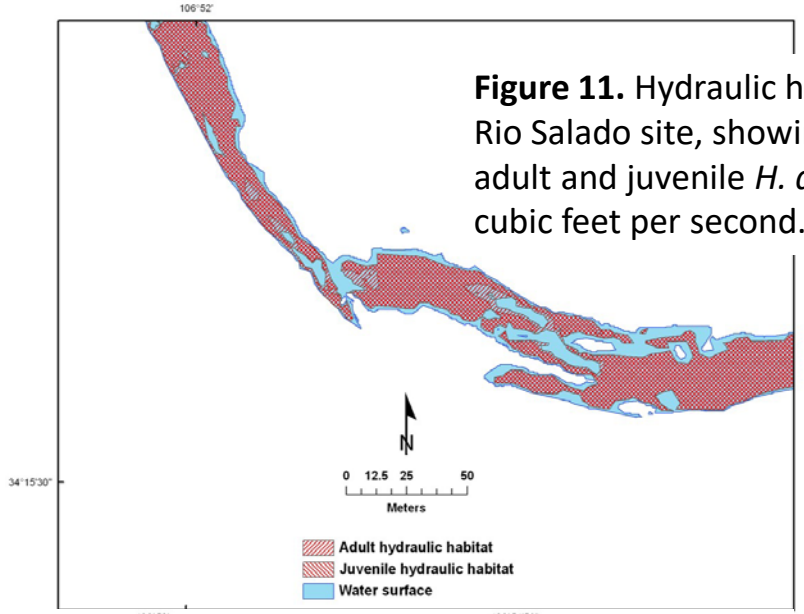


Figure 11. Hydraulic habitat map for a portion of the Rio Salado site, showing suitable conditions for adult and juvenile *H. amarus* at a discharge of 20 cubic feet per second.

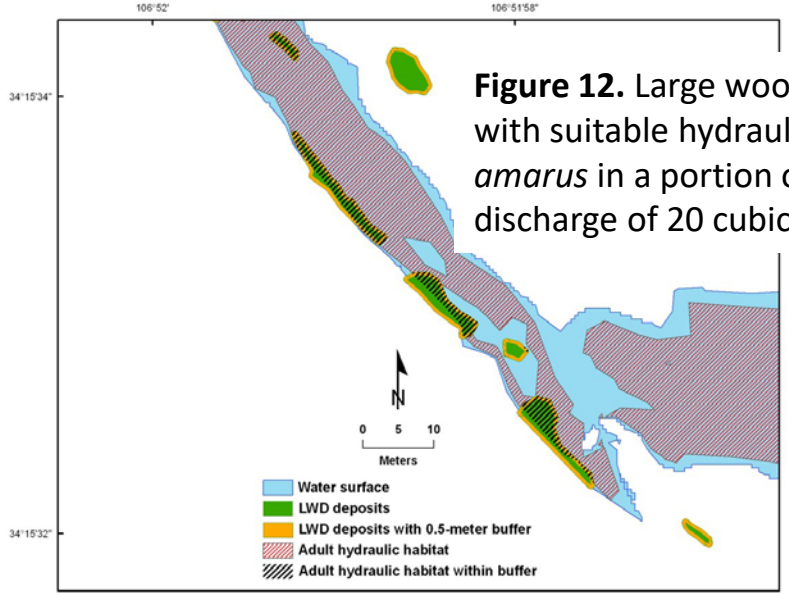


Figure 12. Large woody debris buffers intersected with suitable hydraulic habitat layers for adult *H. amarus* in a portion of the Rio Salado site at a discharge of 20 cubic feet per second.

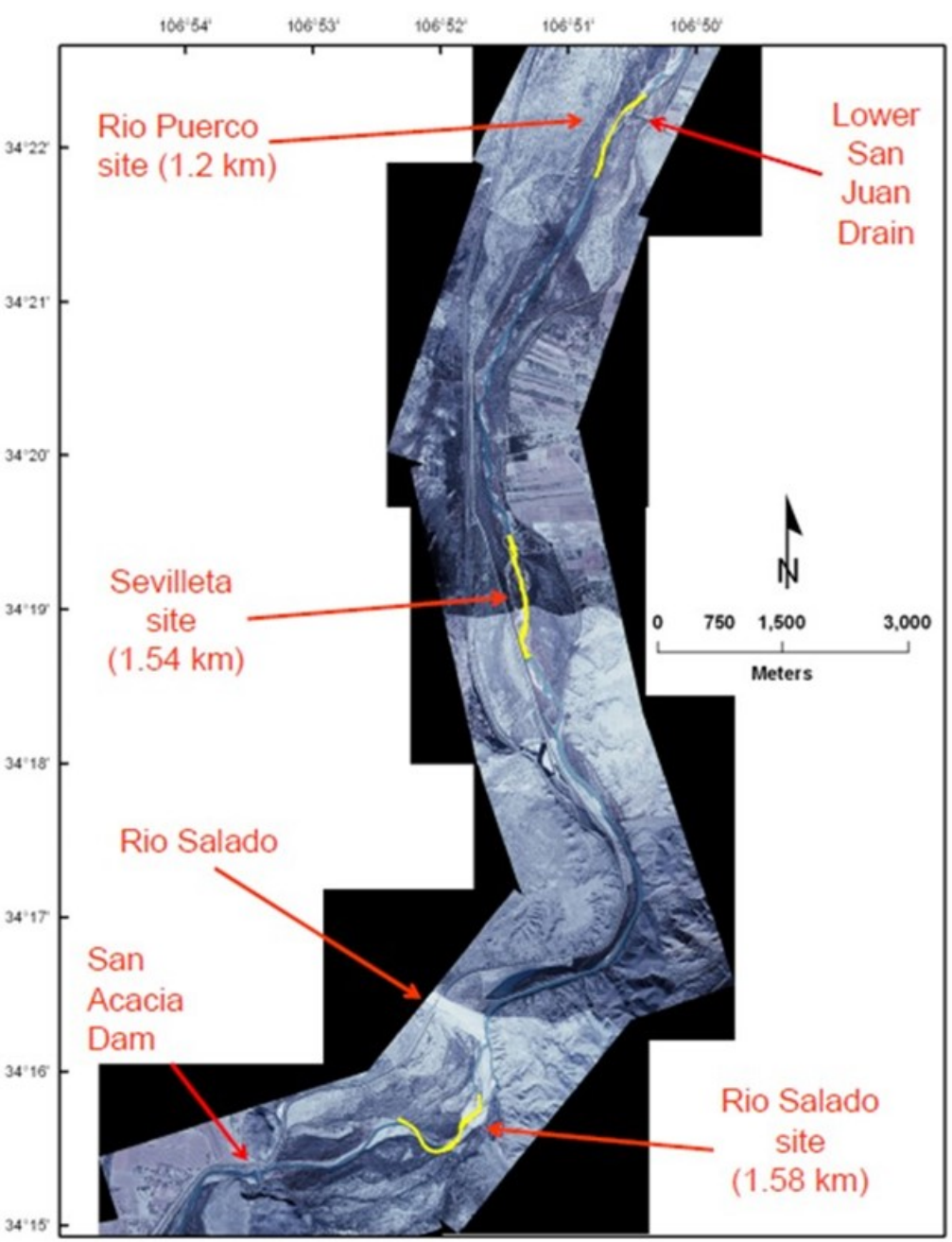


Figure 6. Aerial photograph mosaic of the lower Isleta study area, showing locations of study sites.

1e – Bovee

Habitat criteria are used to define suitable areas of the river channel, but are not linked to RGSM abundance.

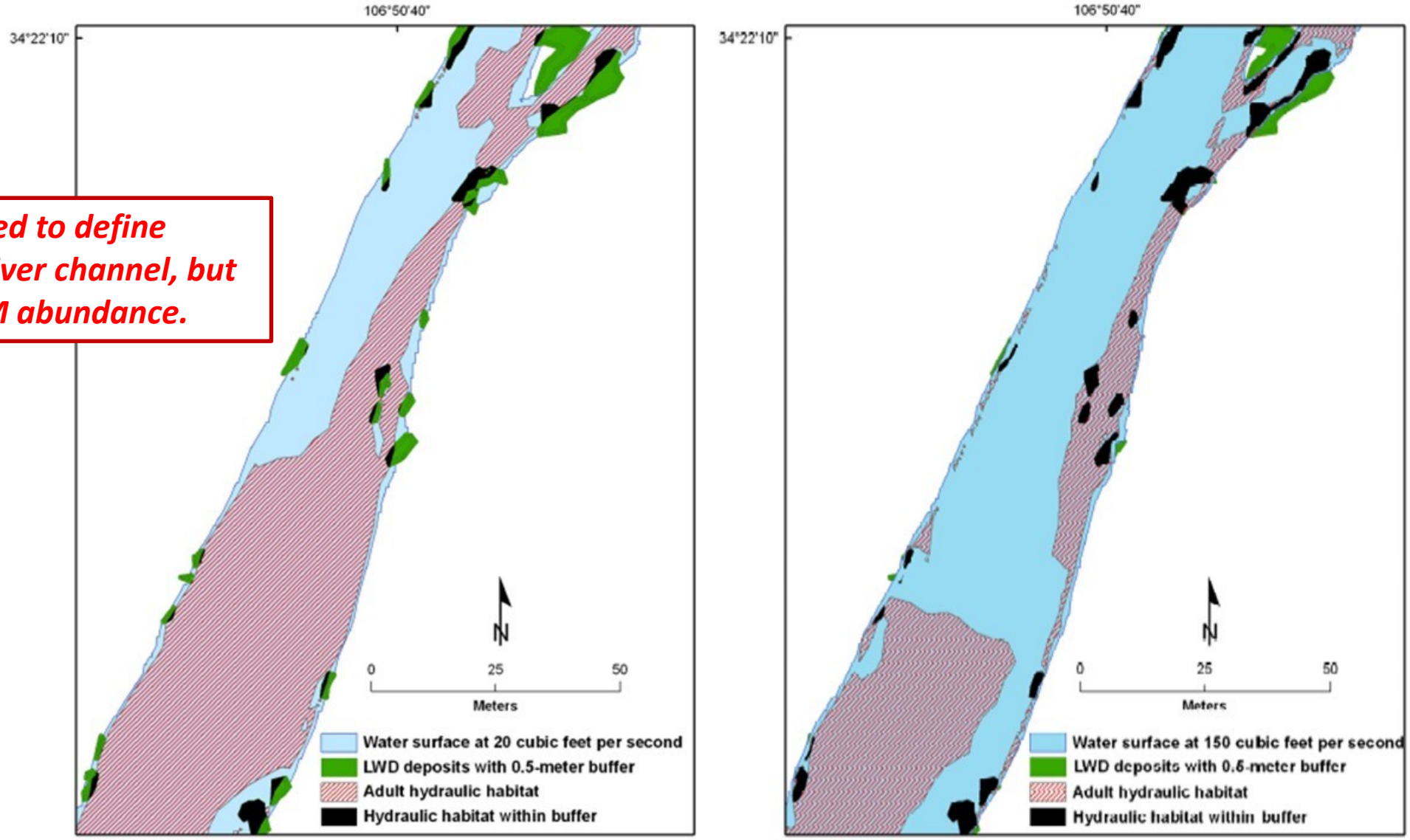
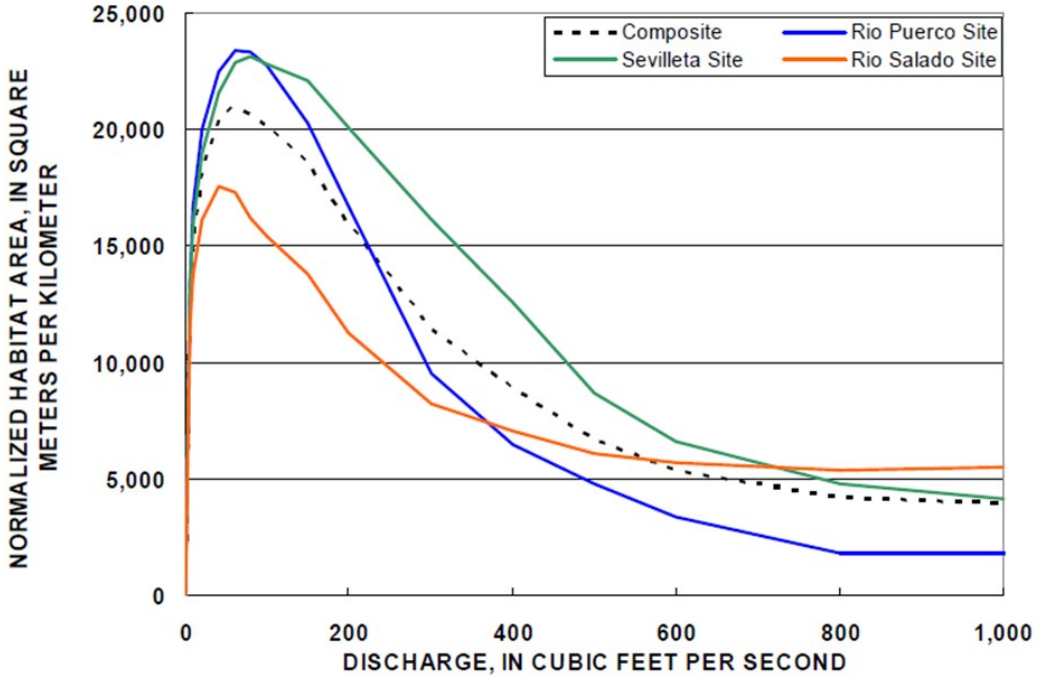


Figure 33. Juxtaposition of large woody debris deposits and suitable hydraulic habitat for adult *H. amarus* in a portion of the Rio Puerco site at 20 cubic feet per second and at 150 cubic feet per second.

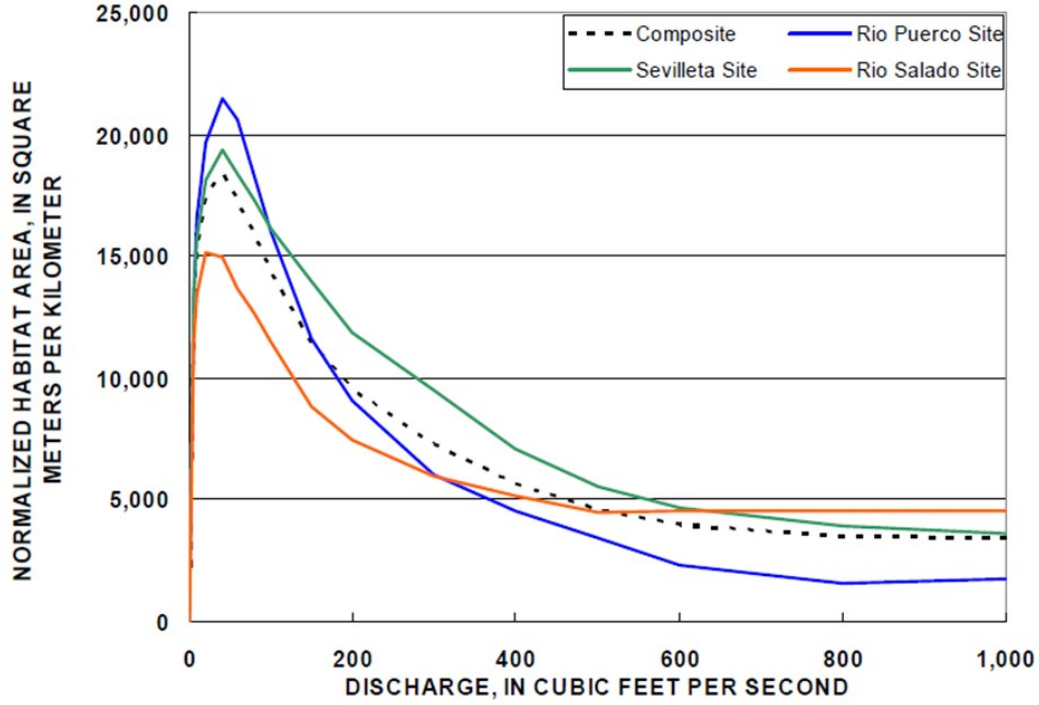
1f – Bovee

Figure 29. Normalized hydraulic habitat area as a function of discharge for adult *H. amarus*.



Habitat criteria are used to define suitable areas of the river channel, but are not linked to RGSM abundance.

Figure 30. Normalized hydraulic habitat area as a function of discharge for juvenile *H. amarus*.



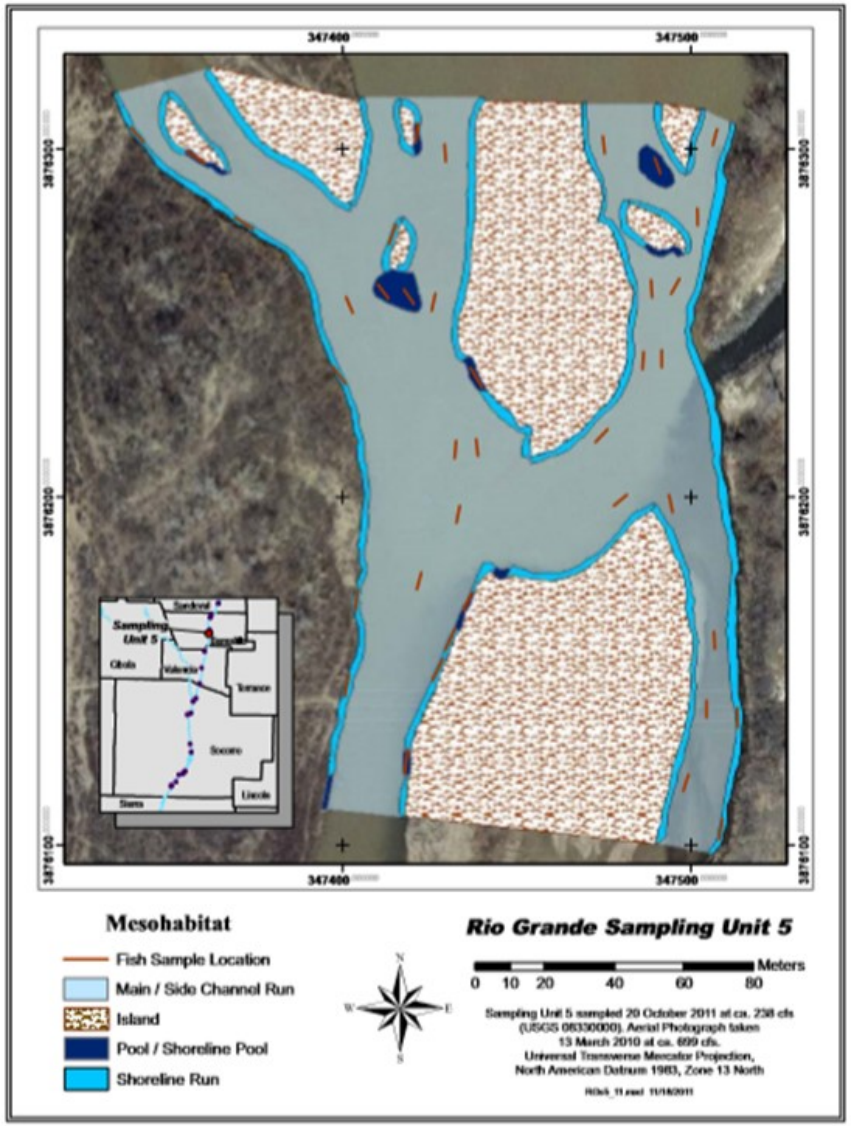
2a – Dudley

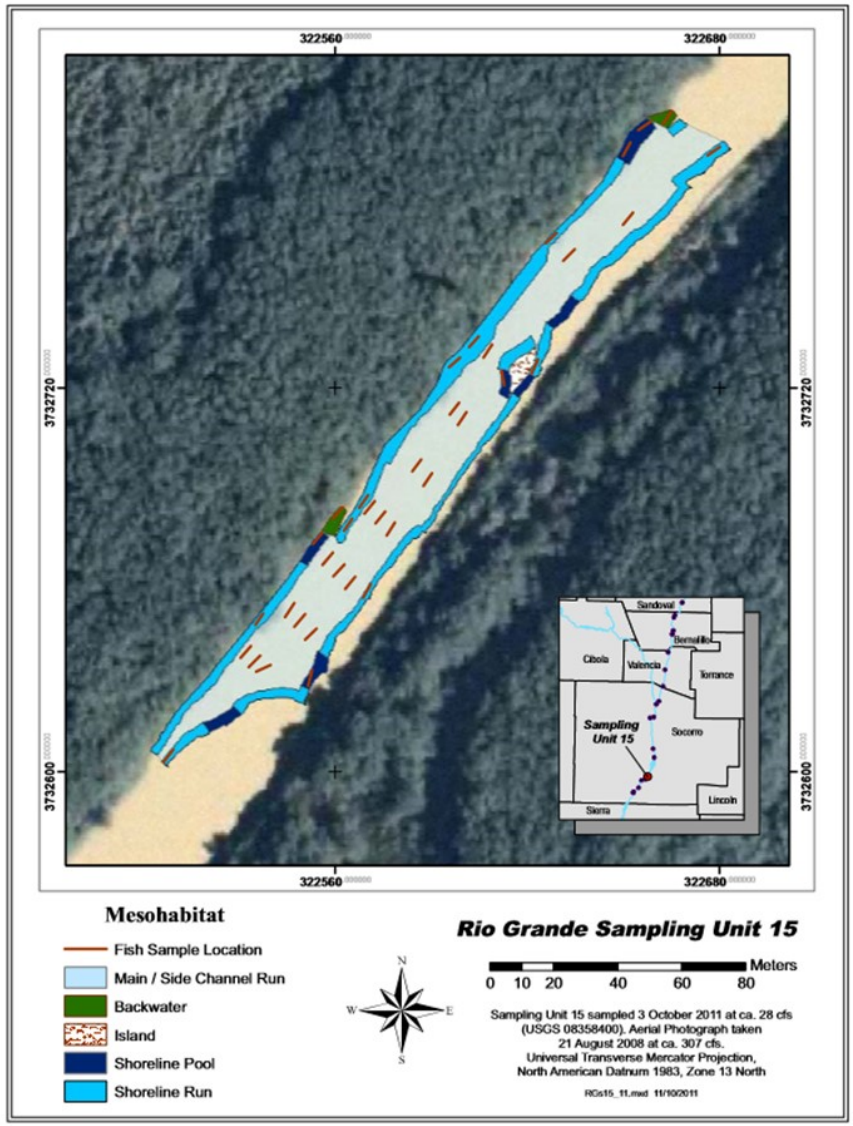
Dudley et al. (2011, 2012)

- Objectives:
  - Estimate numbers of RGSM by reach and total in the MRG.
  - Quantify relationship of RGSM CPUE to total numbers.
- Used multiple depletion estimator by electrofishing within enclosures by mesohabitat.
- Estimates taken in October for 2008, 2009, 2010, and 2011.

2b – Dudley

Mesohabitat area measures and maps delineate habitat types and areas for each sample period at flow.

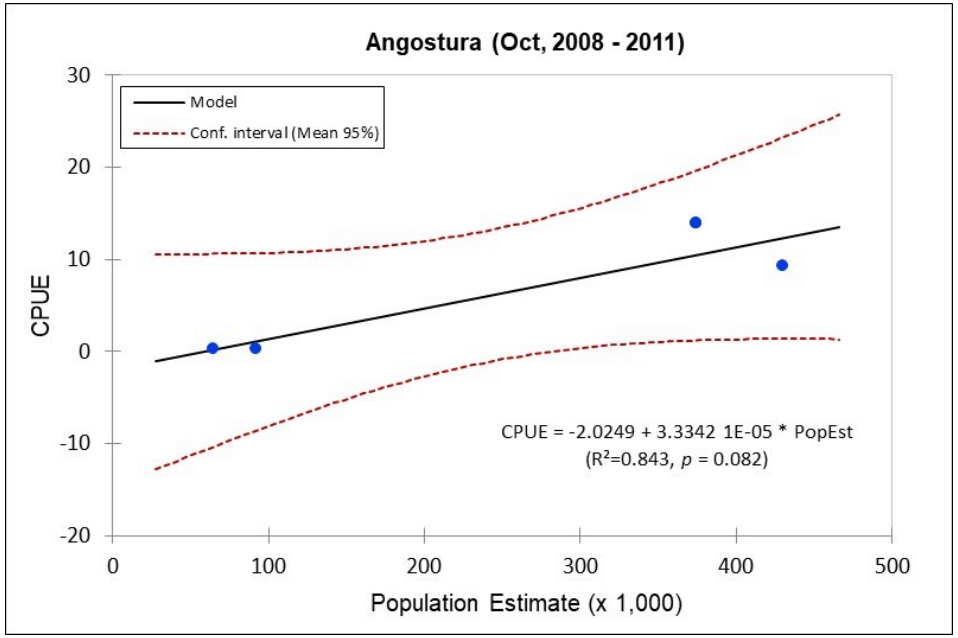


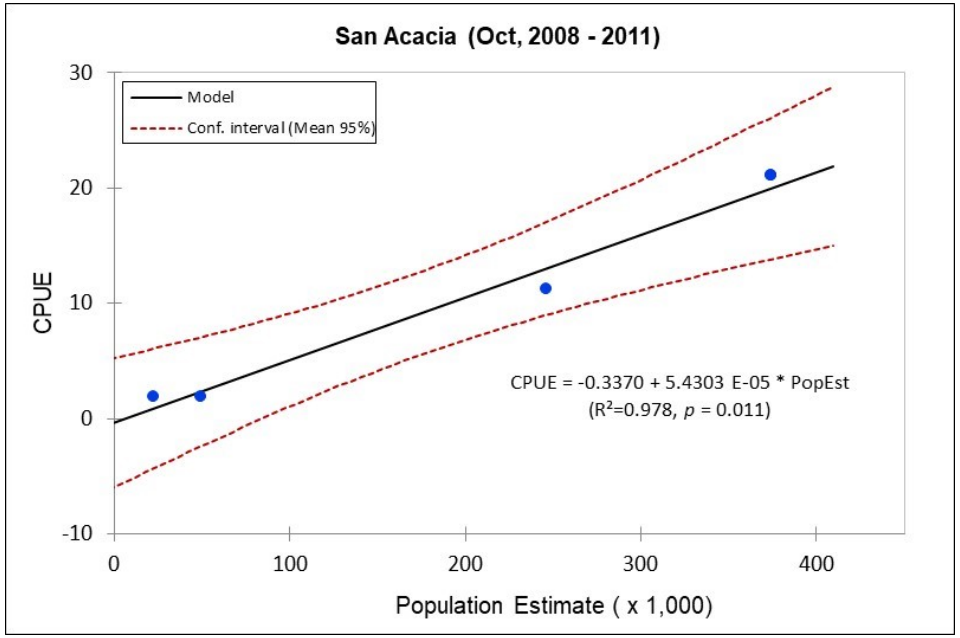


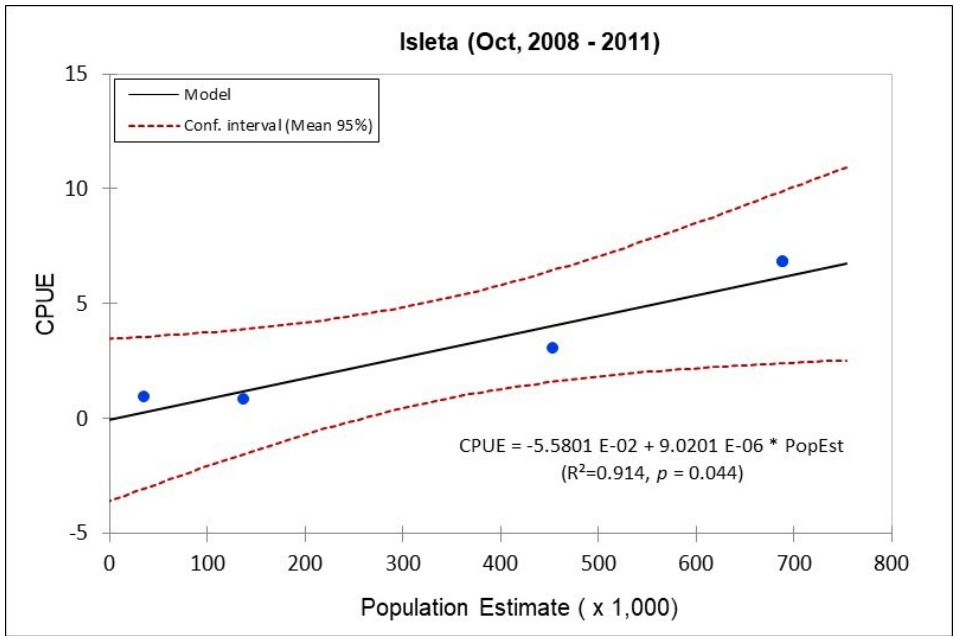
2c – Dudley

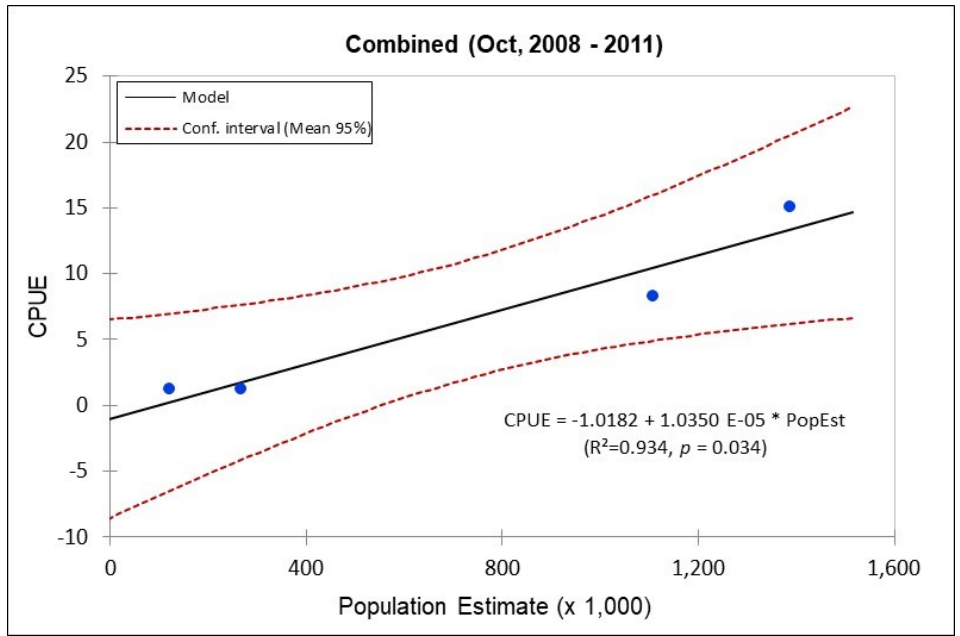
Relationship of CPUE to Pop Est is strong by reach and combined (R^2 = 0.84 – 0.98).

Figures developed by R. Valdez (6/15/2018)









2d – Dudley

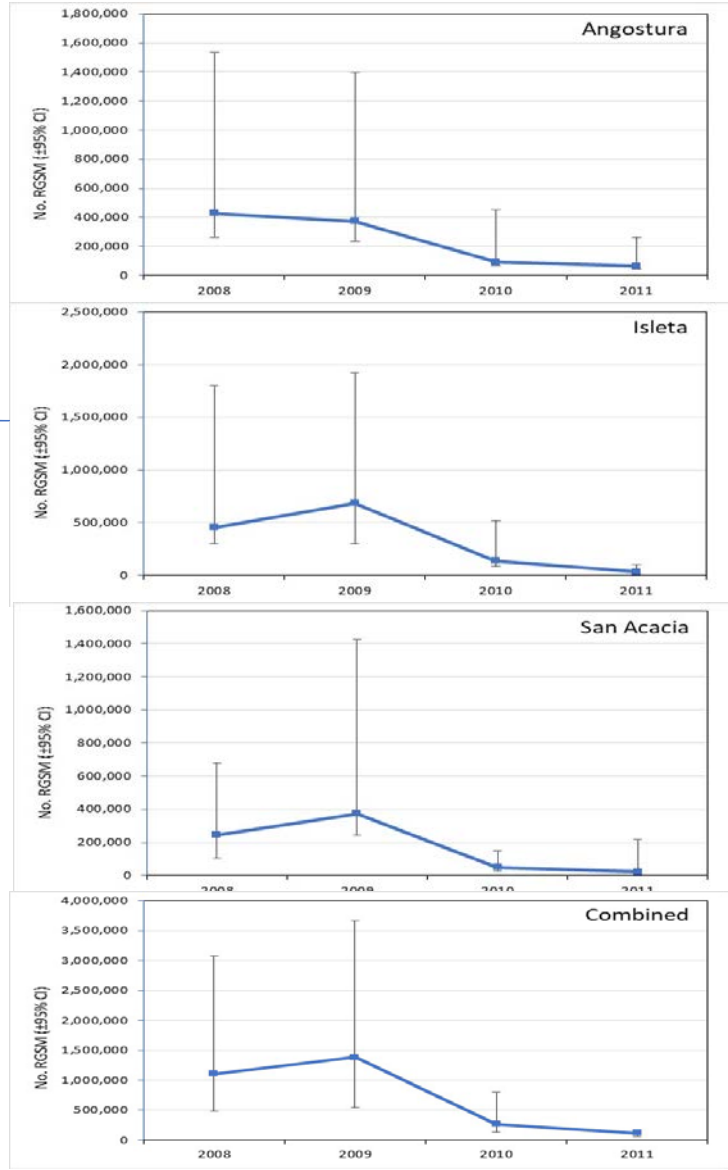
Total numbers of RGSM by reach and for MRG are for October by year.

- electrofishing
- multiple depletion
- by mesohabitat type
- $\hat{p}$ computed
- expanded by area

- open seine
- CPUE
- by mesohabitat type
- $\hat{p}$ set to 1.0
- expanded by area

Estimates of Rio Grande silvery minnow population size (unmarked individuals only)

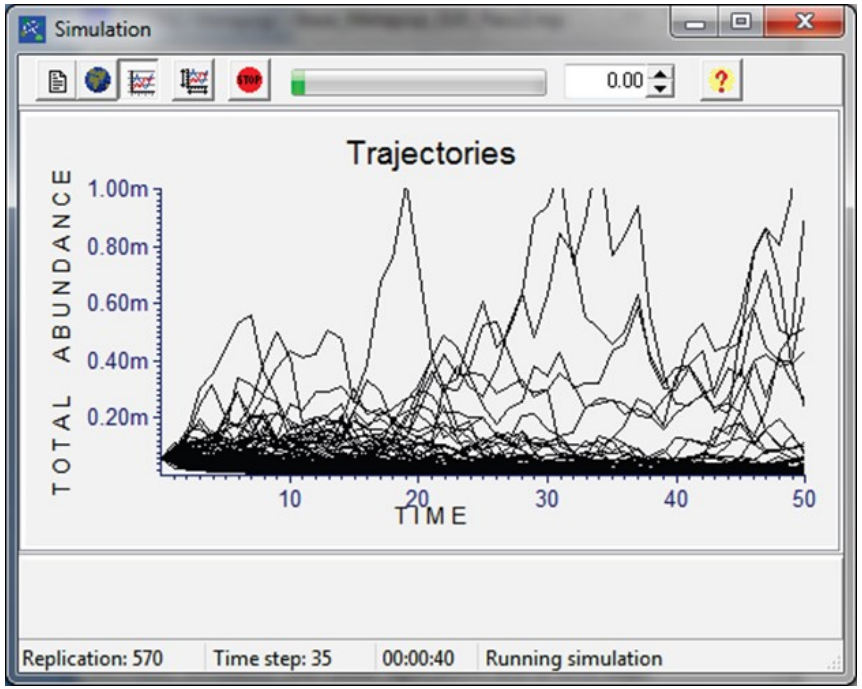
Project	Year	Reach	Estimate	Lower 95% CI	Upper 95% CI
Population Estimation	2008	Angostura	429,544.58	166,651.59	1,107,151.46
Population Estimation	2009	Angostura	374,515.10	137,452.05	1,020,439.96
Population Estimation	2010	Angostura	92,008.76	23,572.76	359,126.88
Population Estimation	2011	Angostura	64,207.21	20,969.71	196,596.19
Population Estimation	2008	Isleta	453,266.74	152,384.15	1,348,242.14
Population Estimation	2009	Isleta	688,256.83	382,896.79	1,237,141.40
Population Estimation	2010	Isleta	137,486.21	49,521.56	381,701.60
Population Estimation	2011	Isleta	34,891.17	18,356.90	66,318.05
Population Estimation	2008	San Acacia	246,362.30	139,867.89	433,940.80
Population Estimation	2009	San Acacia	374,320.84	133,086.93	1,052,816.28
Population Estimation	2010	San Acacia	49,319.23	24,683.69	98,542.23
Population Estimation	2011	San Acacia	22,505.00	9,894.54	196,596.19
Population Estimation	2008	Combined	1,108,430.23	623,544.06	1,970,378.12
Population Estimation	2009	Combined	1,387,948.14	842,933.46	2,285,352.43
Population Estimation	2010	Combined	267,271.94	132,055.17	540,942.76
Population Estimation	2011	Combined	122,380.55	59,971.52	51,187.33
Population Monitoring	2008	Angostura	58,991.04	24,483.06	142,136.75
Population Monitoring	2009	Angostura	108,183.69	54,203.03	215,923.57
Population Monitoring	2010	Angostura	19,283.00	8,519.12	43,647.00
Population Monitoring	2008	Isleta	209,044.46	105,491.13	414,248.90
Population Monitoring	2009	Isleta	305,975.56	152,900.73	612,299.52
Population Monitoring	2010	Isleta	27,655.50	11,913.05	64,200.76
Population Monitoring	2008	San Acacia	276,512.41	200,984.23	380,423.46
Population Monitoring	2009	San Acacia	224,427.01	117,277.83	429,471.47
Population Monitoring	2010	San Acacia	22,121.46	8,744.15	55,964.20
Population Monitoring	2008	Combined	544,170.27	393,990.38	751,595.22
Population Monitoring	2009	Combined	619,453.30	411,414.74	932,689.95
Population Monitoring	2010	Combined	68,138.92	41,318.39	112,369.17

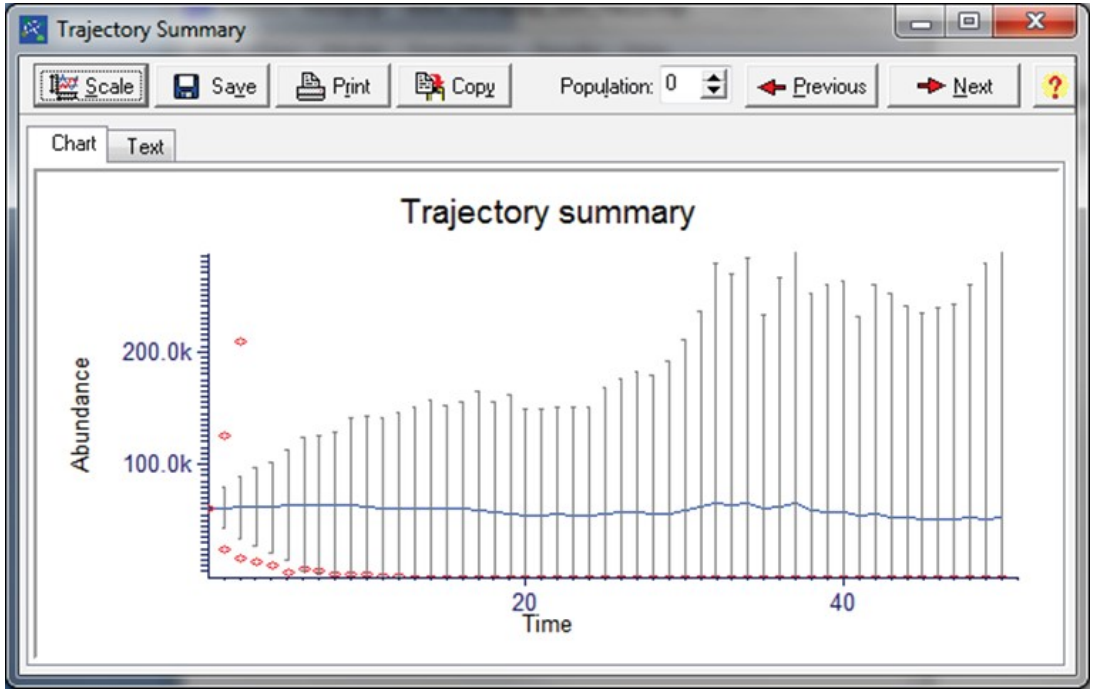


3a – Miller

Miller et al. (2012)

- Develop a Population Viability Analysis (PVA) to evaluate extinction probability of RGSM to various environmental correlates (e.g., flow)





3b – Miller

Page 10 from Miller (2012)

Stock Assessment model is initialized with Total Abundance from Dudley et al. (2012).

Initial population size

In order to construct a meaningful PVA model, we must derive even an estimate of population size so that we can evaluate the impact of predicted growth dynamics that emerge from our Leslie matrix analysis. We must therefore assess the appropriate information available to us and decide on a productive course of action.

Recent population estimation analyses, conducted by ASIR (e.g., Dudley et al. 2012), are valuable sources of initial population size estimates across the Middle Rio Grande. The October 2011 population size estimates for each reach were used as initial abundance values for the models described here. These values are given below.

See next slide from Dudley et al. (2012)

Reach	Total Abundance	Female Abundance
Angostura	64,207	32,104
Isleta	34,891	17,446
San Acacia	22,505	11,253

Initial abundances were apportioned automatically in accordance with that expected from a stable age distribution. Note that these abundance estimates are rather low compared to earlier estimates. This starting point for the models discussed here may be instructive for understanding the impact of small population instability on persistence probabilities.

3c – Miller

Dudley et al. (2012): Table 8. Rio Grande silvery minnow 2011 population estimation results for all sampling reaches and the overall study area in the Middle Rio Grande (all individuals and unmarked individuals only).

Rio Grande silvery minnow (all individuals)

Reach	Average Pop. Est. per sampled segment	Standard Dev. of Pop. Est. per sampled segment	Total number of segments	Total Pop. Est	Standard Error of Pop. Est.	Lower 95% CI	Upper 95% CI
Angostura	233.48	326.48	275	64,207.21	39,858.79	20,969.71	196,596.19
Isleta	82.88	68.44	421	34,891.17	11,746.55	18,356.90	66,318.05
San Acacia	47.48	62.80	474	22,505.00	9,865.74	9,894.54	51,187.33
Combined	104.60	177.20	1,170	122,380.55	46,051.61	59,971.52	249,735.18

These estimates were used by Miller (2012) to initialized the Stock Assessment Model of PVA).

Rio Grande silvery minnow (unmarked individuals only)

Reach	Average Pop. Est. per sampled segment	Standard Dev. of Pop. Est. per sampled segment	Total number of segments	Total Pop. Est	Standard Error of Pop. Est.	Lower 95% CI	Upper 95% CI
Angostura	233.48	326.48	275	64,207.21	39,858.79	20,969.71	196,596.19
Isleta	82.88	68.44	421	34,891.17	11,746.55	18,356.90	66,318.05
San Acacia	47.48	62.80	474	22,505.00	9,865.74	9,894.54	51,187.33
Combined	104.60	177.20	1,170	122,380.55	46,051.61	59,971.52	249,735.18

4a – TetraTech

- Objectives—estimate area of:
  - Most Commonly Occupied Habitat,
  - Highest Quality Feeding and Rearing Habitat, and
  - Highest Quality Spawning and Egg/Larval Retention Habitat.
- Methods:
  - Two-dimensional hydrodynamic model (RMA2 and the Surface Water Modeling System or SMS) with capability of predicting depth and velocity values on a finite grid.
  - URGWOPS hydraulic model results coupled with habitat use criteria and hypothetical hydrologic time series derived of usable habitat area for native and non-native fish species at eight study sites (six on the Rio Grande and two on the Rio Chama).
  - Approach parallels flow-habitat relationships of the Instream Flow Incremental Methodology (IFIM; Bovee 1982; Bovee et al. 1998).

4b – TetraTech

Note: Tetra Tech used the same habitat criteria developed in Bovee et al. (2008)—the Delphi consensus process

Table 5. Summary of habitat suitability criteria for the Rio Grande silvery minnow, with justification for deviations from criteria in the 1999 USFWS Recovery Plan (table reproduced from Bovee et al. 2008).

Criteria Type	Criteria source		
	Technical Advisory Group (Initial) June 2007	**Recovery Plan 1999**	**Technical Advisory Group (final) November, 2007**
Adult depth range	10 cm, no upper limit	50 cm, no lower limit given	5 cm[(a)]–50 cm[(b)]
Juvenile depth range	5 cm, no upper limit	50 cm, no lower limit given	5 cm[(a)]–50 cm[(b)]
Adult velocity range	0–60 cm/s	0–40 cm/s	1 cm/s[(c)]–40 cm/s[(d)]
Juvenile velocity range	0–30 cm/s	0–40 cm/s	1 cm/s[(c)]–30 cm/s[(e)]

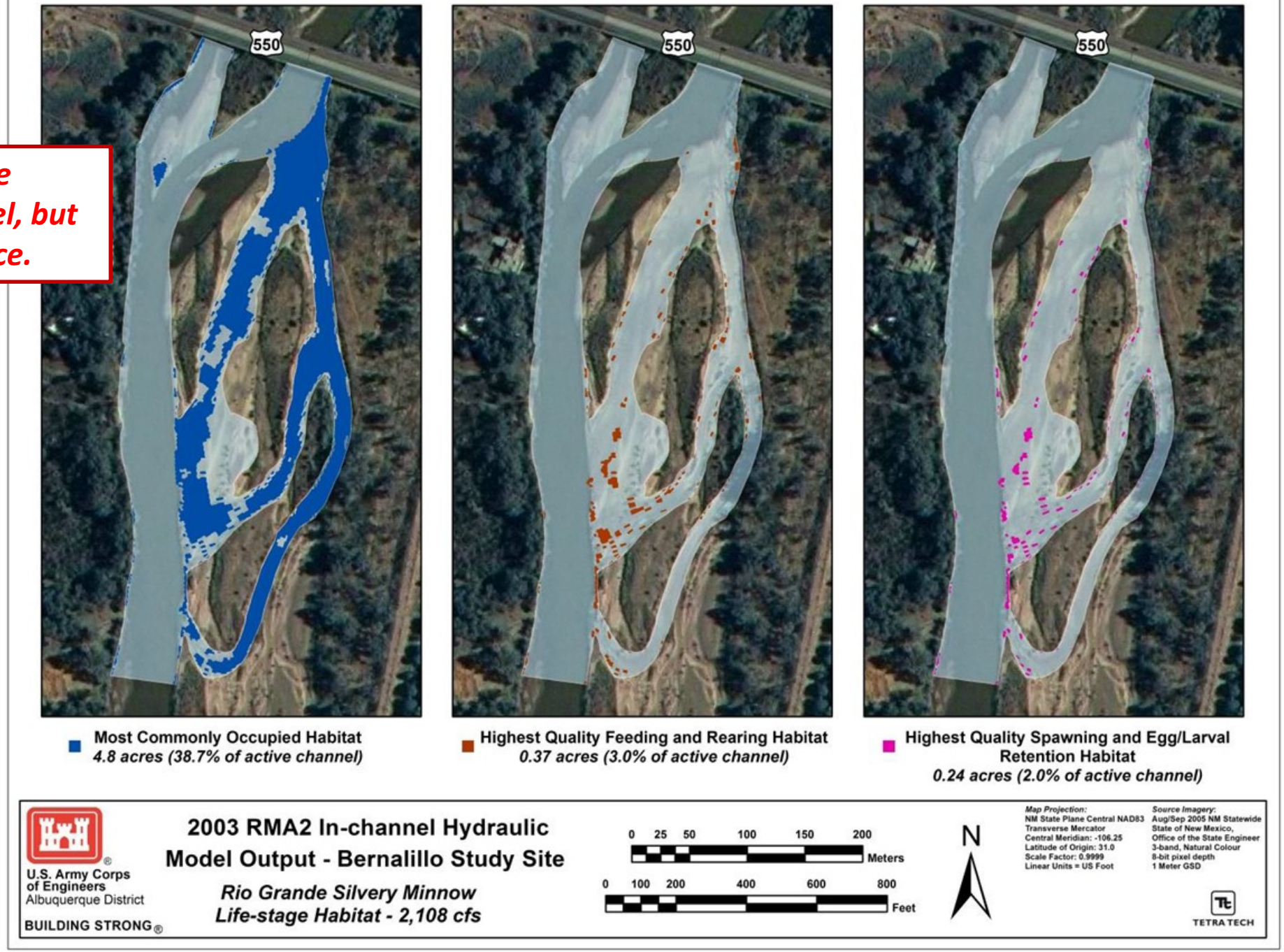
Justification for modifications:

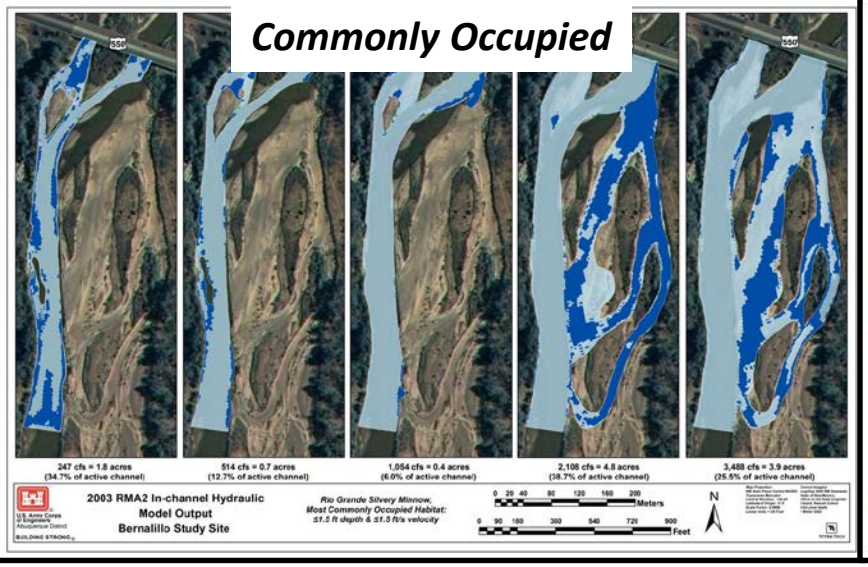
(a) Minimum depth set at 5 cm for habitat use at shallower depths consistent with feeding biology
(b) Maximum depth changed to 0.5 m for consistency with recovery plan
(c) Minimum velocity set at 1 cm/s to differentiate flowing water from stagnant pools
(d) Maximum velocity for adults reduced for consistency with recovery plan
(e) Maximum velocity for juveniles reduced from recovery plan to reflect sustained swimming performance of post-larval fish

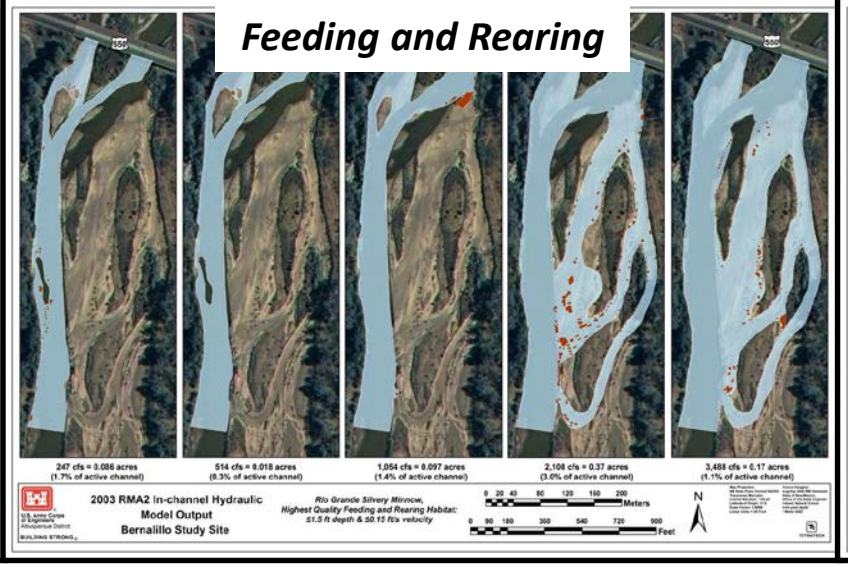
4c – TetraTech

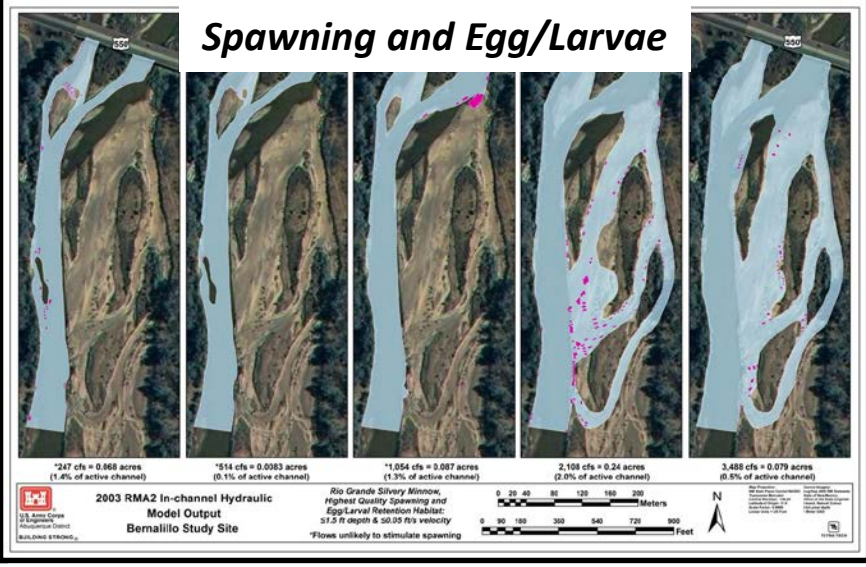
Habitat criteria are used to define suitable areas of the river channel, but are not linked to RGSM abundance.

1. Most Commonly Occupied Habitat
2. Highest Quality Feeding and Rearing Habitat
3. Highest Quality Spawning and Egg/Larval Retention Habitat





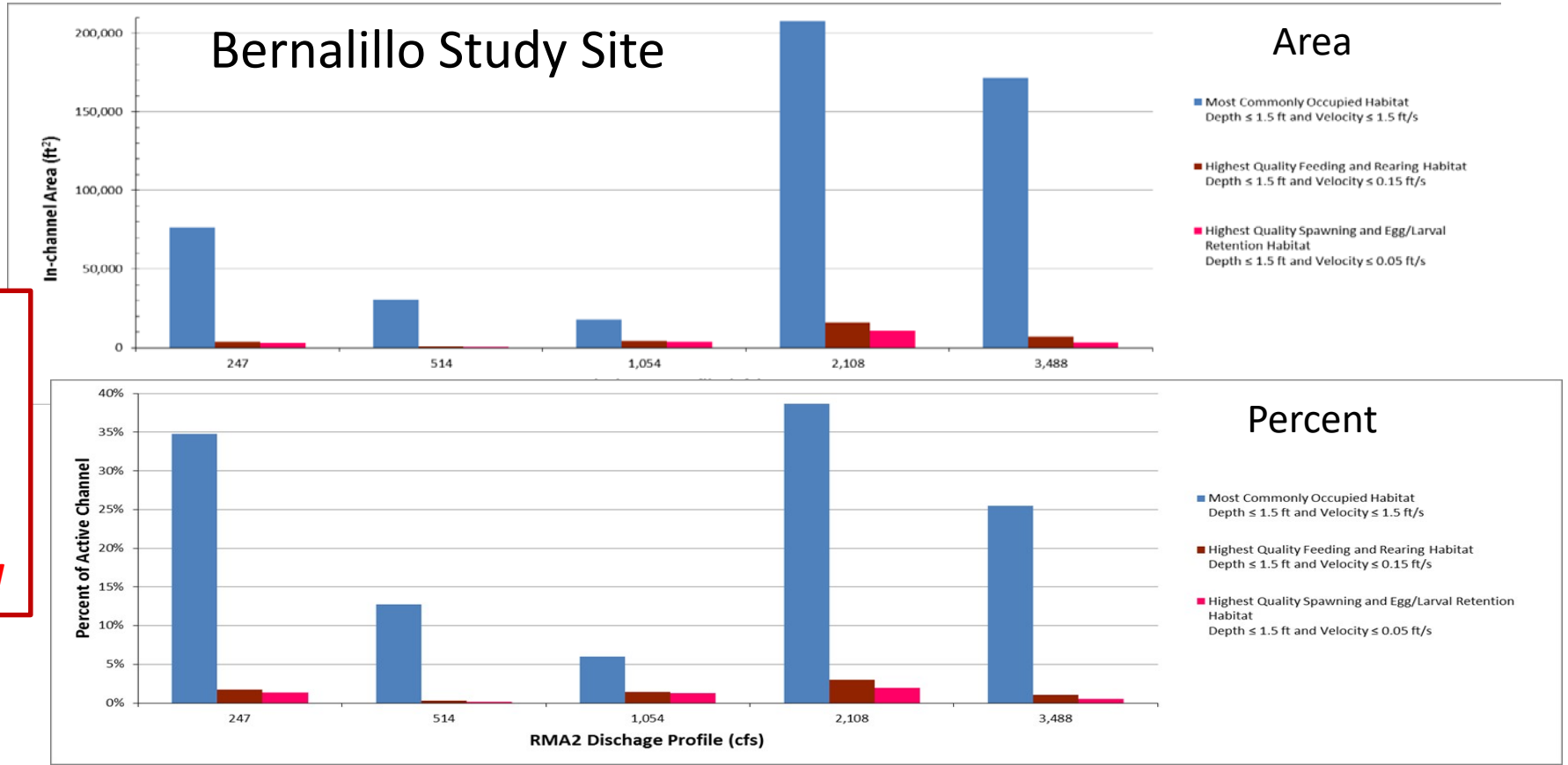


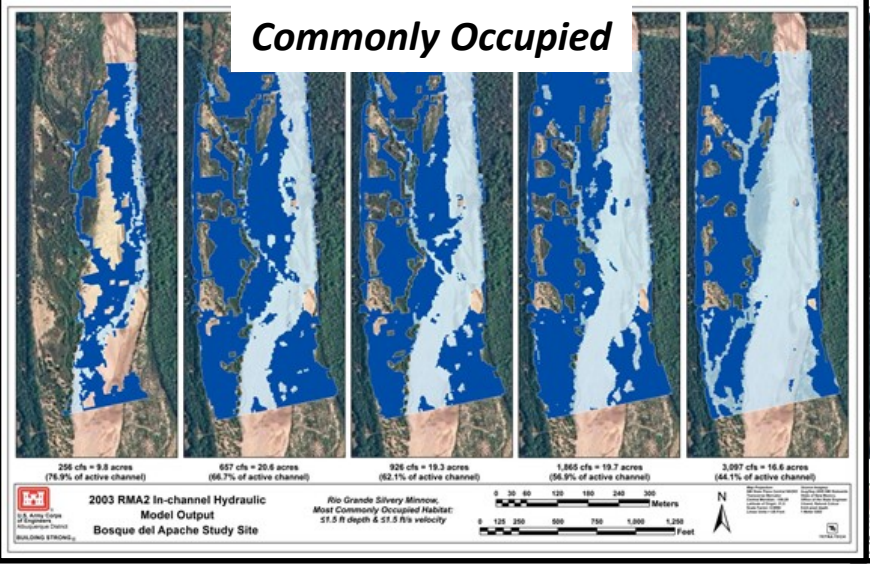


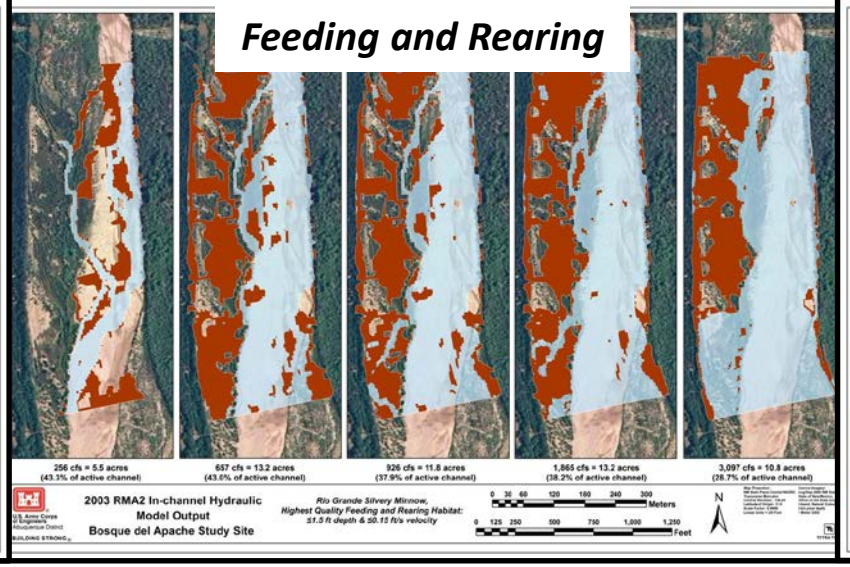
4d – TetraTech

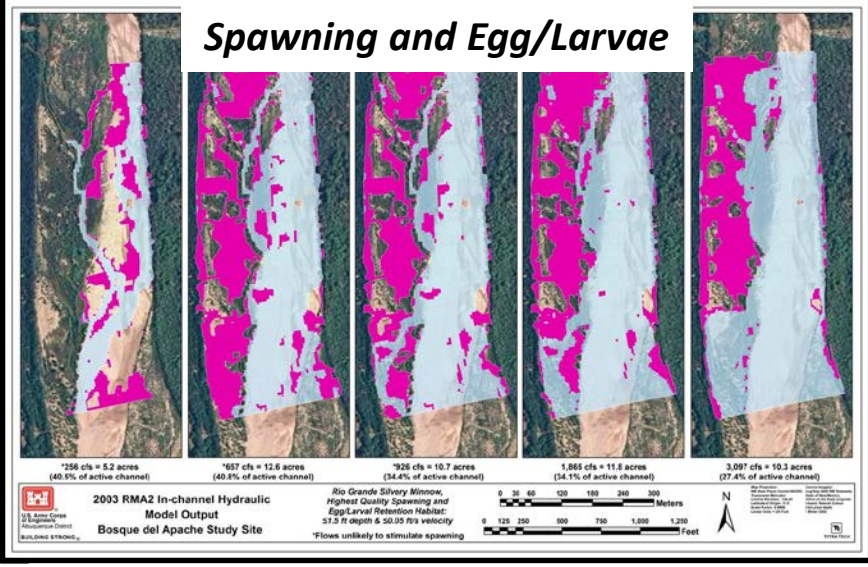
Habitat criteria are used to define suitable areas of the river channel, but are not linked to RGSM abundance.

Big difference by Study Site!





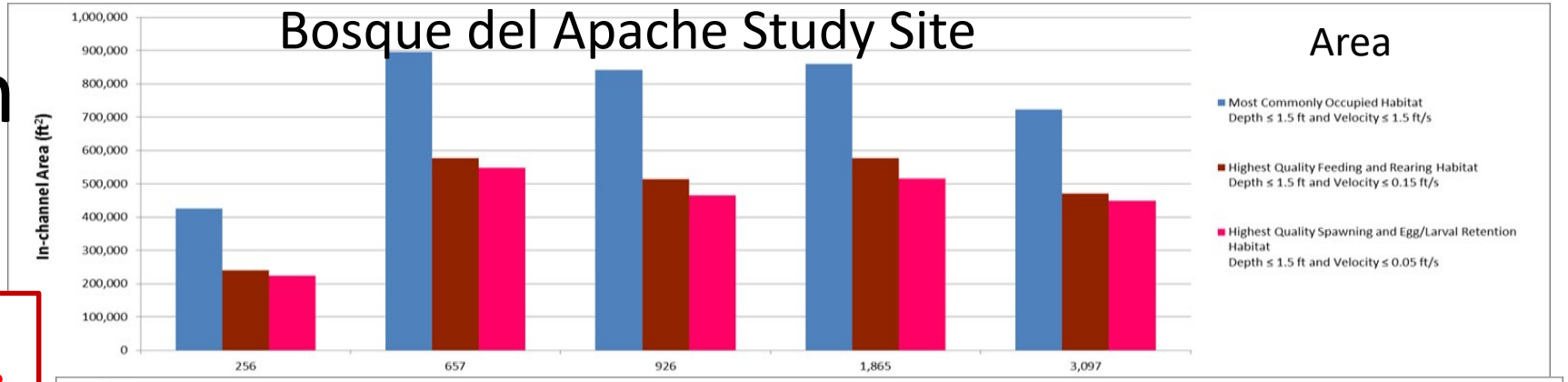


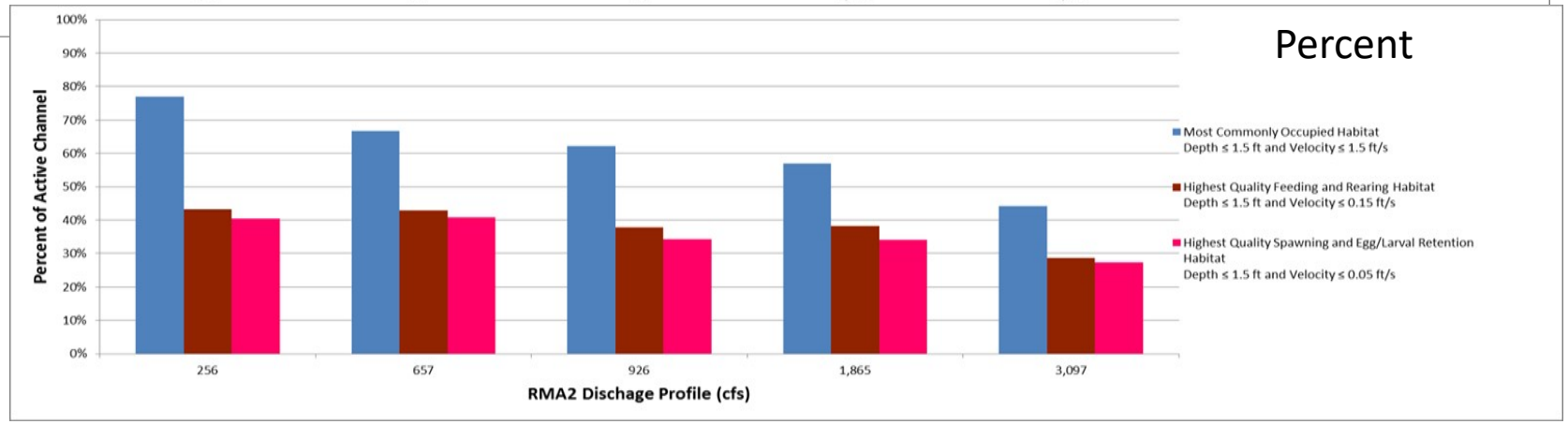


4e – TetraTech

Habitat criteria are used to define suitable areas of the river channel, but are not linked to RGSM abundance.

Big difference by Study Site!





4f – TetraTech

Total capture of RGSM is provided, but not expanded to abundance, and not related to habitat or flow.

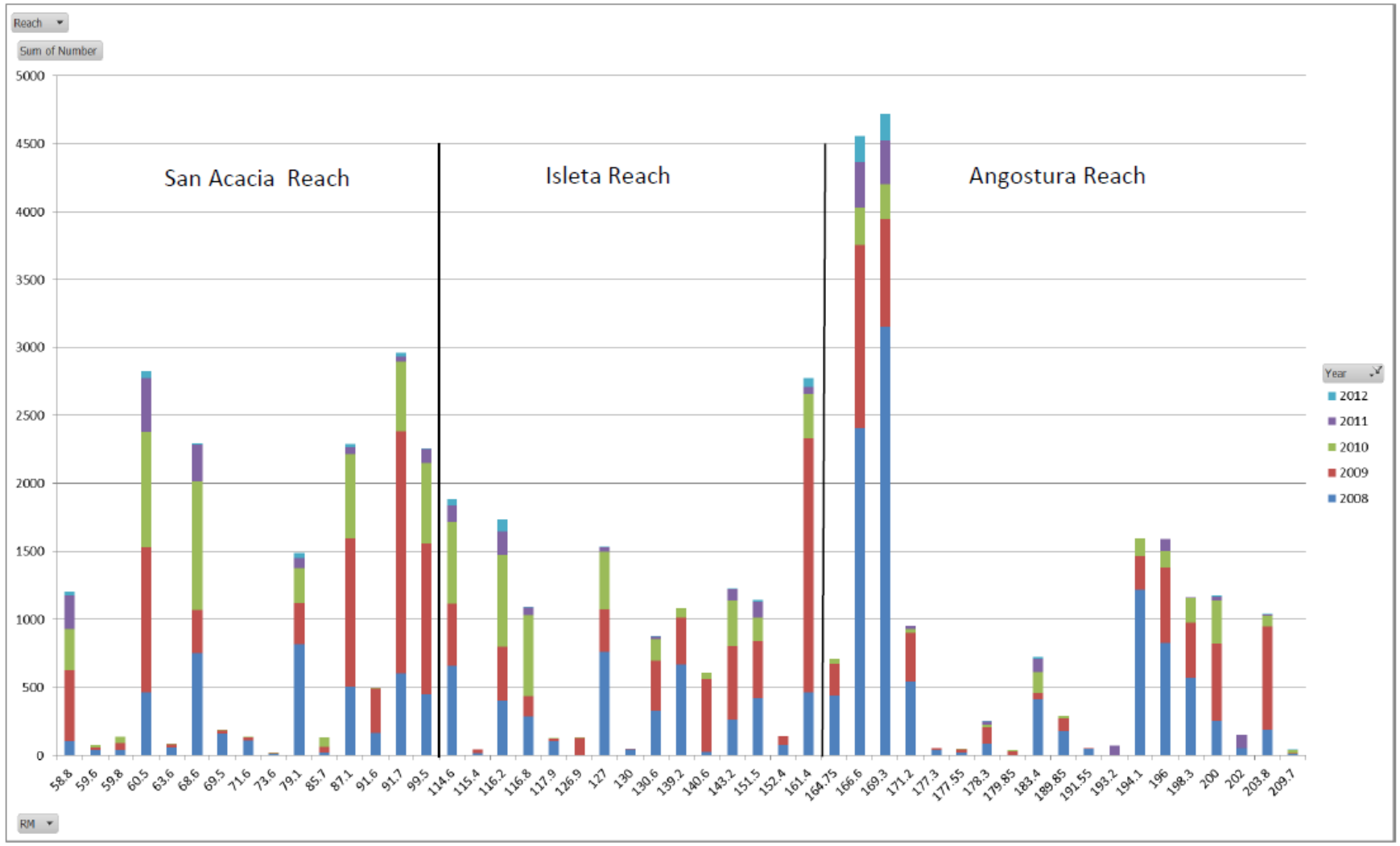


Exhibit C4. MRG Long-Term Monitoring Program total capture of Rio Grande silvery minnow by year and reach, 2008-2012.

5a – Braun

Braun et al. (2015)

- Objectives: Evaluated physical characteristics and fish assemblage composition of mesohabitats over a range of streamflows at 15 sites on the MRG (winter 2011–12 and summer 2012).
- Methods:
  - Wetted area, physical characteristics, and fish assemblage of river mesohabitats were characterized within a 1-km length of stream channel at each site (D, V, Temp, CO, pH, Cond).
  - Fifteen sites distributed along the MRG were selected starting 3 km downstream from Cochiti Dam and ending 40 km upstream of Elephant Butte Reservoir.
  - Sites grouped into four river reaches separated by diversion dams.
    - Cochiti (Peña Blanca),
    - Angostura (Bernalillo, La Orilla, Barelas, Los Padillas),
    - Isleta (Los Lunas I, Los Lunas II, Abeytas, La Joya, Rio Salado), and
    - San Acacia (Lemitar, Arroyo del Tajo, San Pedro, Bosque del Apache I, and Bosque del Apache II).

5b – Braun

- Mesohabitat assessment generally consists of three steps that together lead to conclusions regarding the effects of various management options.

- To assess mesohabitats, geospatial measurements (data associated with a particular location) are made as a first step to generate maps, which provide quantitative descriptions of the ecohydraulic habitat conditions in the river over a range of streamflows (that is, how the various mesohabitat types change under different streamflow conditions) (Bovee and others, 1998, 2008).

- The second and third steps include the collection of physical measurements and biological measurements, respectively, both of which are used to determine habitat use by selected fish species.

5c – Braun

Mesohabitat Types

Mesohabitat types modified from Platania (1993)—and Dudley et al. (2019).

Table 2. Description of mesohabitat types (modified from Platania, 1993) and channel features that were mapped on the Middle Rio Grande, New Mexico, 2011–12.

[ft/s, feet per second; ft, feet; NA, not applicable]

Mesohabitat type	Description	Velocity minimum to maximum (ft/s)	Depth minimum to maximum (ft)
Riffle	Relatively shallow and low to moderate velocity feature characterized by moderately turbulent water	-0.05–4.80	0.01–2.58
Run	Relatively high-velocity feature with laminar flow and a nonturbulent surface	-1.05–5.39	0.02–4.31
Pool	Feature with little or no velocity that may be deep in places	-2.14–1.70	0.04–4.40
(a) Channel	Type of pool where current moves in the same flow direction as the channel		
(b) Eddy	Type of pool where current moves in the opposite direction relative to flow		
Isolated pool	Type of pool that is separate from the main channel; frequently a portion of a former backwater or forewater that has become disconnected from a secondary channel	-0.06–0.21	0.01–2.40
Forewater	Slackwater feature oriented into the principal direction of flow	-0.10–0.08	0.01–1.00
Backwater	Slackwater feature oriented in an opposing direction to the principal flow direction	-0.23–2.25	0.01–2.87
Embayment	Slackwater feature located adjacent to the channel and oriented perpendicular to flow	-0.27–1.02	0.03–1.26
Flat	Very shallow, low-velocity feature typically located on the periphery of an existing point or channel bar; caused by a slight rise in stage	-0.62–3.13	0.01–2.4

Channel feature	Description		
Point bar	Crescent-shaped depositional feature located on the inside of a stream bend; typically either devoid of or containing annual vegetation	NA	NA
Channel bar	Transitory parcel of land surrounded by water; typically either devoid of or containing annual vegetation	NA	NA

5d – Braun

Mesohabitat types modified from Platania (1993)—and Dudley et al. (2019).

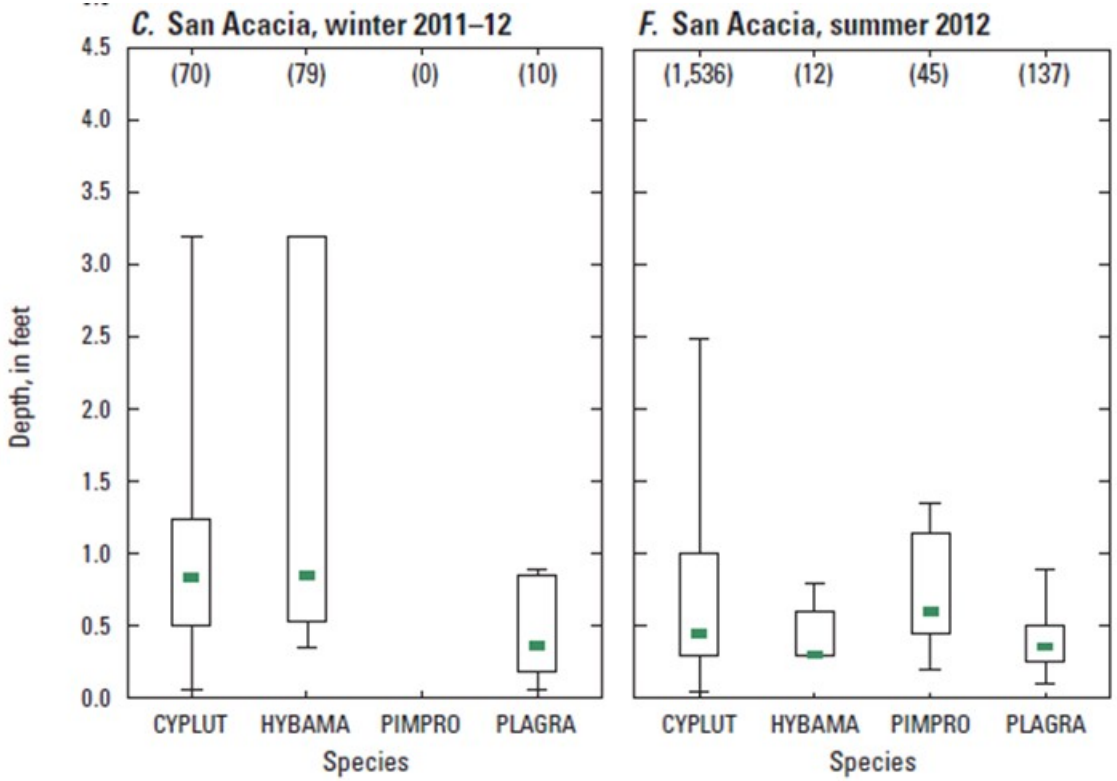


Figure 20. Depths associated with the collection of selected minnow species from three reaches of the Middle Rio Grande, New Mexico, during winter 2011–12 *A*, Angostura; *B*, Isleta; and *C*, San Acacia; and during summer 2012 *D*, Angostura; *E*, Isleta; and *F*, San Acacia.

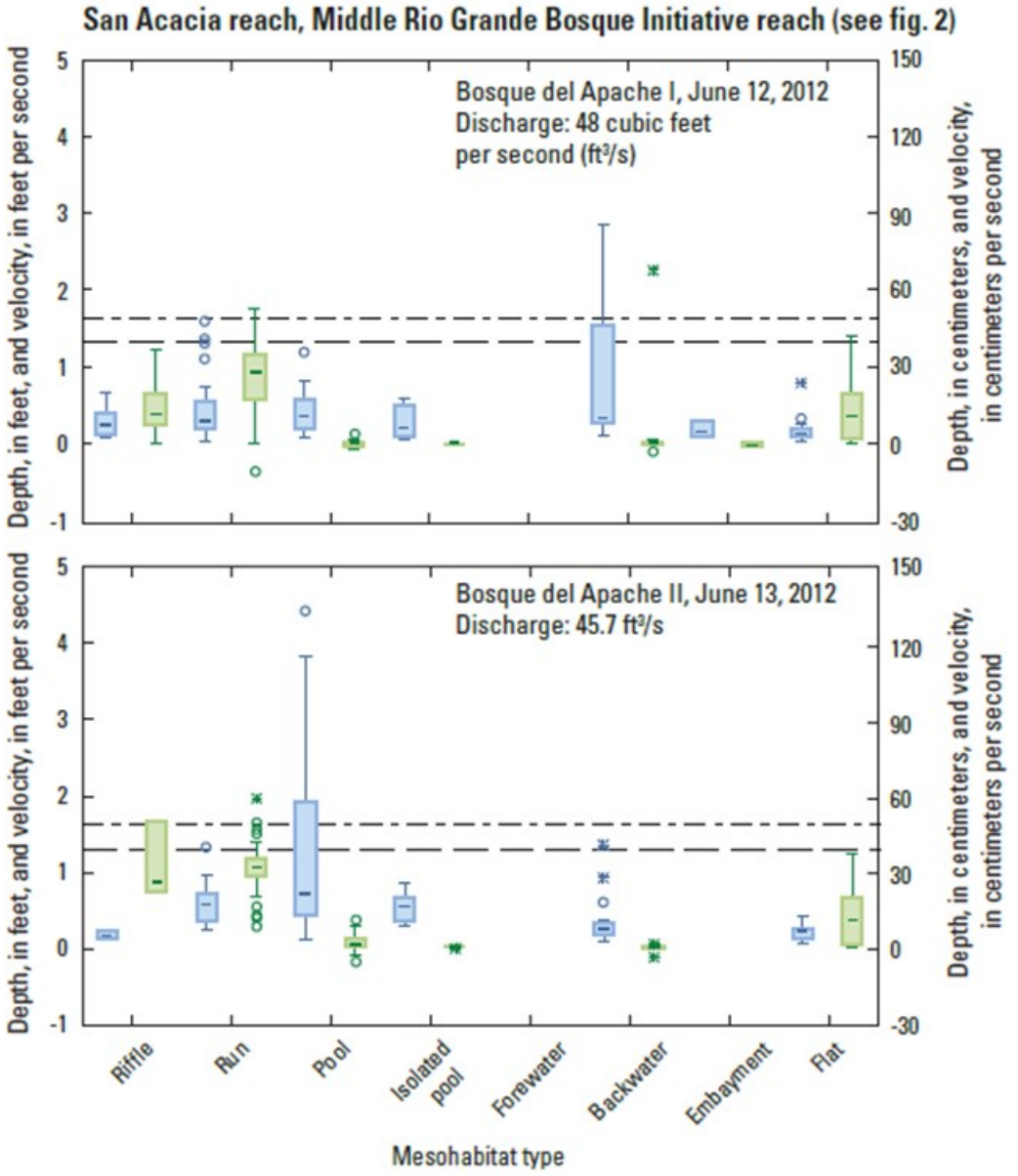
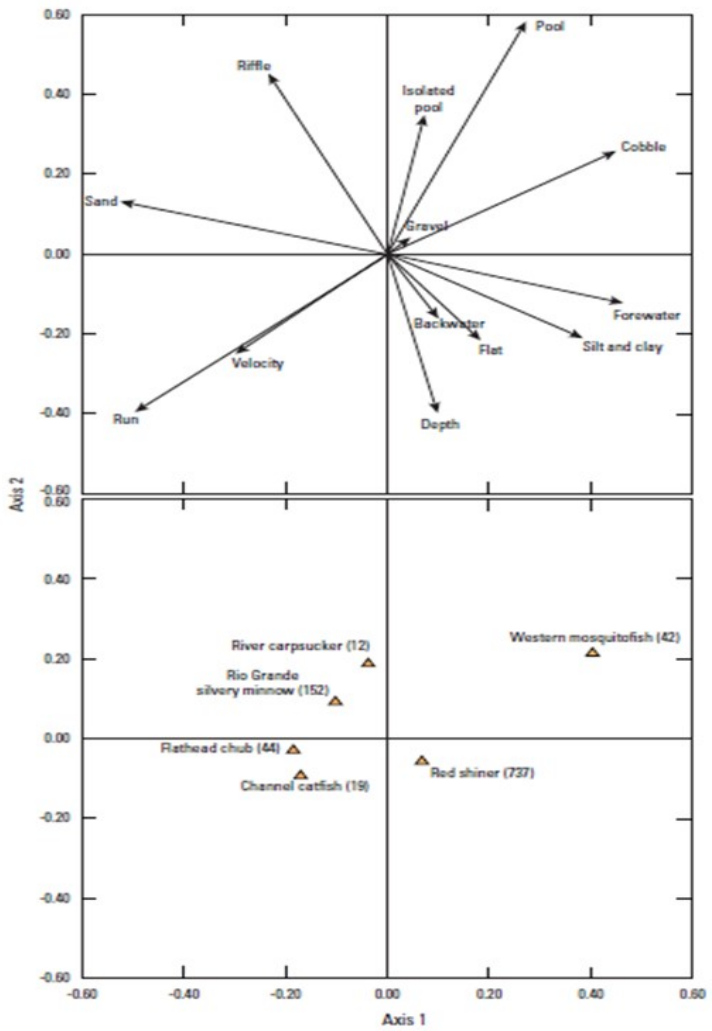


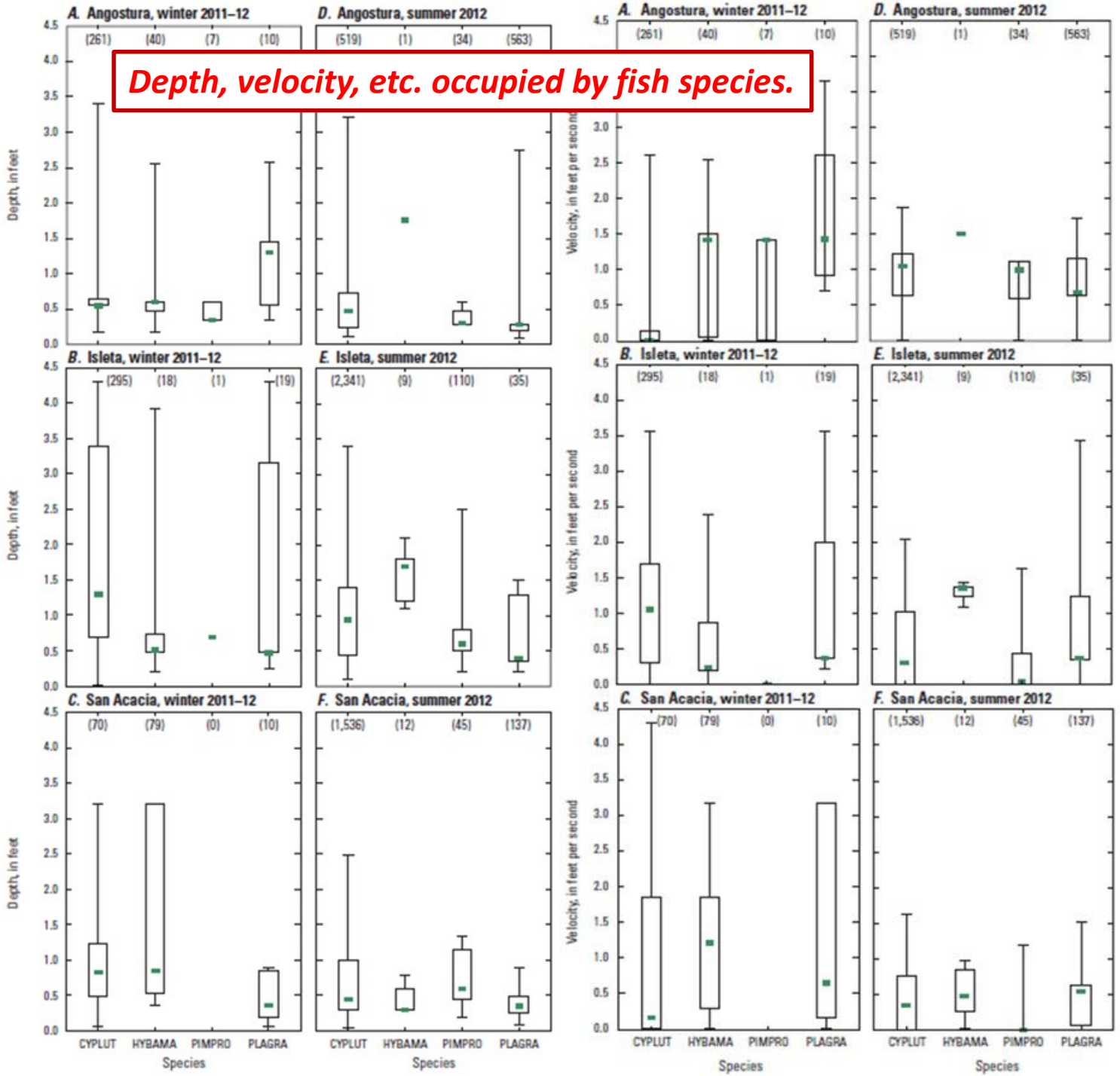
Figure 10. Depth and velocity in different mesohabitat types at 15 sites on the Middle Rio Grande, New Mexico, winter 2011–12 and summer 2012.

5e – Braun

PCA: Similarity of fish species to mesohabitat type and selected environmental variables.



Depth, velocity, etc. occupied by fish species.



6a – USFWS

USFWS (2016)—Appendix A, 2016 BiOp

- Objective:
  - Determine (or affirm) relationships between indices of RGSM population abundance estimates and occupancy distribution indices (Dudley et al. 2016) with measures river discharge and levels or areas of water inundation of the channel and associated floodplain in the MRG.
- Methods:
  - Hydrobiological analyses based on linear and polynomial relationships (scatterplots) between RGSM abundance and distribution indices and historical river flows, channel inundation areas, and other hydrological attributes and measurements collected annually.
  - Hydrobiological Objectives are recommendations for potential water management flow regimes according to historical information about duration, magnitude, and timing of spring runoff and areas of channel inundation that appear necessary to support survival and conservation of RGSM population in the MRG.

6b – USFWS

Same computation of Ne, MVP, and buffered MVP as used for 2002 Recovery Goals for four CPM, HBC, RBS, and BYT.

- Computation of a MVP for silvery minnow in the MRG:
- Ng = Ne/(Ne/Ng)
  - Where: Ne = genetic effective population size, 5,000
  - Ne/Ng = proportion of adults contributing genes to next generation; ~0.30 for most fish (Service 2002, their Table 2)
  - Therefore: Ng = 5000/0.30 (~assuming 30 percent successfully spawn)
  - Ng = 16,667, the minimum number of spawners in May
- Given our assumptions:
  - Estimated MVP is 16,667 individual spawners.
  - Used a modified analysis provided (Bui 2016) to estimate the average top width of MRG (Angostura Dam to RM 60 (253 km) during low flow (July through October) for three hydrologic scenarios (Very Wet, Average, Very Dry). (average area of ~ 49,202,405 m^2)
  - = 16,667 / 49,202.4 x 100m^2) = **0.3 fish per 100 m^2 (lowest density to protect against genetic inbreeding**.
  - Monthly rates of RGSM mortality from May to October varies substantially (Miller 2012), estimated density in October would be approximately 1.6 fish per 100 m^2.

6c – USFWS

Same computation of Ne, MVP, and buffered MVP as used for 2002 Recovery Goals for four CPM, HBC, RBS, and BYT.

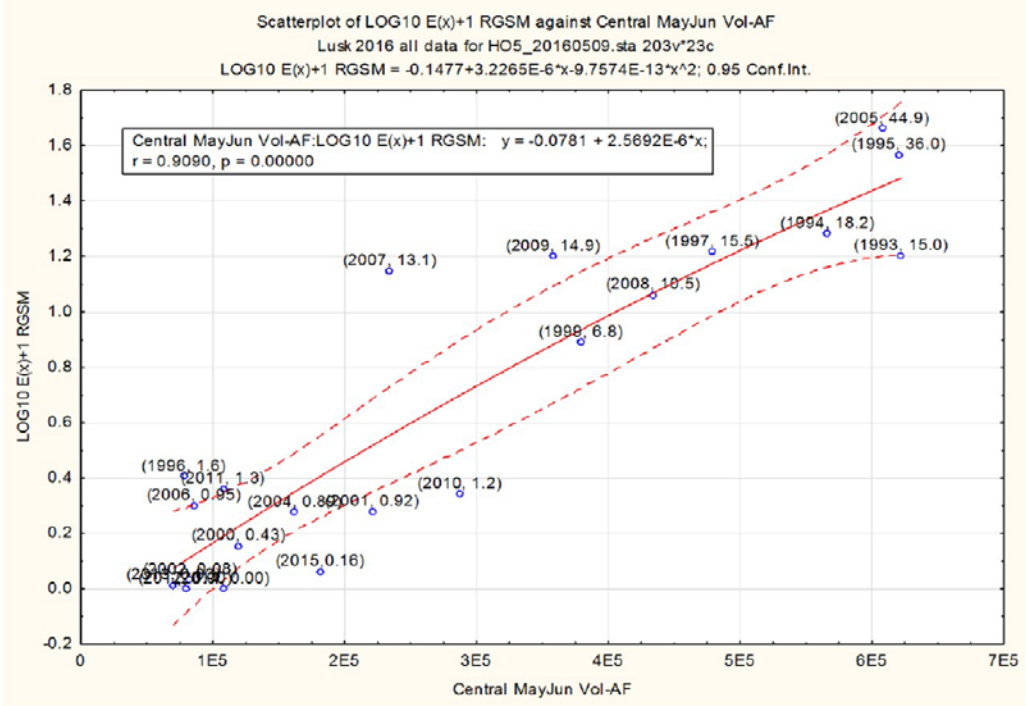
- MVP calculation does not reflect a density dependent population a mortality factor is added to estimate a genetically viable population.
- Modified annual mortality factor (Goodman (2012) and runoff rates (Very Dry =1.33; when the year is Average = 1.46, and if the years is Very Wet = 1.92), to develop a buffered MVP.
  - Very Dry Year buffered MVP = 16,667 x 1.33 = 22,167 adults
  - Average Year buffered MVP = 16,667 x 1.46 = 24,334 adults
  - Very Wet Year buffered MVP = 16,667 x 1.92 = 32,001 adults
- Buffered MVP population sizes ranged from 22,167 to 32,001 spawning adults that are estimated for May and June.
- Assumed 33 to 92% loss from previous May and June to October.
- Used modified analysis (Bui 2016) to estimate channel width of three river reaches during low flow conditions for the three hydrologic scenarios (Very Wet, Average, Very Dry).
  - For Very Wet years ~ 63,095,135 m^2 at maximum top width by its length from Angostura Dam until about RM 60 or 253 km (157 mi) and with an estimated density of (32,001 fish divided by 63,095.1x100m^2) = 0.8 fish per 100 m^2.
  - For Average type years, ~ 25,561.1 m^2 at maximum top width in the MRG with 24,404 RGSM, resulting in estimated density of (24,404 fish/25,561.1x100 m^2) of approximately 1.0 fish per 100 m^2.
  - For Very Dry years, ~ 20,635.7 m^2 at maximum top width in the MRG with 20,635 RGSM, resulting in estimated density of (20,635 fish/20,635.7x100 m2) of approximately 1.1 fish per 100 m^2.
  - Overall average of 32,001 fish in an average river width of 49,202,205 m^2, was 0.7 fish per 100 m^2. = **buffered MVP of ~ 1.0 fish per 100 m^2 to evaluate whether a self-sustaining population was achieved**.

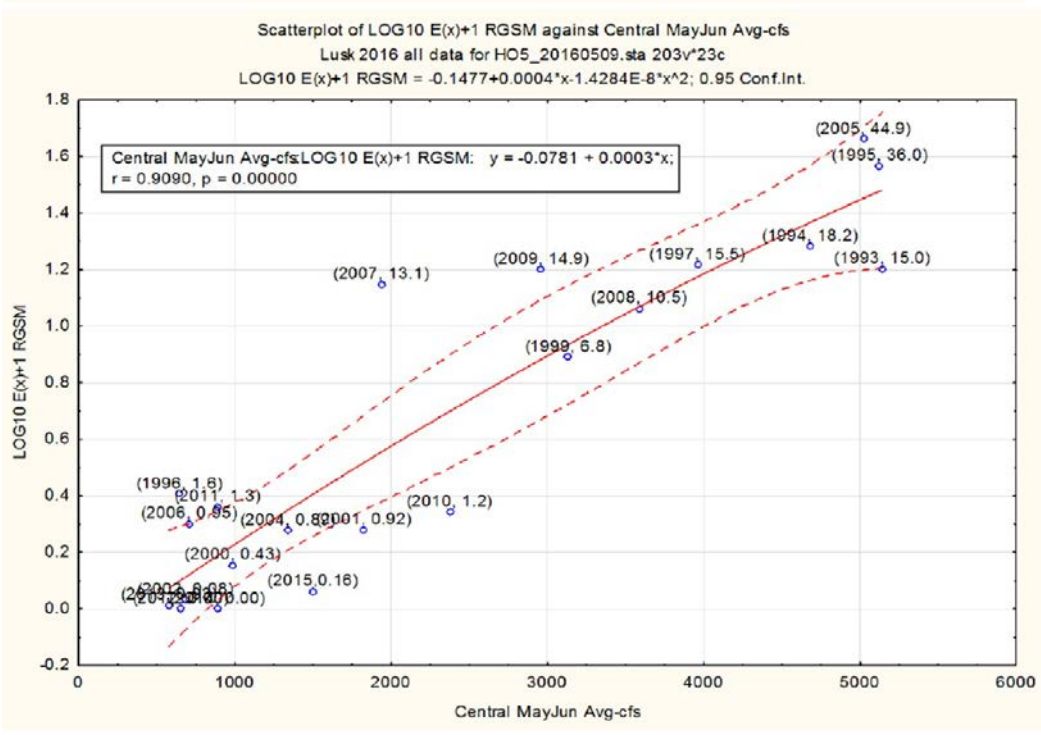
6d – USFWS

Relates total numbers of RGSM to flow. *(being evaluated by Budy and Walsworth (2019)*

Table A3. Relationship between the volume (in acre-feet) crossing the ABQ-Central Gage during May and June and the estimated abundance density of silvery minnows in fall (transformed base 10 logarithms of estimated October silvery minnow abundance densities ((E(x)) ~fish per 100 m^2 + 1)(Dudley et al. 2016).

May and June Runoff Volume (in acre-feet) at ABQ-Central Gage	Y-axis value (log10 E(x) + 1) for silvery minnow abundance model in Figure 1	Estimated silvery minnow abundance in fall using a polynomial model (Estimated October abundance E(x) = fish per 100 m^2+1)	Estimated silvery minnow abundance in fall using a LINEAR model (Estimated October abundance E(x) = fish per 100 m^2+1)
20,000	-0.08	-0.2	-0.1
40,000	-0.02	0.0	0.1
60,000	0.04	0.1	0.2
80,000	0.10	0.3	0.3
100,000	0.17	0.5	0.5
120,000	0.23	0.7	0.7
145,000	0.30	1.0	1.0
165,000	0.36	1.3	1.2
180,000	0.40	1.5	1.4
200,000	0.46	1.9	1.7
220,000	0.51	2.3	2.1
251,500	0.60	3.0	2.7
260,000	0.63	3.2	2.9
280,000	0.68	3.8	3.4
295,000	0.72	4.2	3.8
318,000	0.78	5.0	4.5
332,000	0.82	5.5	5.0
360,000	0.89	6.7	6.0
380,000	0.94	7.7	6.9
400,000	0.99	8.7	7.9
420,000	1.04	9.8	9.0
440,000	1.08	11.1	10.3
460,000	1.13	12.5	11.7
480,000	1.18	14.0	13.3
500,000	1.22	15.7	15.1





7a – Yang

Yang et al. (2018) – Objectives

- Delineate Isleta Reach into six subreaches.
- Use historic flow and sediment discharge.
- Compare RGSM population to peak discharges.
- Analyze geomorphological drivers at a subreach level (sinuosity, width, braiding, bed elevation, bed material, volume change, and hydraulic parameters).
- Create a conceptual geomorphic model to help predict how the river will change in the future
- Analyze how RGSM habitat changes with different flow regimes.
- Analyze habitat quality of RGSM with remote sensing (GIS).



Figure 1: Map of Isleta Reach and location of breaks of subreach.

7b – Yang

- Analyzed amount of “inadequate”, “adequate”, “good”, “feeding/ rearing”, and “spawning” habitat.
- By looking at simulated velocities and depths at range of flows, we have insight into RGSM habitat and how it changes with different flow regimes, spatially, and temporally.
- HEC-RAS is employed to analyze the hydraulic condition at different flow conditions.
- Flows used in HEC-RAS were based on past analyses and practicality; e.g., 25-day exceedance spring runoff peak flow for dry, mean, and wet year are identified by MEI (2006) to be 1400, 3500, and 5600 cfs, respectively.

7c – Yang

Yang et al. (2018)

The classification of habitat for silvery minnow used in this section is based on criteria and descriptions of habitat from Tetra Tech (2014).

Note: these are the criteria developed by Bovee et al. (2008) and also used by Tetra Tech (2014)

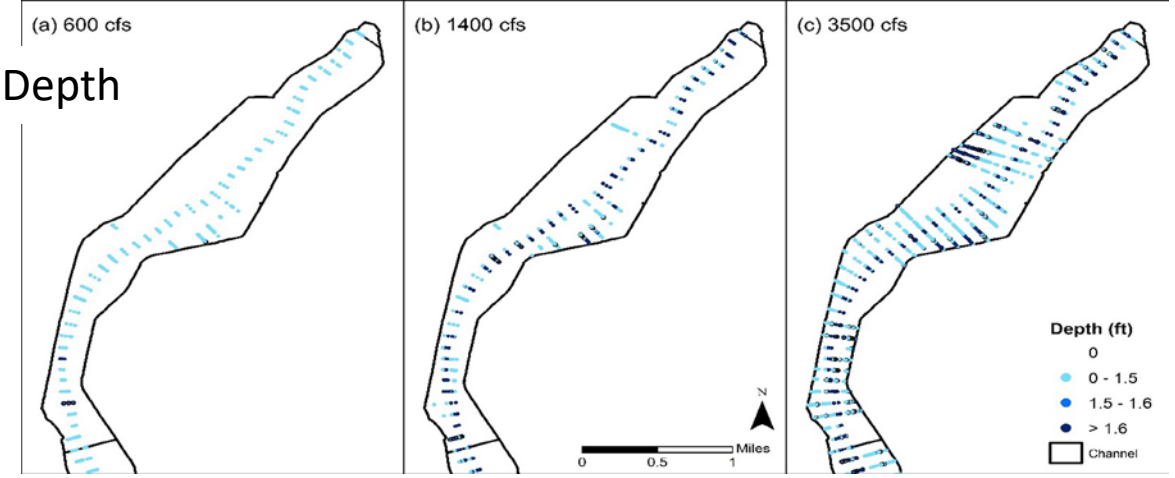
Table 9: Habitat Classification based on flow depth and velocity

Depth (ft)	Velocity (ft/s)			
	0 – 0.05	0.05 – 0.5	0.5 – 1.5	> 1.5
0 - 1.5	Spawning	Feeding/rearing	Good	Inadequate
1.5 – 1.6	Adequate	Adequate	Adequate	Inadequate
>1.6	Inadequate	Inadequate	Inadequate	Inadequate

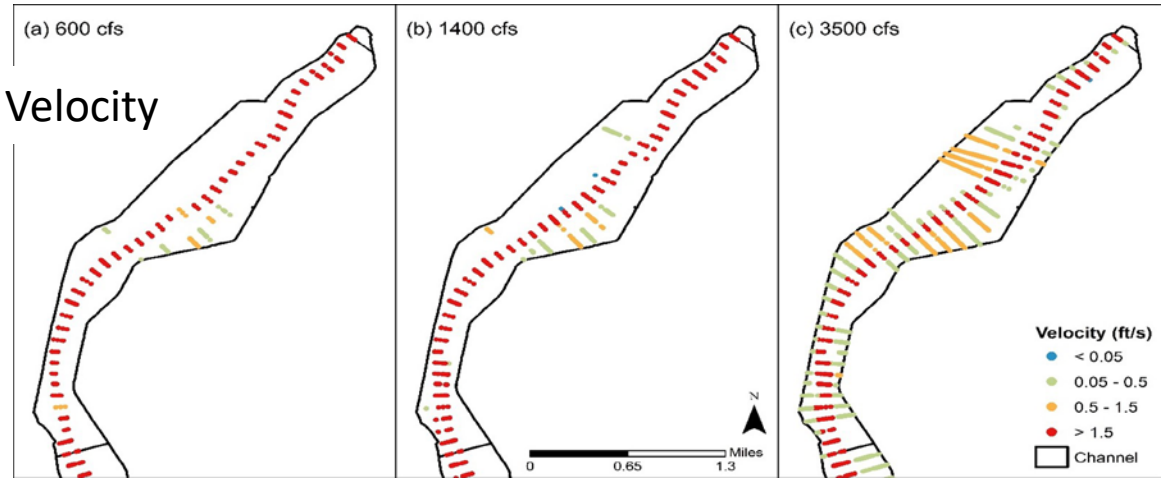
7d – Yang

Simulated depth, velocity, hydraulic habitat determined for 6 subreaches in Isleta Reach, but not related directly to fish abundance.

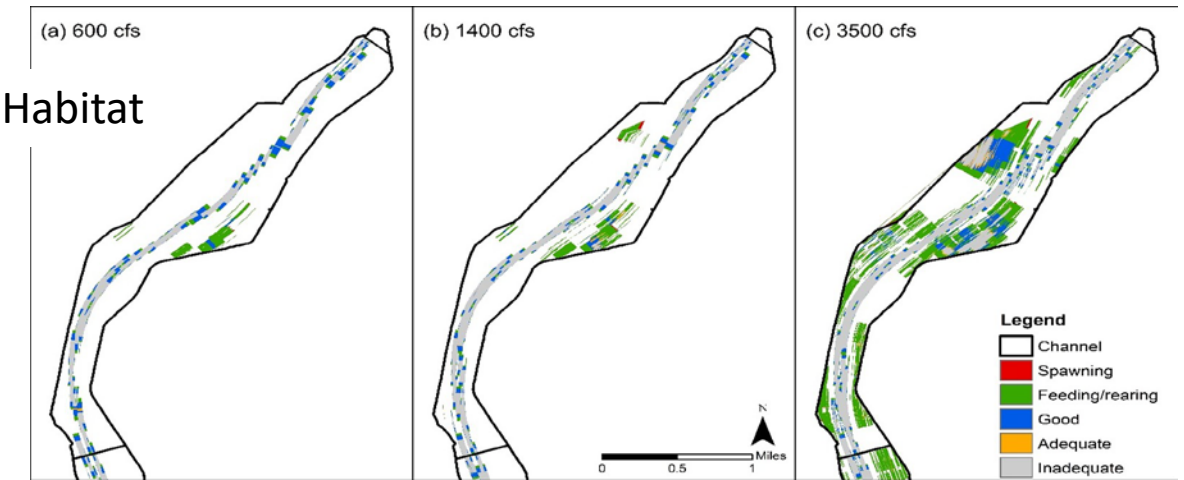
Simulated Depth



Simulated Velocity



Hydraulic Habitat



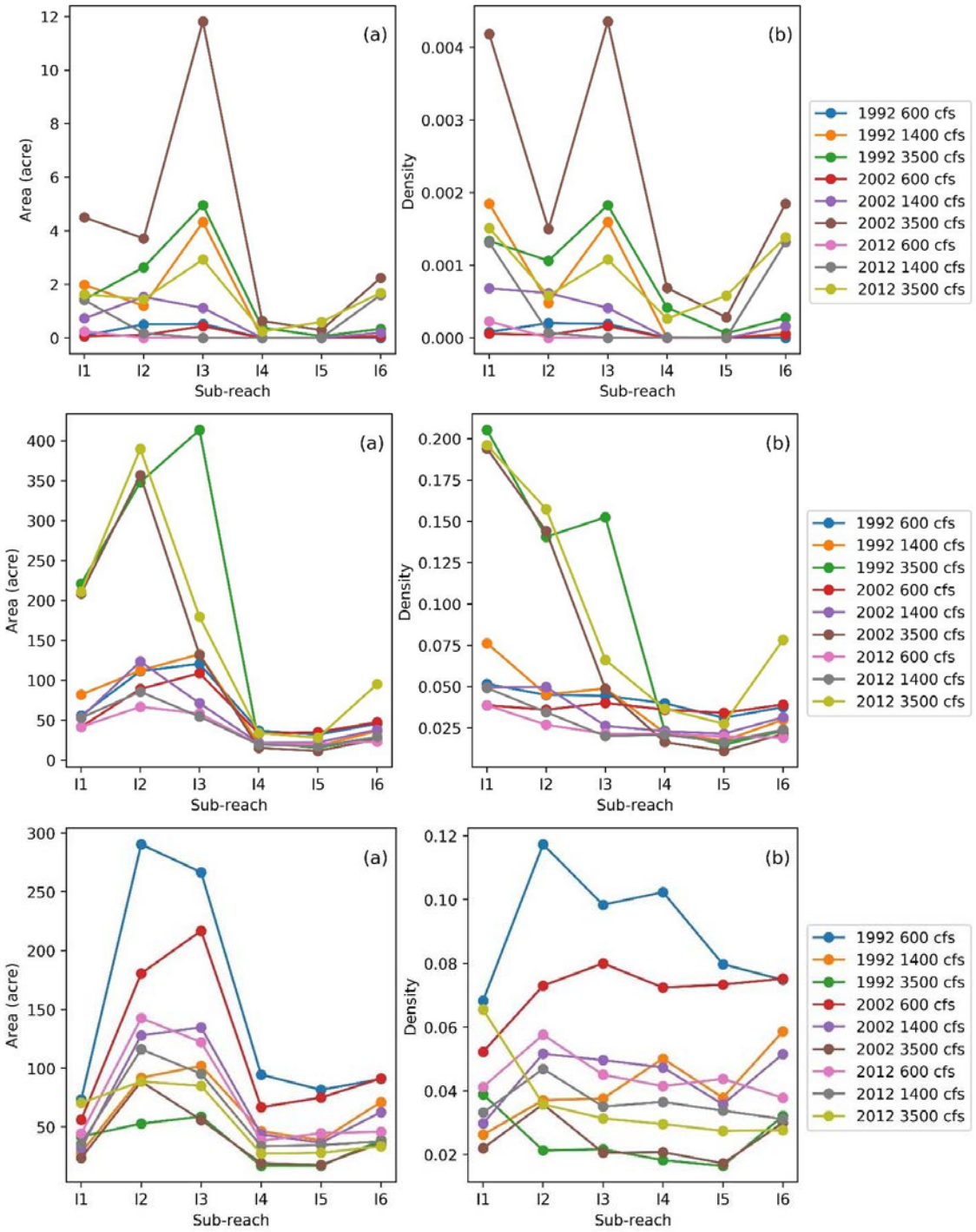
7e – Yang

Spawning Habitat

Spawning, feeding/rearing, and good habitat determined for 6 subreaches in Isleta Reach, but not related directly to fish abundance.

Feeding/Rearing Habitat

“Good” Habitat

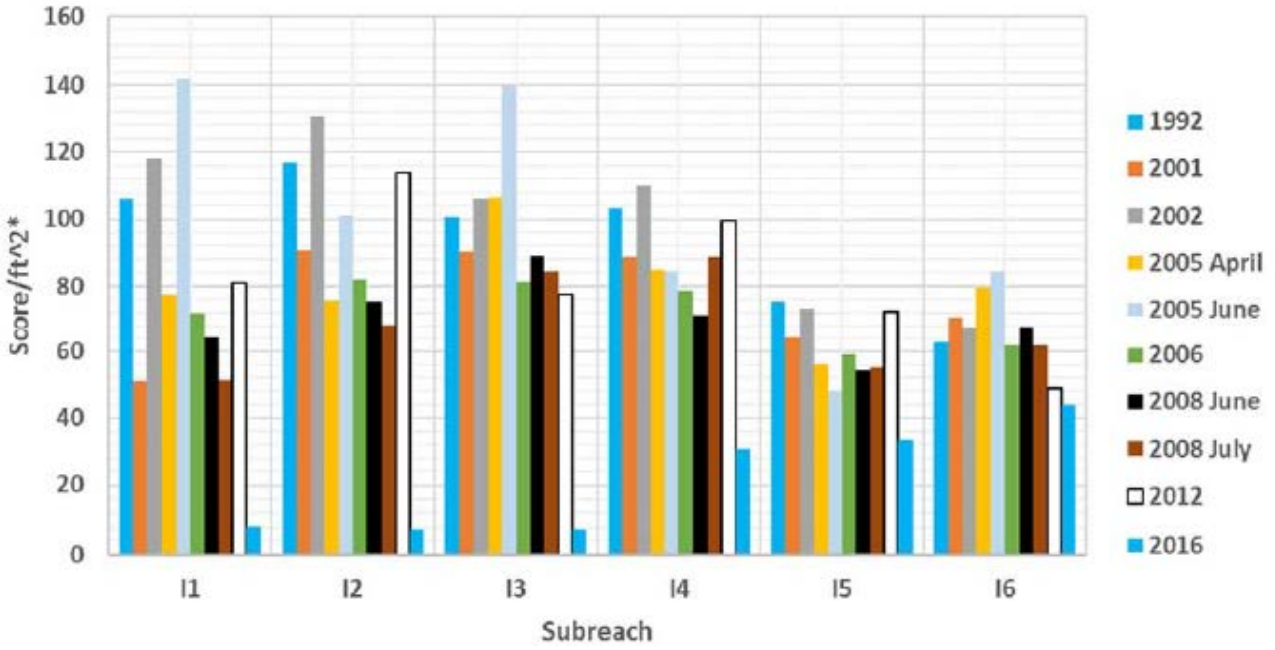


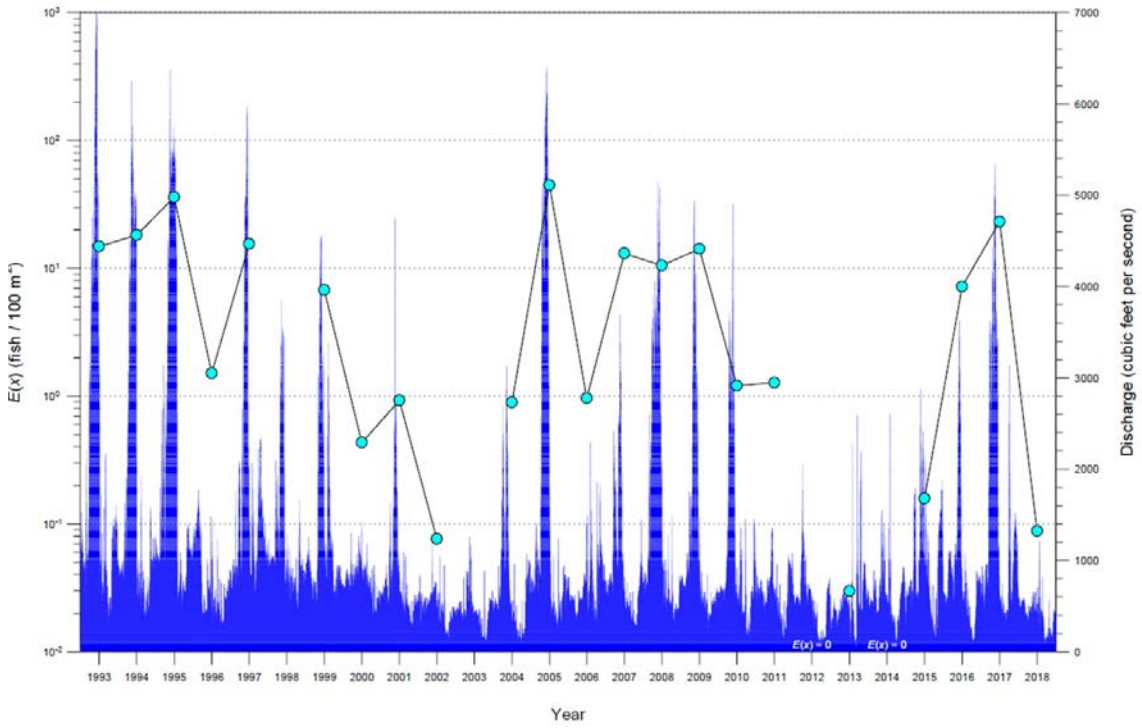
7f – Yang

- "…1992 and 2002 have better habitat than 2006 and 2012. This makes sense because habitat quality for silvery minnows in the Middle Rio Grande has been decreasing over time (Scurlock 1998; Bovee et al. 2008; Tetra Tech 2014)." ***Does not correspond with mean annual CPUE.***

- "When comparing all the years 2002, June and April of 2005, and 1992 consistently have the highest scores. 2006, July of 2008 and 2016 generally have the lowest scores. By subreach, I1-I3 have the highest scores for these years." ***Corresponds with high CPUE in 2005, but not 2002—or with 2008 and 2016 with moderate to high CPUE.***

- "2016 has the lowest score by far because the river is dry for a lot of this reach, so it provides minimal habitat for silvery minnows. June of 2005 has the highest score mostly likely because of its high flow. By looking at the aerial photography, it is evident that the floodplain is inundated." ***Corresponds with 2005 with high CPUE, but not with 2016, which had a moderate CPUE.***





8a – Budy and Walsworth

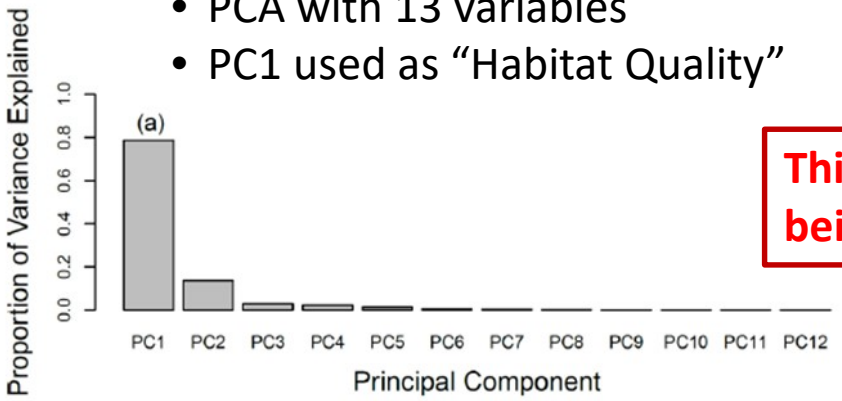
Budy and Walsworth (2019)

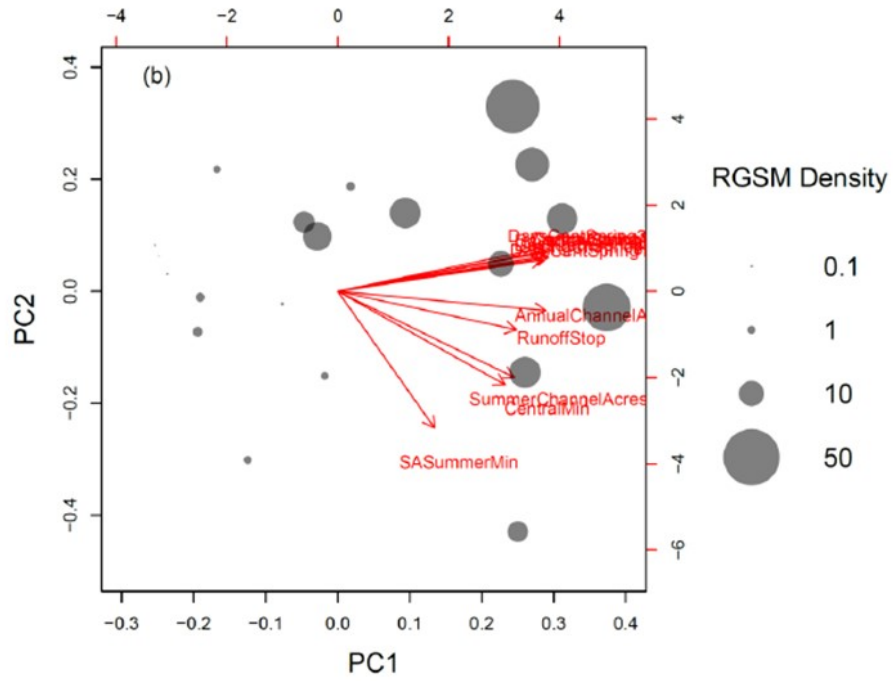
- This review was initiated to support the refinement of analyses and recommendations from the HBO, as new information has continued to be collected and the report and analyses in the Appendix had yet to be externally reviewed.
- The overall goal of this assessment is to review the HBO analyses and associated spreadsheet models to provide recommendations for refining the analyses and identifying data gaps.
- This review comprises the first of three potential phases, where the second phase may involve refining the models used to assess the impacts of hydrology on RGSM, and the third phase may involve providing tools for adaptive management.

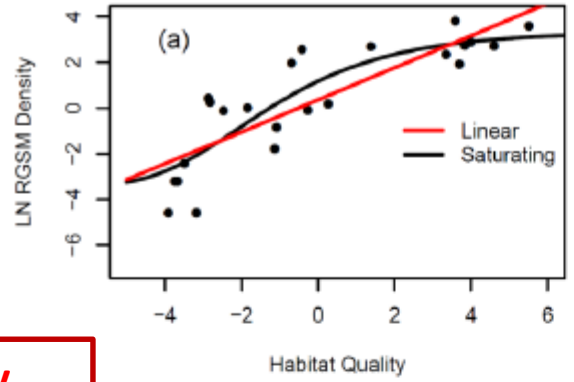
8b – Budy and Walsworth

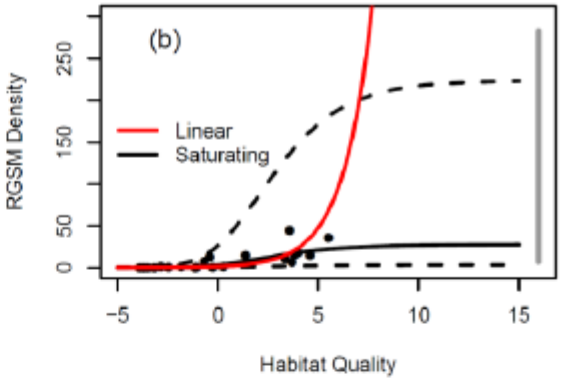
- PCA with 13 variables
- PC1 used as “Habitat Quality”

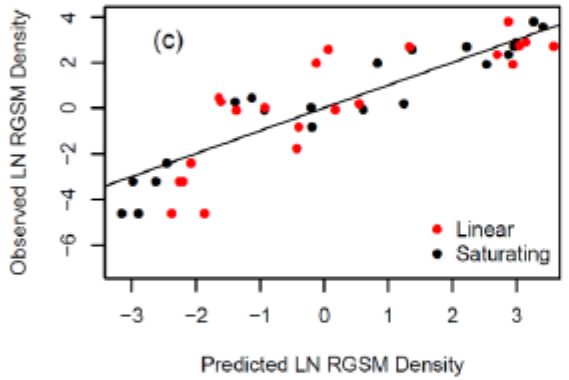
This analysis is currently being conducted.

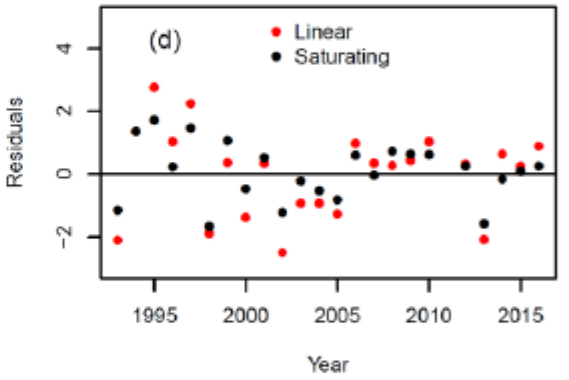


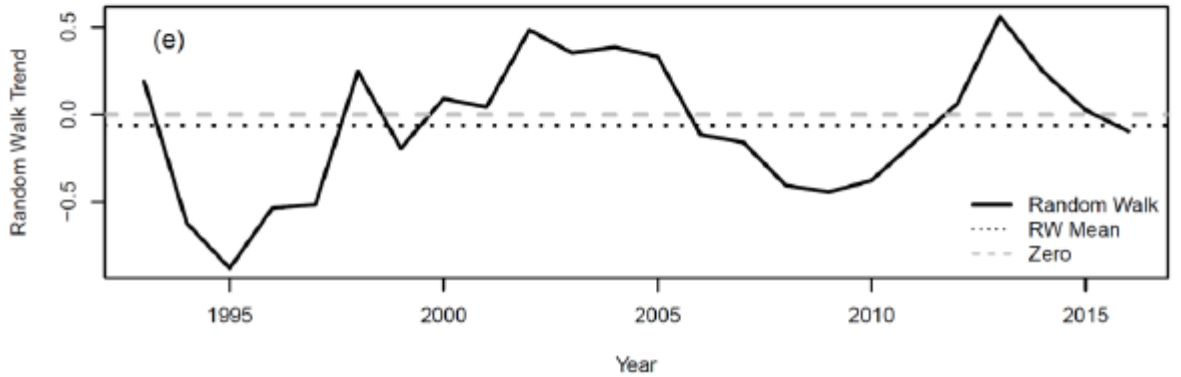




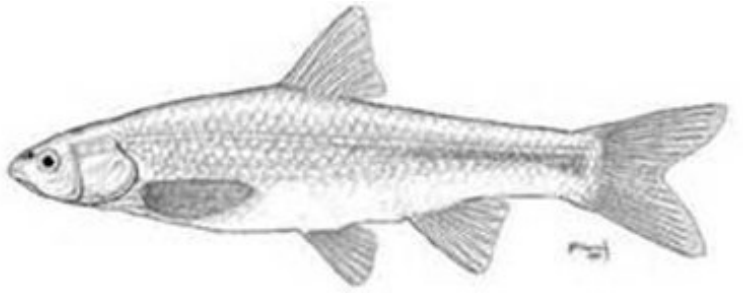








Findings



- No study provides a direct relationship between flow, habitat, and RGSM total numbers.
- One study provides a direct relationship between flow and RGSM total numbers, derived from CPUE to flow relationships.
- 4 of 8 studies provide direct relationship of habitat to flow (RGSM abundance is inferred by habitat area and quality).
- 4 of 8 studies utilize the RGSM Habitat Criteria (depth, velocity) developed by Bovee et al. (2008) using a consensus Delphi process.

Preliminary –Revised

Overview of Flow, Habitat, and RGSM Abundance

Rich Valdez

Population Monitoring Workgroup Meeting

Albuquerque, NM

November 6, 2019

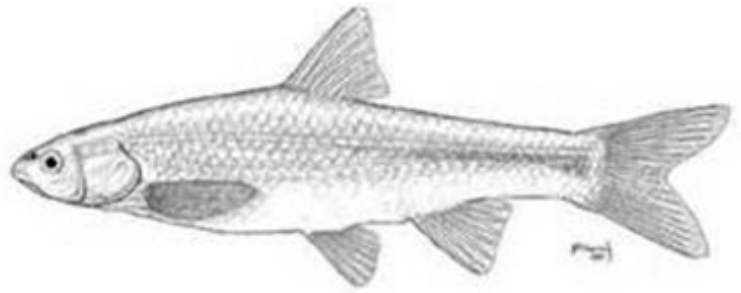
The Issue:

The abundance parameter is vital to an integrated model.

There is a need to quantify total RGSM abundance as related to habitat and flow

- Abundance is defined as total number of individuals in the population (not CPUE)

Purpose for this Overview



- To assimilate and review relevant literature.
- To initiate a conversation of the PMWG.
- To reconcile the relationship of flow, habitat, and RGSM abundance.

Key Documents—Flow, Habitat, and RGSM Abundance

1. Remshardt, W.J., and P.L. Tashjian. 2003. Habitat preference of Rio Grande silvery minnow in relation to fluvial geomorphology, and flow regime, Middle Rio Grande Valley, New Mexico. Interim Report for Funding Year 2003. U.S. Fish and Wildlife Service, Albuquerque, NM.

2. Bovee, K.D., T.J. Waddle, and J.M. Spears. 2008. Streamflow and endangered species habitat in the lower Isleta reach of the Middle Rio Grande. US Geological Survey, Open-File Report 2008-1323.

3. Stone, M.C. 2008. Physical habitat model for the Rio Grande silvery minnow. World Environmental and Water Resources Congress 2008: Ahupua'a. American Society of Civil Engineers.

4. Dudley, R.K., G.C. White, S.P. Platania, and D.A. Helfrich. 2011, 2012. Rio Grande silvery minnow population estimation program results from October 2010 (2011). Final Report. American Southwest Ichthyological Researchers, L.L.C., Albuquerque, NM.

5. Miller, P.S. 2012. A RAMAS-Based Population Viability Model for the Rio Grande silvery minnow (*Hybognathus amarus*). Final Report, Middle Rio Grande Endangered Species Act Collaborative Program, Conservation Breeding Specialist Group (SSC/IUCN), Apple Valley, MN.

6. Tetra Tech, Inc. 2014. Ecohydrological relationships along the Middle Rio Grande of New Mexico for the endangered Rio Grande silvery minnow. Final Report, Contract WP912PP-08-D-0009-0-20, Task Order 20, Task 5. U.S. Army Corps of Engineers, Albuquerque District, Albuquerque, NM.

7. Braun, C.L., D.K. Pearson, M.D. Porter, and J.B. Moring. 2015. Physical characteristics and fish assemblage composition at site and mesohabitat scales over a range of streamflows in the Middle Rio Grande, New Mexico, Winter 2011–12, Summer 2012. U.S. Geological Survey, Investigations Report 2015–5025. U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service, Albuquerque, NM.

8. U.S. Fish and Wildlife Service. 2016. Appendix A: Analytical framework for evaluating the proposed water management and maintenance actions on Rio Grande silvery minnow, southwestern willow flycatcher, and yellow-billed cuckoo and their critical habitats. Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico, Consultation Number 02ENNM00-2013-F-0033, U.S. Fish and Wildlife Service, Albuquerque, NM.

9. Harris, A., J. Bachus, E. Gonzales, and N. Holste. 2018. 2-D Hydraulic modeling to visualize aquatic fishery habitat (Rio Grande Silvery Minnow) with a suitability index. U.S. Bureau of Reclamation, Albuquerque Area Office, Technical Services Division, Albuquerque, NM.

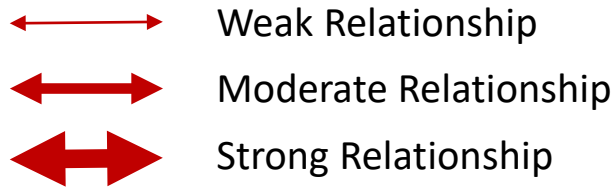
10. Yang, Y., K. LaForge, and P. Julien. 2018. Middle Rio Grande—Isleta Reach: Isleta Diversion Dam to Rio Puerco, hydraulic modeling and silvery minnow habitat analysis, 1918-2016. Draft Report, August 2018, Prepared for: U.S. Bureau of Reclamation, Colorado State University, Engineering Research Center, Department of Civil Engineering, Fort Collins, CO.

11. Budy, P., and T.E. Walsworth. 2019. Review of the "Analytical framework for evaluating the proposed water management and maintenance actions on Rio Grande silvery minnow, southwestern willow flycatcher, and yellow-billed cuckoo and their critical habitats" with recommendations for future analytical considerations. USGS Cooperative Fish and Wildlife Research Unit, Utah State University, Logan, UT.

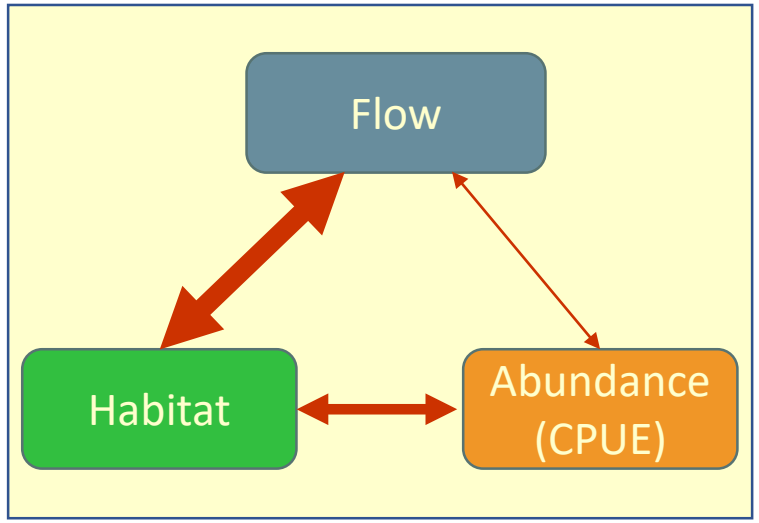
Source	Purpose	Sites	Tools (models)	Parameters	Results	Conclusion
1.Remshardt and Tashjian (2003)	Describe habitat use and investigate variation related to fluvial geomorphology and flow	10 (Bernalillo to BDA)	Cross sections at low (< 100 cfs), mid (100-750 cfs) high (750-4000 cfs); FLO 2D (Tetra Tech 2004); concurrent fish seining	Depth, velocity, mesohabitat from cs and seines; similar to 1-D PHABSIM	Flow vs shoreline complexity, preferred habitat, channel width	Best habitat in Sevilleta and Socorro reaches; second in Isleta reach; poorest in Albuquerque reach
2. Bovee et al. (2008)	Quantify changes in low flow habitat features from ~150 cfs into "Bernardo Siphon" near SADD	3 (10-mile reach between Lower San Juan Riverside Drain and SADD)	2-D PHABSIM	Depth, velocity in 2-D; large woody debris; parameters from **Delphi with expert panel**	Weighted Useable Area (WUA) for YOY, adult	Diversions to Bernardo siphon resulted in substantial increases to suitable habitat for both life stages (YOY, adult)
3. Stone, M.C. (2008)	Develop a habitat evaluation model to evaluate habitat suitability under unsteady flow conditions, near Albuquerque	1 (3-km reach from Alameda Boulevard bridge to Paseo Del Norte bridge)	CCHE2D hydrodynamic and sediment transport model (National Center for Computational Hydroscience and Engineering, Univ. of Mississippi)	Depth, velocity, mesohabitat from "Habitat Use of the Rio Grande Silvery Minnow" (Dudley and Platania, 1997)	Velocity and habitat suitability (HIS) for low and high flows; emphasize availability and fragmentation of overbank habitats	Flows less than bankfull, high quality habitat in regions with low velocity and high complexity (wakes of sandbars and in backwaters); overall habitat quality reduced as flow increased towards bankfull; above bankfull, high quality habitat shifted to the floodplains
4. Tetra Tech (2014)	Develop reach-wide baseline evaluation of habitat availability and quality to determine state of system along the San Acacia Reach	5 (Bernalillo to San Marcial)	Flow from URGWOPS; depth and velocity from RMA2 hydrodynamic model; Thiessen polygons in ArcGIS 10.1 (ESRI 2013); floodplain inundation from a FLO-2D	Depth, velocity of RGSM from **Delphi with expert panel** (Bovee et al. 2008)	Maps with polygons showing (1) most commonly occupied habitat, (2) feeding and rearing habitat, (3) spawning and egg/larval retention habitat	1,500-2,000 cfs for 7 days (~21,000- 28,000 AF) as minimum for producing a successful spring spawn with population recruitment in Albuquerque Reach; maintaining 100 cfs through Isleta reach (~200 AF per day) plus 600 AF for conveyance losses, surface evaporation, total ~800 AF per day
5. Braun et al. (2015)	Evaluate summer and winter physical characteristics and fish assemblage composition of mesohabitats over a range of flows (2011-2012)	15 (Cochiti Dam to Elephant Butte Reservoir)	Mapped polygons from geospatial database	Depth, velocity, substrate, embeddedness on transects; mesohabitat mapped at each site	Depth, velocity by mesohabitat type by site	Highest mean CPUE in isolated pools and lowest in flats, in summer and winter; RGSM occurred in narrowest range of depths (0.30–2.1 ft) during summer 2012, and narrowest range of velocities in both winter 2011–12 (0.0– 3.18 ft/s) and summer 2012
6. Yang et al. (2018)	Better understand link of morphodynamic processes and RGSM habitat	6 subreaches (Isleta Reach)	GIS analysis of aerial photographs (1918-2018); HEC-RAS analyses to show geomorphic changes	Depth, velocity; RGSM habitat criteria from **Delphi with expert panel** (Bovee et al. 2008) and also used by Tetra Tech (2014)	Analyzed amount of "inadequate", "adequate", "good", "feeding/ rearing", and "spawning" habitat	Current channel width less than 1/5 since 1918; slight increase in sinuosity, depth, velocity, and median grain size, while slope has decreased from 1972-2012; decrease in habitat quality due to: (1) a reduction in frequency and magnitude of peak discharges; and (2) channel narrowing and incising causing a loss of connectivity to floodplain
7. Harris et al. (2018)	Evaluate engineering design for pilot realignment of Rio Grande channel through the Bosque del Apache National Wildlife Refuge (BDA)	1 (3-mile reach at BDA where sediment plugs have previously formed)	HEC-RAS 5.0 to perform 2D hydrodynamic routing that produces detailed 2D channel and floodplain analysis (USACE 2016)	Depth, velocity; RGSM habitat criteria from **Delphi with expert panel** (Bovee et al. 2008) and also used by Tetra Tech (2014) and Yang et al. (2018)	(1) Ideal Habitat (meets both target ranges for depth and velocity); (2) Suitable Habitat (within maximum limits for depth and velocity; (3) Unsuitable Habitat (where wetted areas disconnected from river channel)	HSI modeling results demonstrate anticipated improvements to aquatic fish habitat resulting from the BDA Pilot Project

Source	Purpose	Sites	Tools (models)	Parameters	Results	Conclusion
1. Dudley et al. (2011, 2012)	Estimate numbers of RGSM by reach and total in the MRG. Quantify relationship of RGSM CPUE to total numbers	20 (5 Angostura, 6 Isleta, 9 San Acacia reaches)	Used multiple depletion estimator by electrofishing within enclosures by mesohabitat	Mesohabitat capture probability	RGSM population size calculated from Oct Population Estimation and Population Monitoring data by reach and for all reaches combined for 2008-2011	Total Number RGSM all reaches (unmarked, all ages): 2008: 1,108,430 2009: 1,387,948 2010: 267,272 2011: 122,381
2. Miller, P.S. (2012)	Develop a Population Viability Analysis (PVA) to evaluate extinction probability of RGSM under various environmental correlates (e.g., flow)	Based on 20 sites from Dudley et al. (2012)	RAMAS-Metapop (Akçakaya 2005) simulation model	Stock assessment model is Initialized with population size by reach for October 2011 from Dudley et al. (2012)	Probability of quasi-extinction for different correlates; ages 0-3	Elasticity analysis indicates long-term dynamics of RGSM populations is strongly tied to reproductive output (fecundity) of Age 0 fish, i.e., those that survive to their first spawning season. Both egg production and first-year survival of newly-hatched fish are critical elements of this fecundity parameter
3. U.S. Fish and Wildlife Service (2016)	Determine (or affirm) relationships between indices of population abundance estimates and occupancy distribution indices (Dudley et al. 2016) with river discharge and levels or areas of water inundation and associated floodplain	Average top width of MRG (Angostura Dam to RM 60 during low flow (July through October) for Very Wet, Average, Very Dry (Bui 2016)	(1) Hydrobiological analyses based on linear and polynomial relationships (scatterplots) between RGSM CPUE and historical river flows; (2) Number of individuals for genetic and population viability derived from MVP and buffered MVP (U.S. Fish and Wildlife Service 2002)	(1) Genetic effective size (Ne) used to compute MVP as minimum size for genetic viability; and (2) buffered MVP as minimum size for population viability	(1) MVP = 16,667 / 49,202.4 x 100m^2) = 0.3 fish per 100 m^2 (lowest density to protect against genetic inbreeding); (2) Average Year buffered MVP = 32,001/ 49,202,205 m^2 = 0.7 fish per 100 m^2. (~ 1.0) for self-sustaining population	MVP (0.3) and Buffered MVP (1.0) used as criteria for Incidental Take Statement of 2016 BiOp
4. Budy and Walsworth (2019)	Review HBO analyses and associated spreadsheet models (USFWS 2016) to provide recommendations for refining the analyses and identifying data gaps	N/A	PCA with 13 variables; PC1 used as “Habitat Quality”	13 flow variables	Analyses ongoing	Analyses ongoing

Summary of Key Documents Principal Variables:

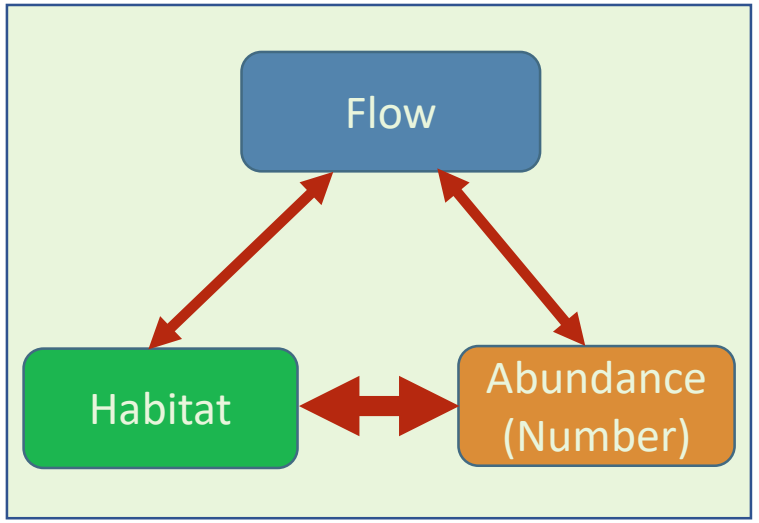


Strong Relationship: Flow to Habitat



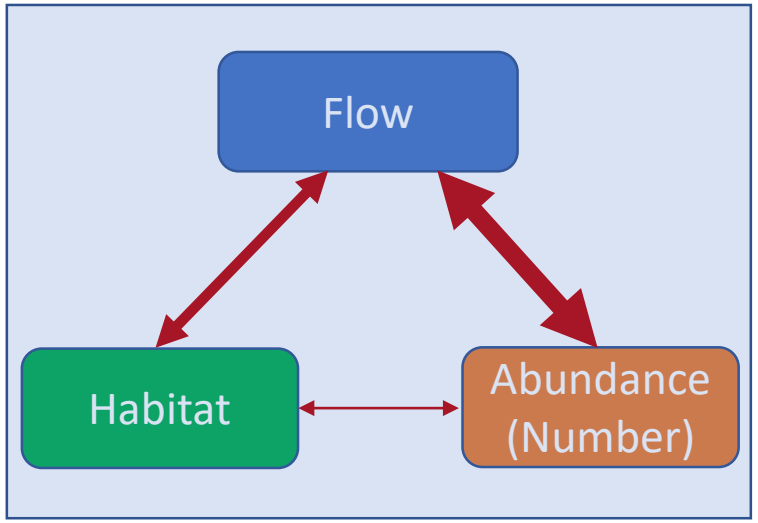
- Remshardt and Tashjian (2003)
- Bovee et al. (2008)
- Tetra Tech (2014)
- Braun et al. (2015)
- Harris et al. (2018)
- Yang et al. (2018)

Strong Relationship: Habitat to Abundance



- Dudley et al. (2011, 2012)
- Miller (2012)

Strong Relationship: Flow to Abundance



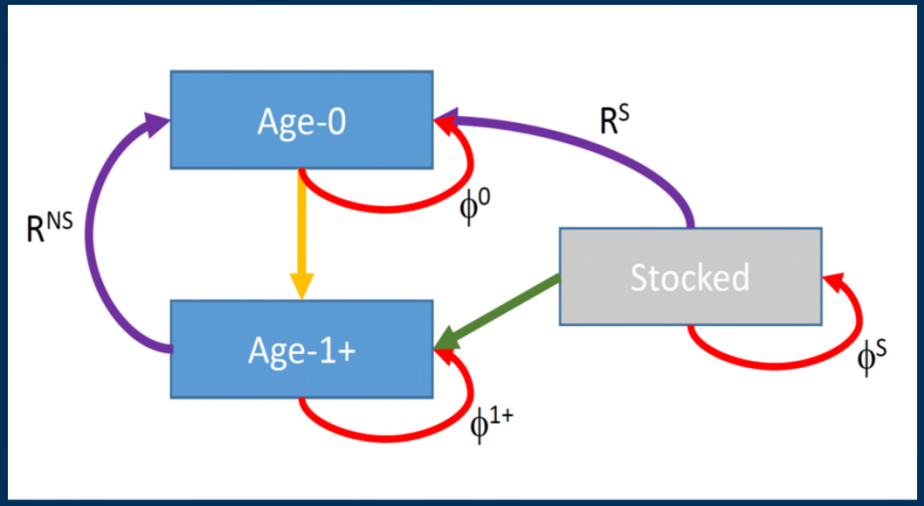
- USFWS (2016)
- Budy and Walsworth (2019)

USGS
science for a changing world



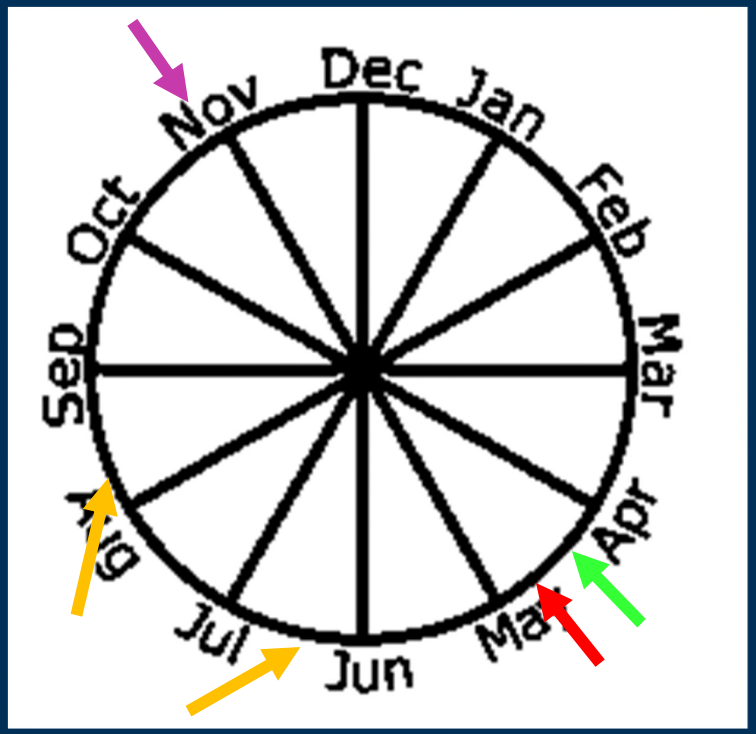
Steps towards an integrated population modelling of Rio Grande Silvery Minnow

Charles B. Yackulic, *U.S. Geological Survey*
email: cyackulic@usgs.gov



U.S. Department of the Interior
U.S. Geological Survey

Timing of life history and other key events



Spring runoff, floodplain inundation

Spawning

Peak irrigation, drying, salvage.

Augmentation

USGS

Questions/assumptions

- Fecundity in wild?
- cpe to N?
- what role for variation in survival? (especially drying or increased water temperature)
- fate of augmented and salvaged fish?

USGS

Spatial questions

- How much do fish move? (to what degree are diversions barriers?)
- How much do stocked fish move? (difficult to interpret stocked fish data without this info)
- How much of reproduction is local vs. from upstream?

USGS

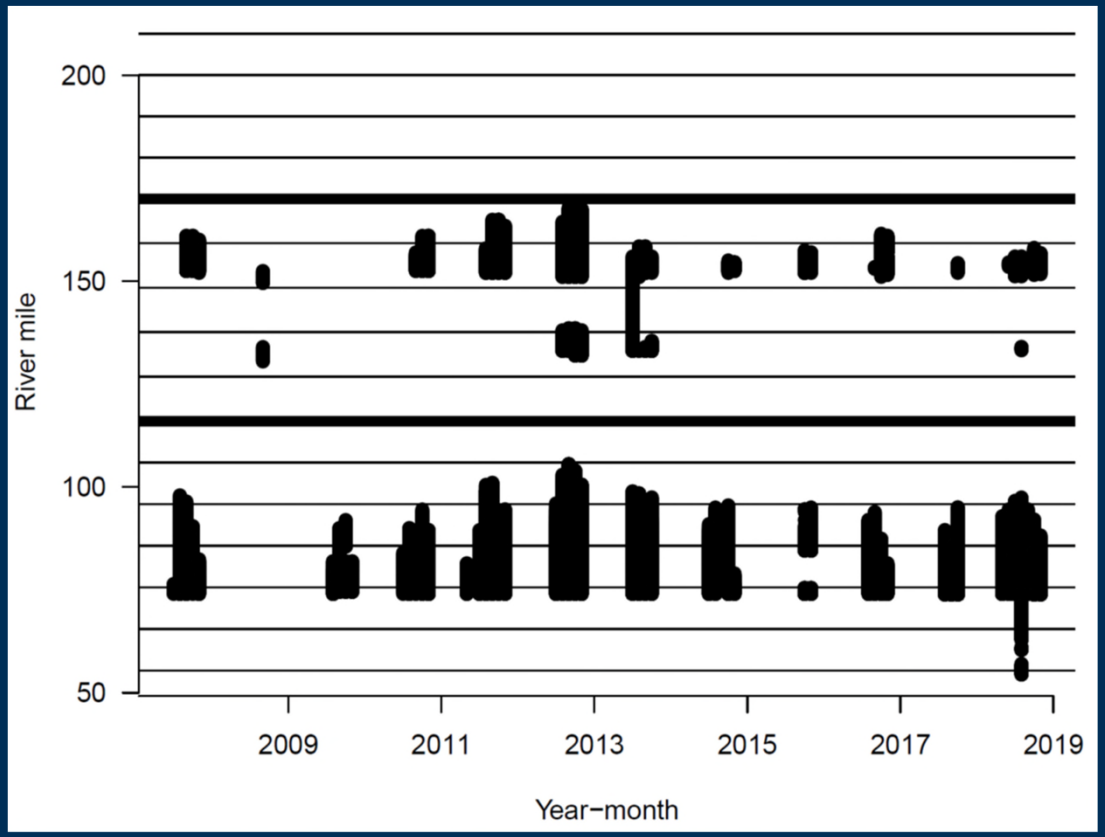
Data

- Abundance estimates from 4 years.
- Pop. monitoring data from 1993-2018
- Some habitat data
- Discharge
- Augmented (hatchery reared) & marked fish

USGS

Other data

- Salvage
- Repeat surveys
- Drying data



USGS

Catch per area seined

Pro's

- Great time series (27 years)
- Good temporal coverage within years (6+ months in most years)
- Decent spatial coverage
- Reasonably standardized

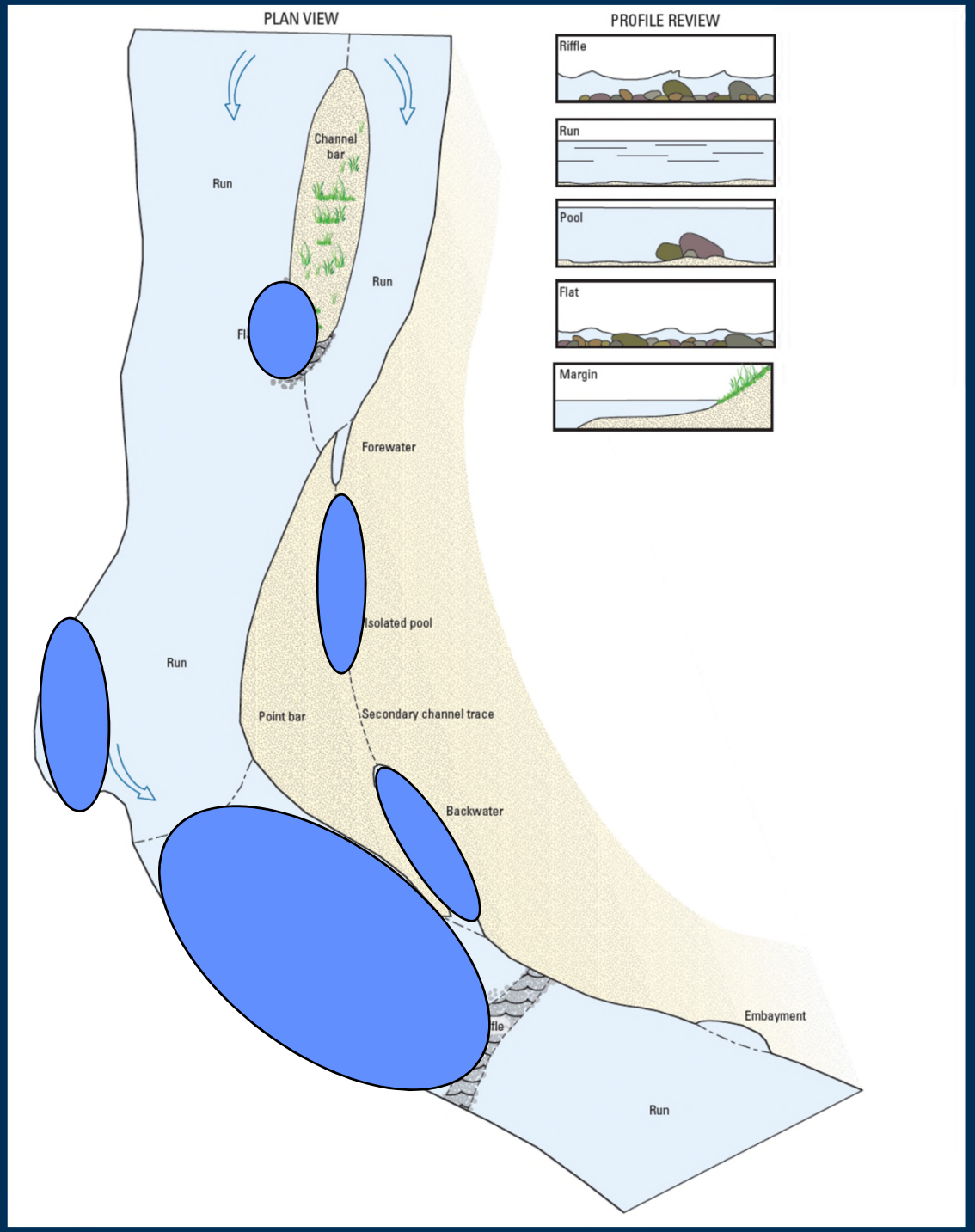
Con's

- Meso-habitat variability
- Unknown total area
- No estimate of sampling uncertainty
  - Relative abundance
  - Density dependence
- Some concerns about catchability of age 1+ fish

USGS

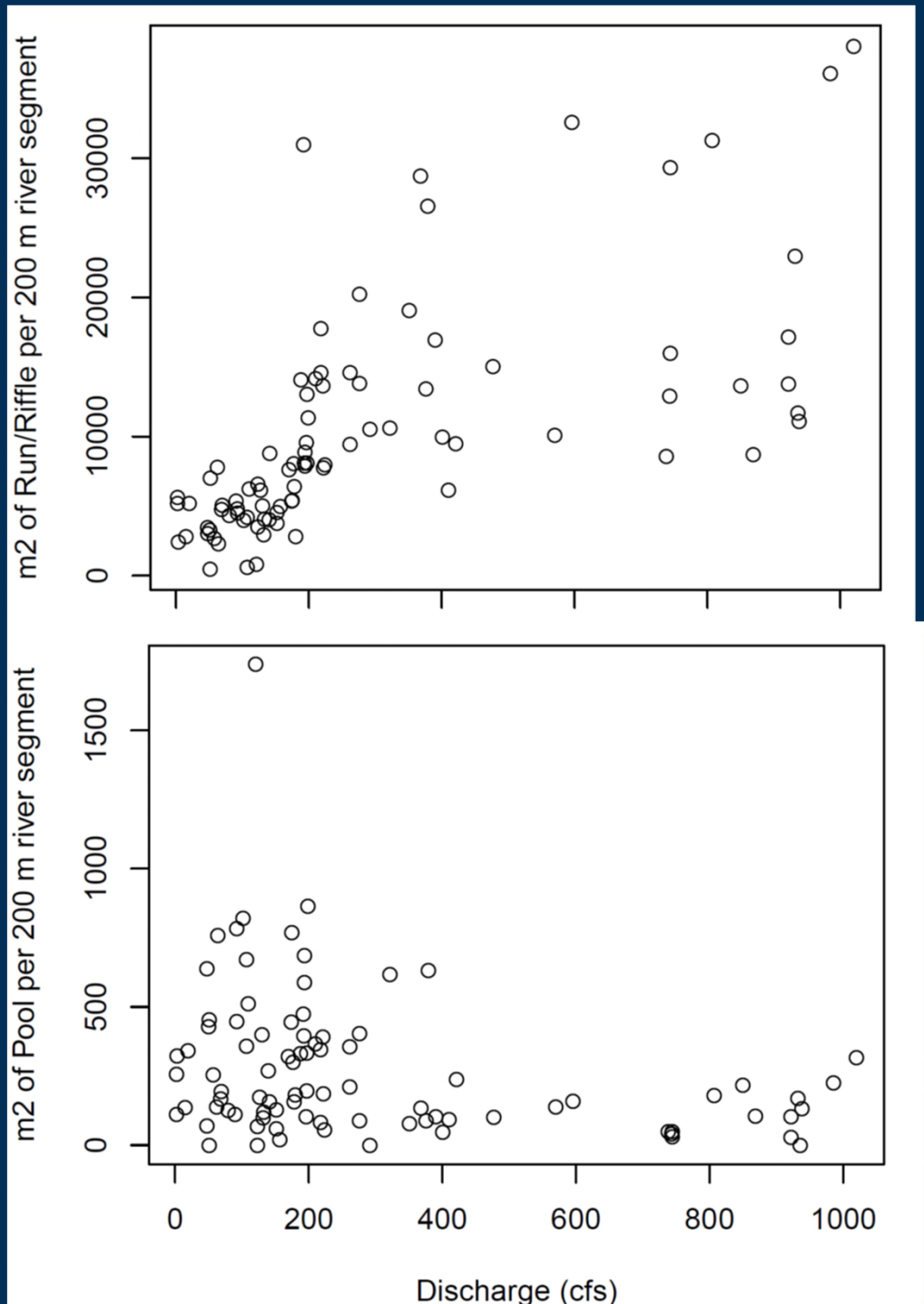
Mesohabitat

- Pool
  - ~4x catch rate of age-0
  - ~3x catch rate of age-1
  - Declining with season for both
- ~25% of samples taken in pool type habitats



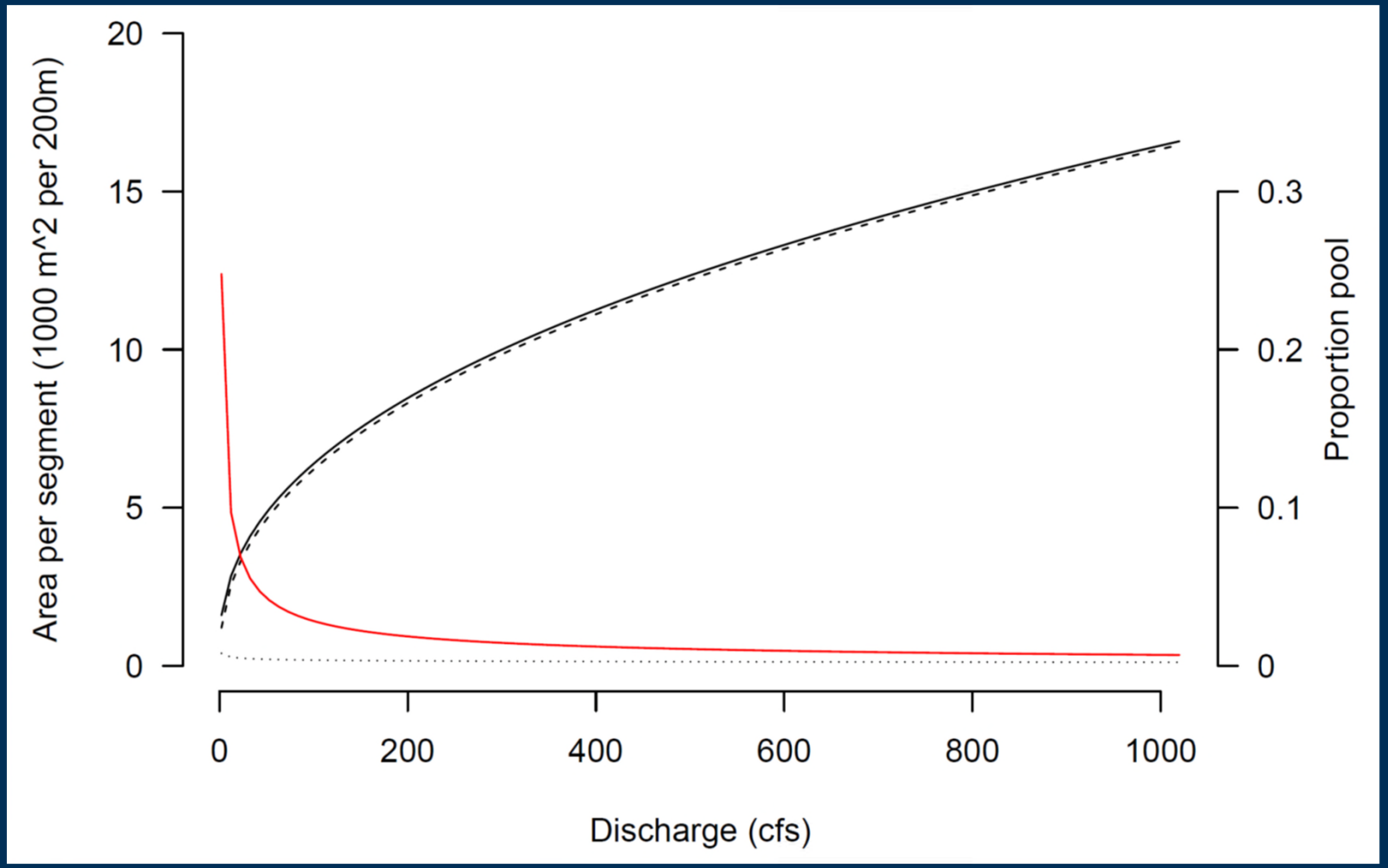
Strata area

- For a stratified random design need to know strata area.



USGS

Strata area



USGS

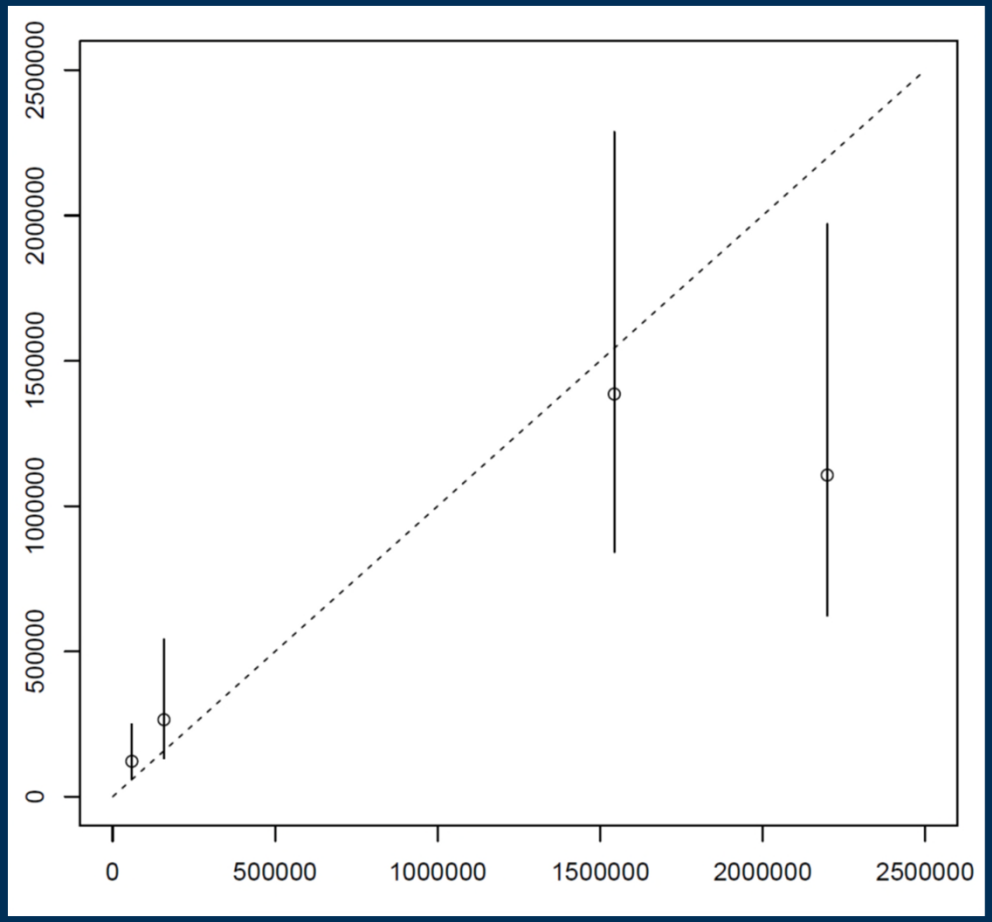
Some relatively straightforward analyses

- Cpe to N
- Fecundity
- Sampling uncertainty

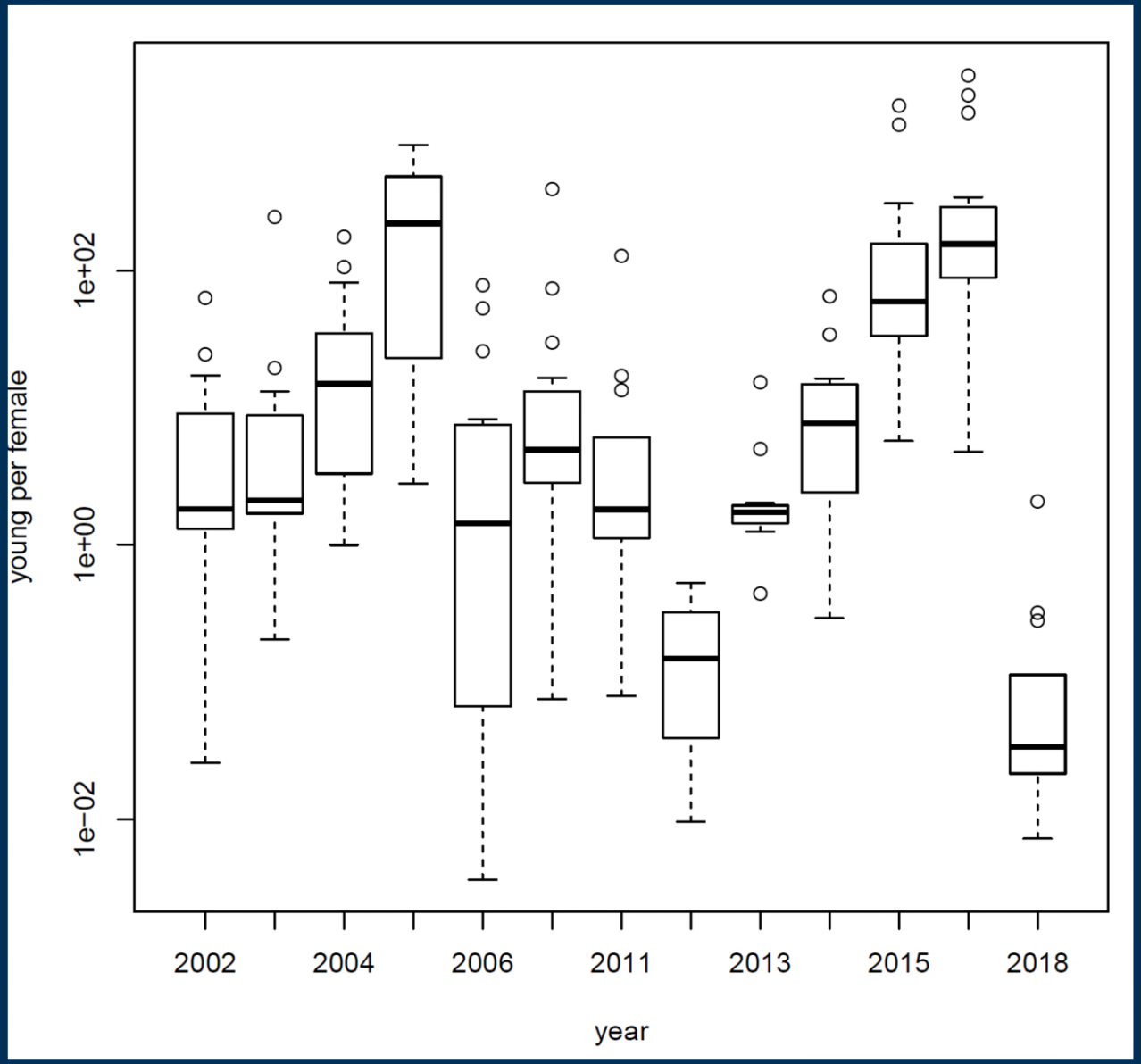
USGS

Cpe to N

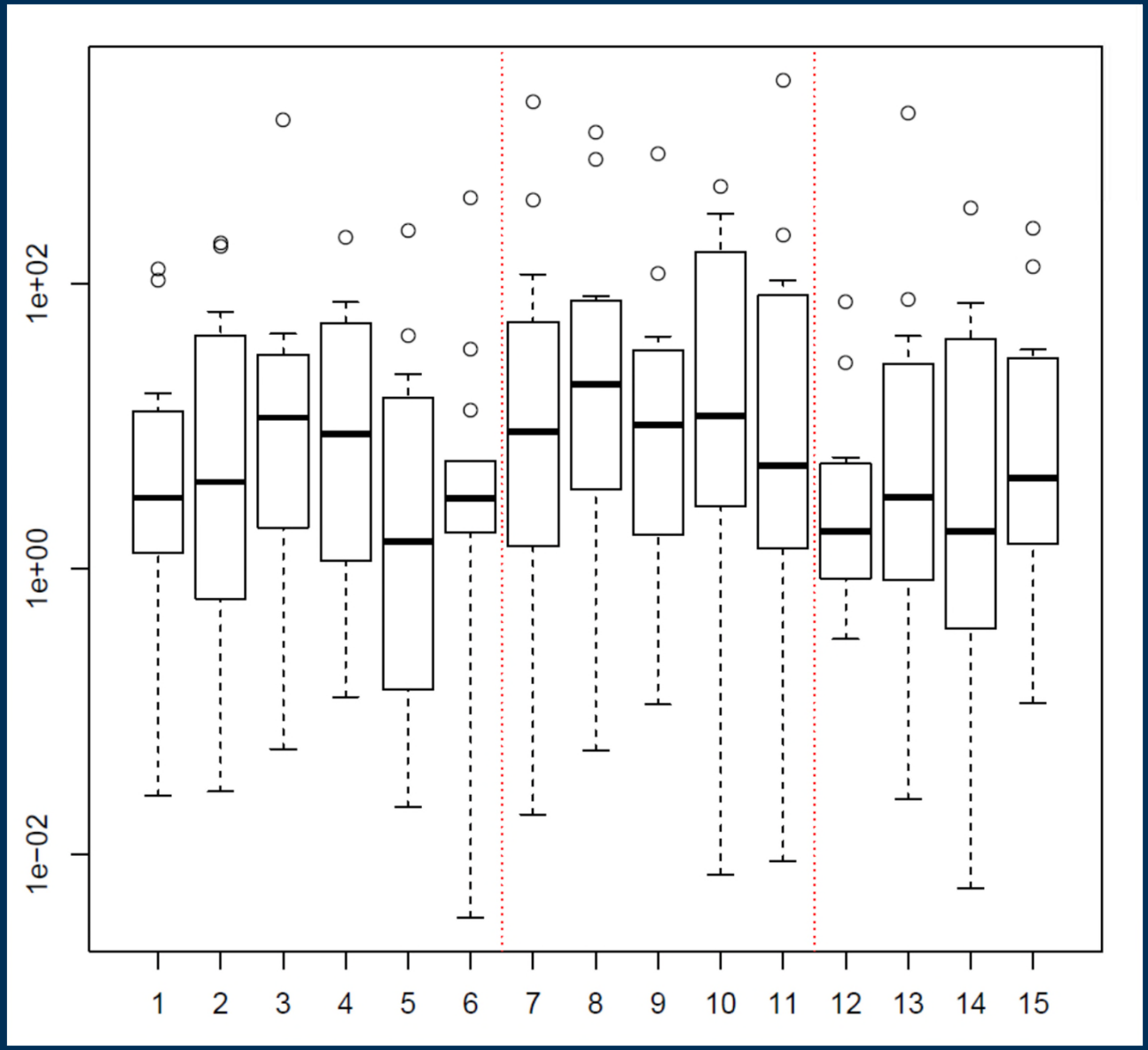
- $n = N / 1170$
- $n = n_p + n_r$
- $n_p = A_p d_p$
- $n_r = A_r d_r$
- $pd_p = \frac{C_p}{e_p}$
- $pd_r = \frac{C_r}{e_r}$
- $n = \frac{A_p \frac{C_p}{e_p} + A_r \frac{C_r}{e_r}}{p}$



USGS

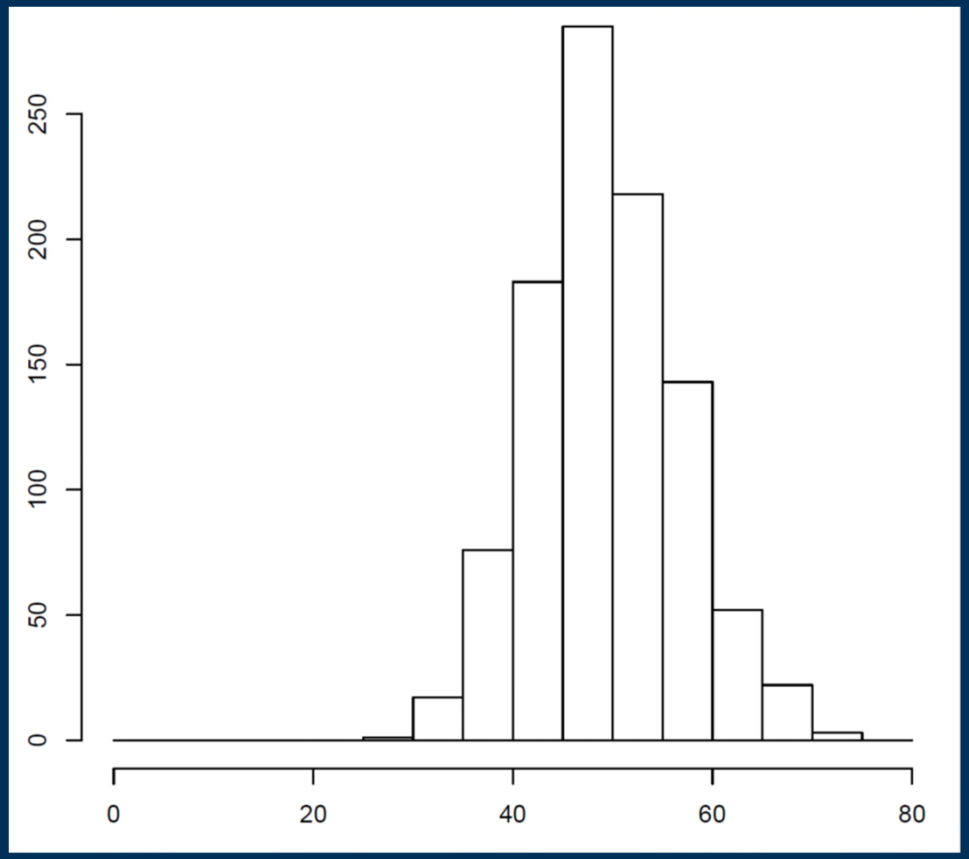

young per female
1e−02
1e+00
1e+02
2002
2004
2006
2011
2013
2015
2018
year

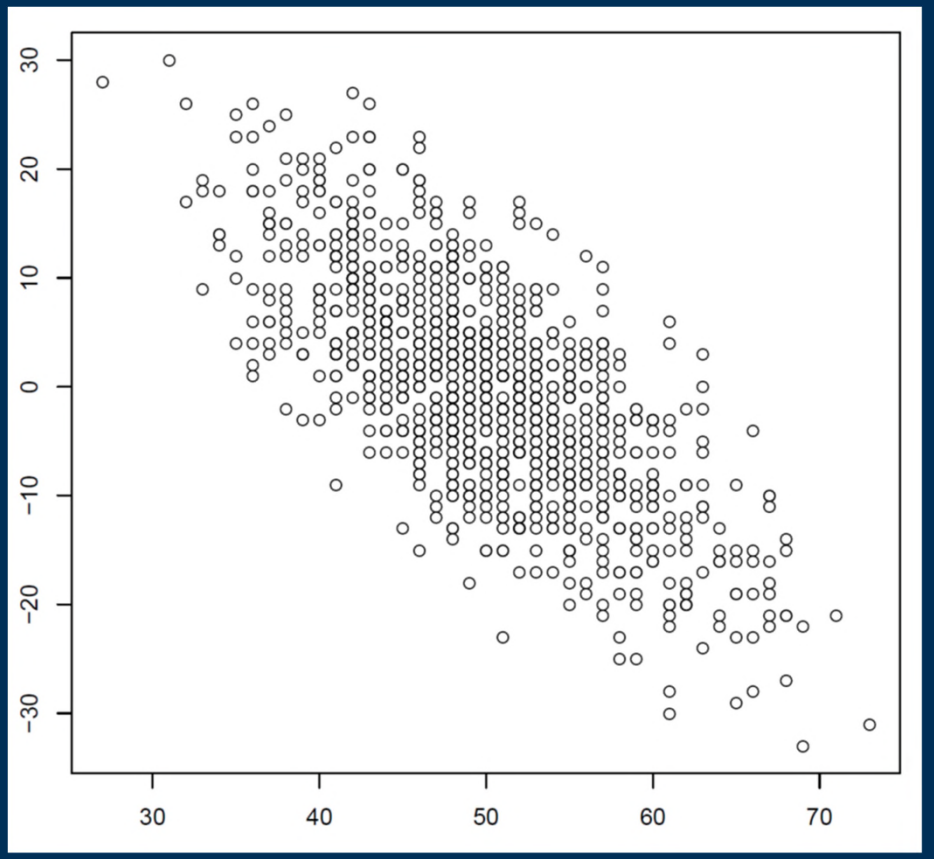
USGS



USGS

Sampling uncertainty and density dependence





USGS

Questions/assumptions

- Fecundity in wild?
- cpe to N?
- what role for variation in survival? (especially drying or increased water temperature)
- fate of augmented and salvaged fish?

USGS

Spatial questions

- How much do fish move? (to what degree are diversions barriers?)
- How much do stocked fish move? (difficult to interpret stocked fish data without this info)
- How much of reproduction is local vs. from upstream?

USGS

Rio Grande Silvery Minnow Model Survey

The Middle Rio Grande Endangered Species Collaborative Program's Population Monitoring Workgroup (PMW) began developing an integrated stock assessment model for the Rio Grande silvery minnow (RGSM) in 2018. This model will integrate environmental and species-specific information and data to assess the status of the RGSM population in the Middle Rio Grande, and ultimately make predictions about how the population may respond to current and future management options. Species-specific information will include RGSM vital rate information, such as growth, survival, and reproductive capabilities of RGSM at various ages.

To complete this model, the Albuquerque Bernalillo County Water Utility Authority and New Mexico Interstate Stream Commission contracted Dr. Charles Yackulic of the Southwest Biological Science Center of the U.S. Geological Survey through the 2019 and 2020 fiscal years. The PMW has been and will continue to work closely with Dr. Yackulic in the development and evaluation of the integrated stock assessment model. To assist in model development, PMW is soliciting feedback from stakeholders regarding the types of management questions that you would like us to consider, such as:

1. What does a self-sustaining population of silvery minnows look like in the Middle Rio Grande according to this population model? How many individuals, sexes, and ages does the model predict are most likely present in the different reaches by season?
2. How does this modeled population respond to different types of water management actions? What is the expected measurable effect of intermittency, river drying, spring flow augmentation, or habitat restoration efforts on the modeled population?

Please provide us with your feedback in the space provided below. All input will be consolidated for consideration by the PMW and Dr. Yackulic during model development and testing. Additionally, we anticipate a future interactive modeling workshop with interested parties and Dr. Yackulic. Please help us schedule this workshop by selecting which time frames work best for you (final question).

1. Email Address

2. Please detail the management questions you would like to be considered:

3. When should we consider holding a modeling workshop? Please select all time frames that work for you.

   _____Between January 13th and January 24th

   _____Between January 27th and February 7th

   _____Between February 10th and February 21st

Rio Grande Silvery Minnow Sampling Methods

Population Monitoring (PM) & Population Estimation (PE)



Robert K. Dudley[1,2], Steven P. Platania[1,2], and Gary C. White[1,3]

[1] American Southwest Ichthyological Researchers (ASIR); 800 Encino Place NE, Albuquerque, NM, 87102
[2] Museum of Southwestern Biology (Fishes), UNM; MSC03-2020, Albuquerque, NM, 87131
[3] Dept. of Fish, Wildlife, and Conservation Biology, CSU; 10 Wagar, Fort Collins, CO, 80523

Native Distribution
(*Hybognathus amarus*)



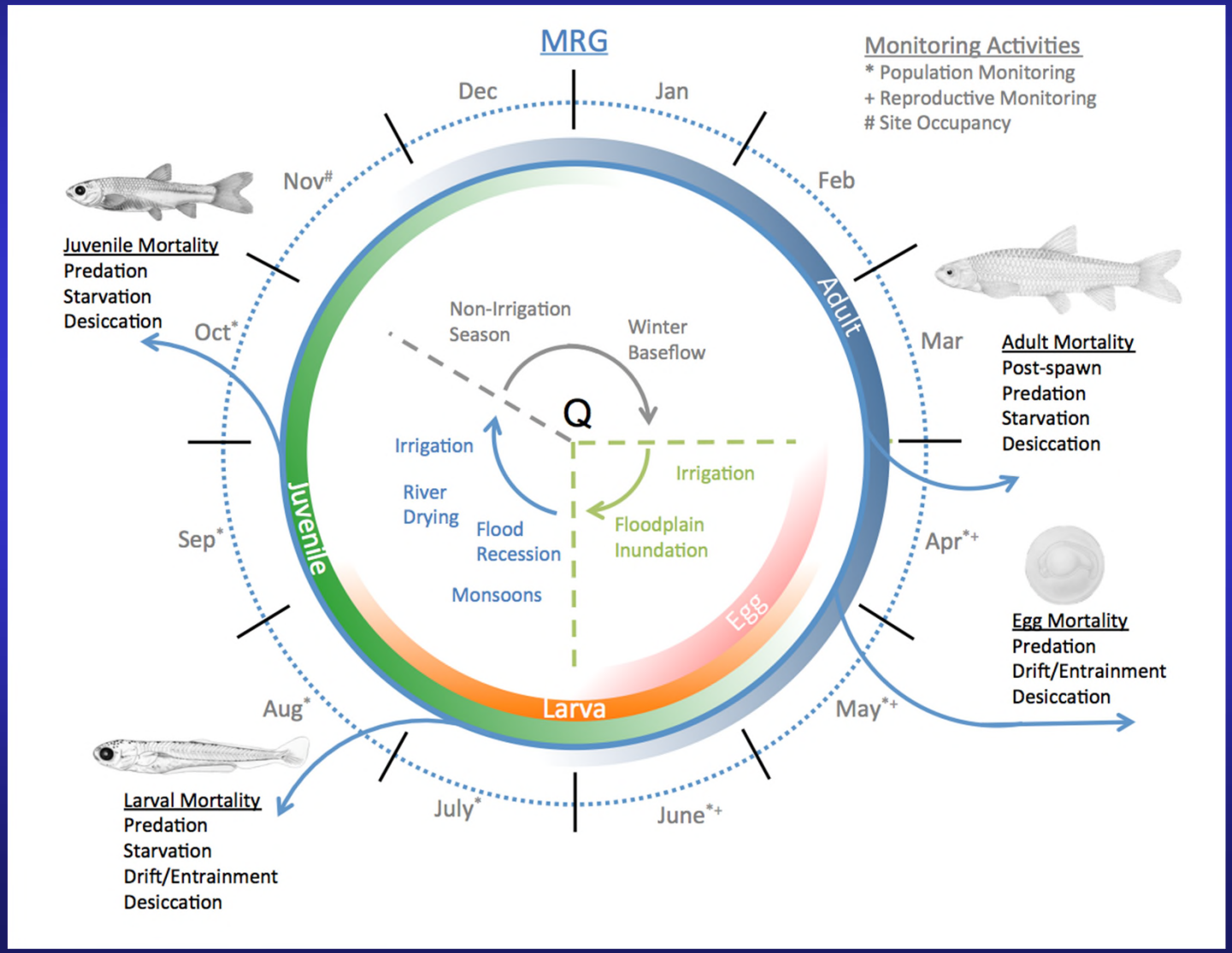
Current

Historical

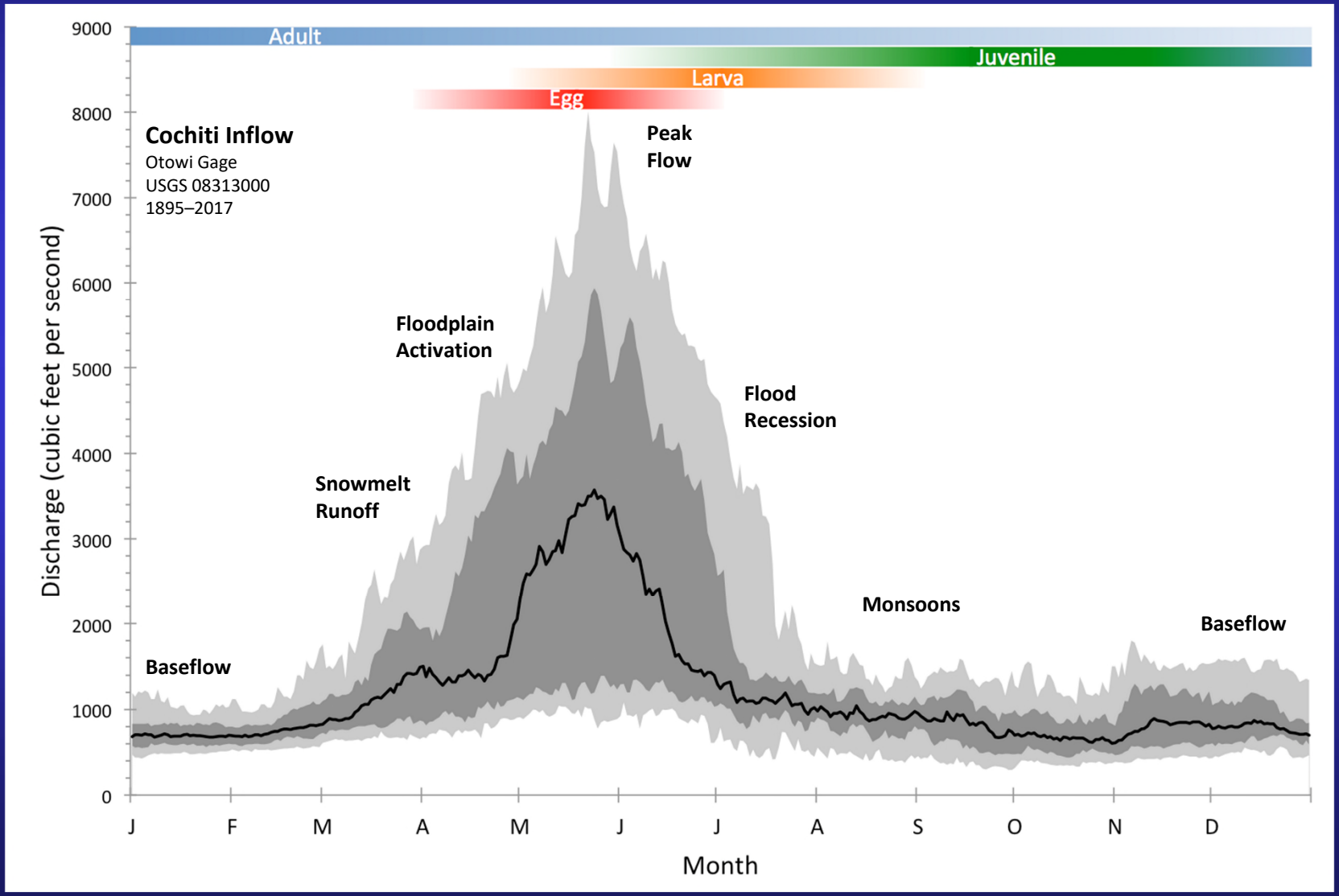
Experimental

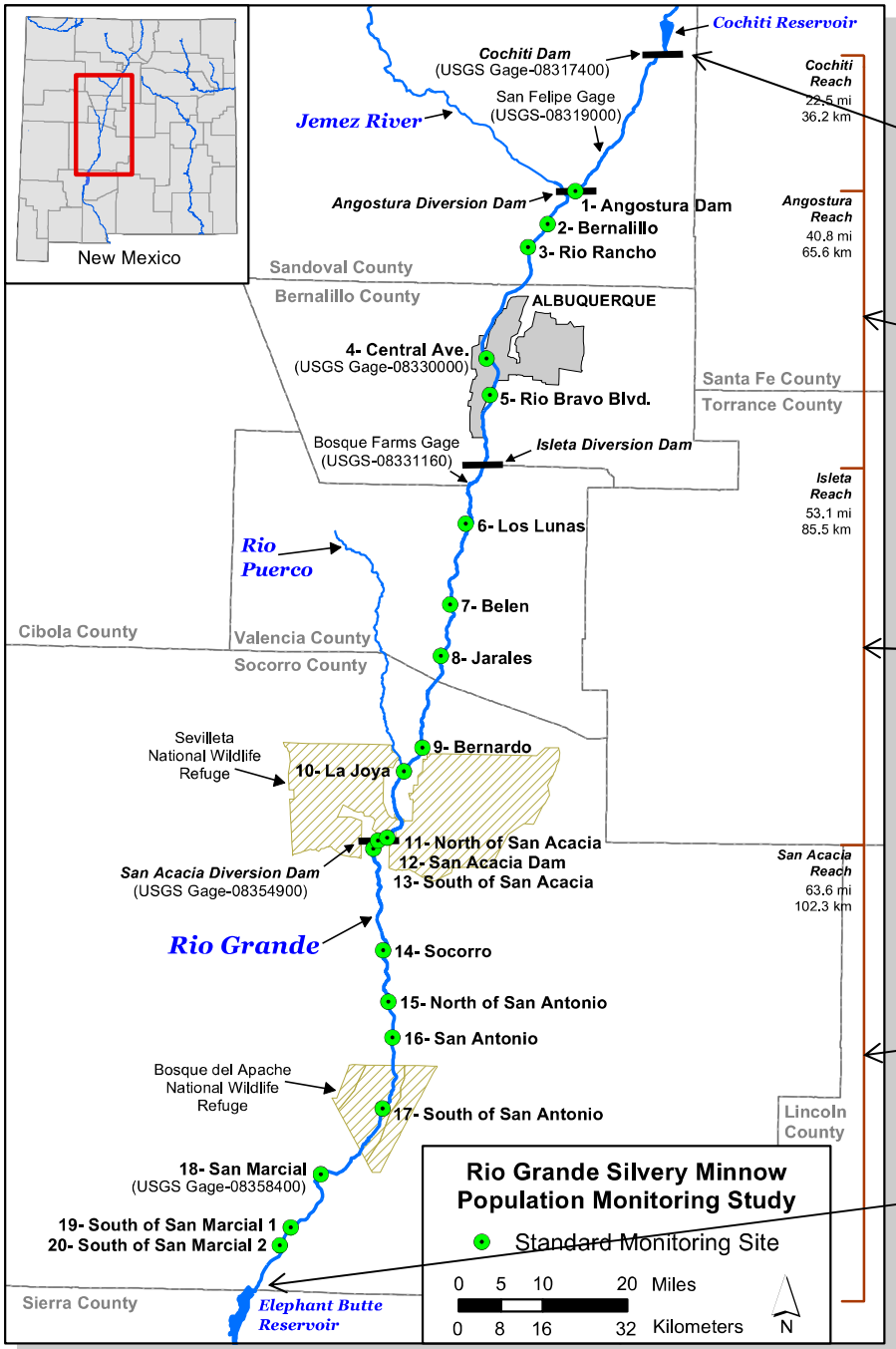
Rio Grande PS Reproductive Guild:
Rio Grande Silvery Minnow *Hybognathus amarus*
Speckled Chub *Macrhybopsis aestivalis*
Rio Grande Shiner *Notropis jemezanus*
Phantom Shiner *Notropis orca*
Rio Grande Bluntnose Shiner *N. simus simus*

Life History of Rio Grande Silvery Minnow



Life History of Rio Grande Silvery Minnow





Study Area

Cochiti Dam

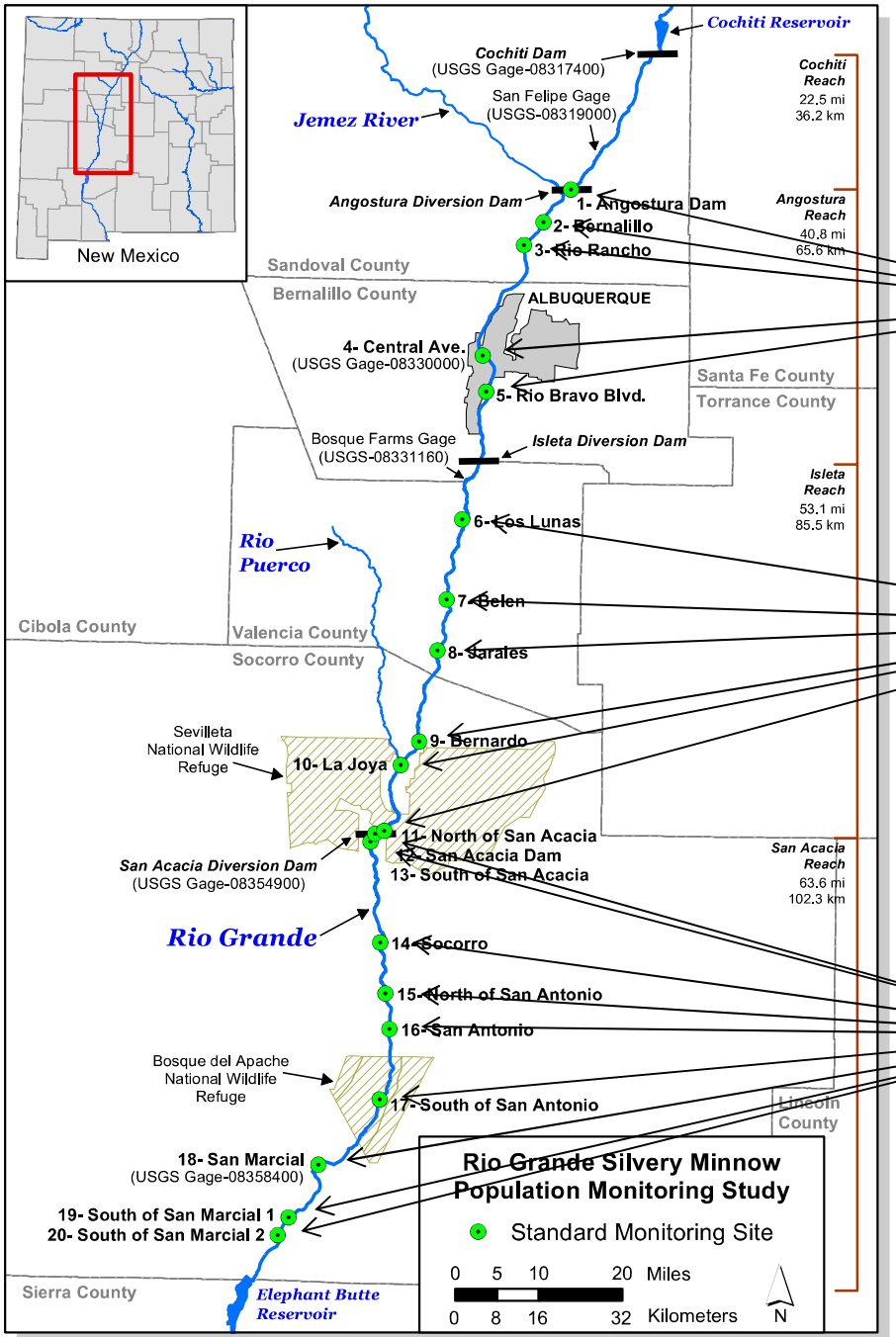
Angostura Reach

Isleta Reach

San Acacia Reach

Elephant Butte Reservoir

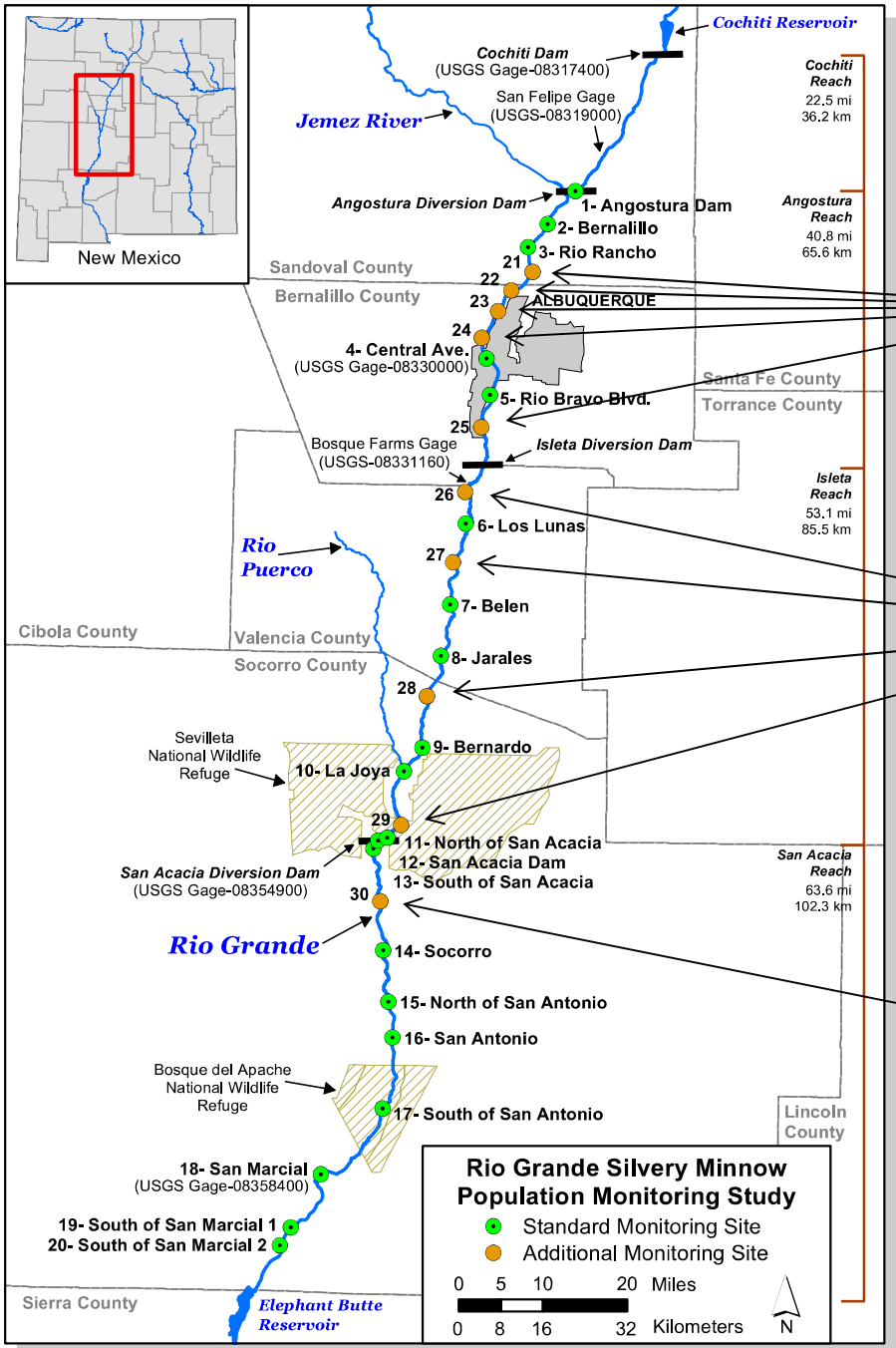
PM Sampling Sites



Angostura Reach sites (5)

Isleta Reach sites (6)

San Acacia Reach sites (9)



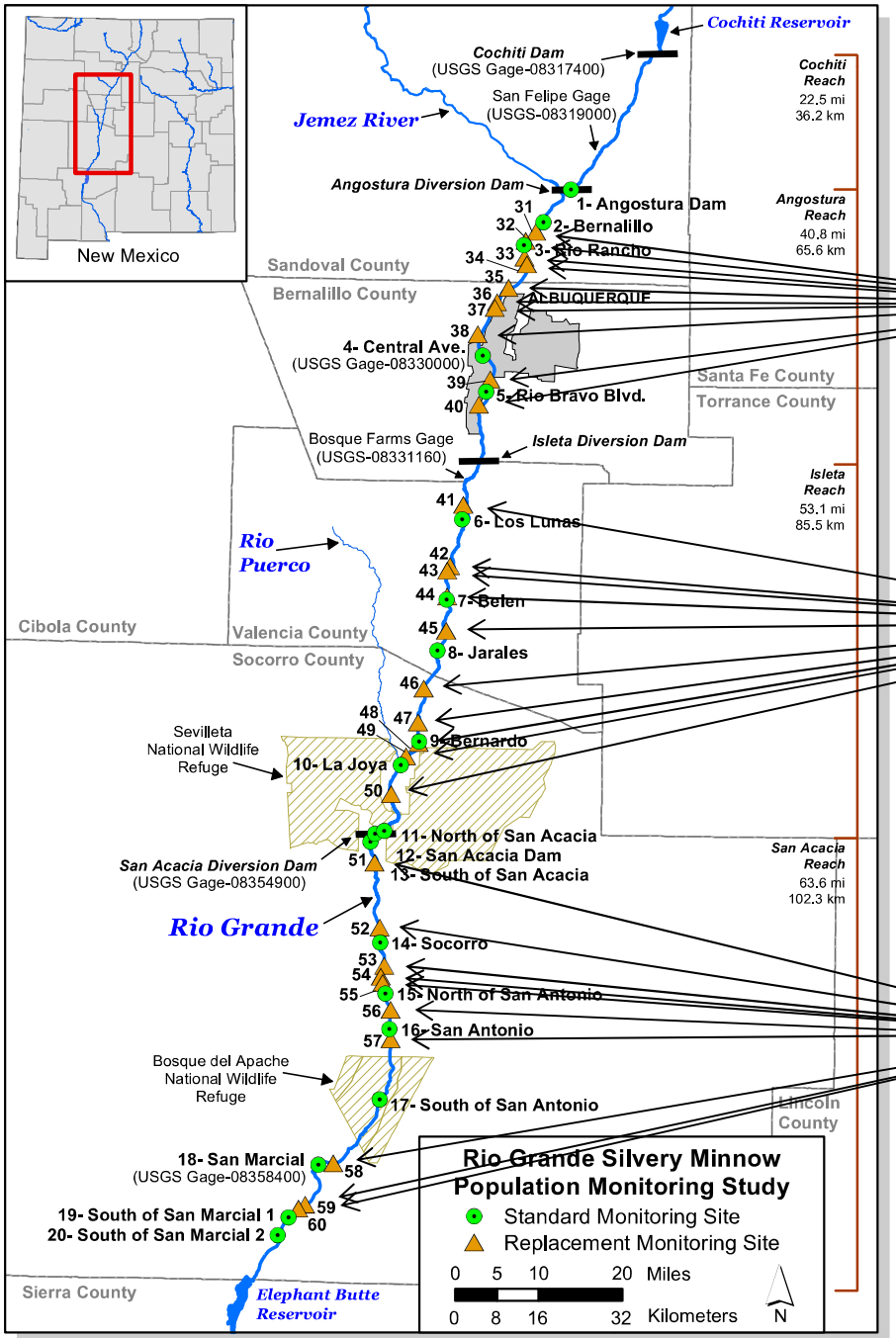
PM Additional Sites

Angostura Reach sites (5)

Isleta Reach sites (4)

San Acacia Reach sites (1)

PM Replacement Sites



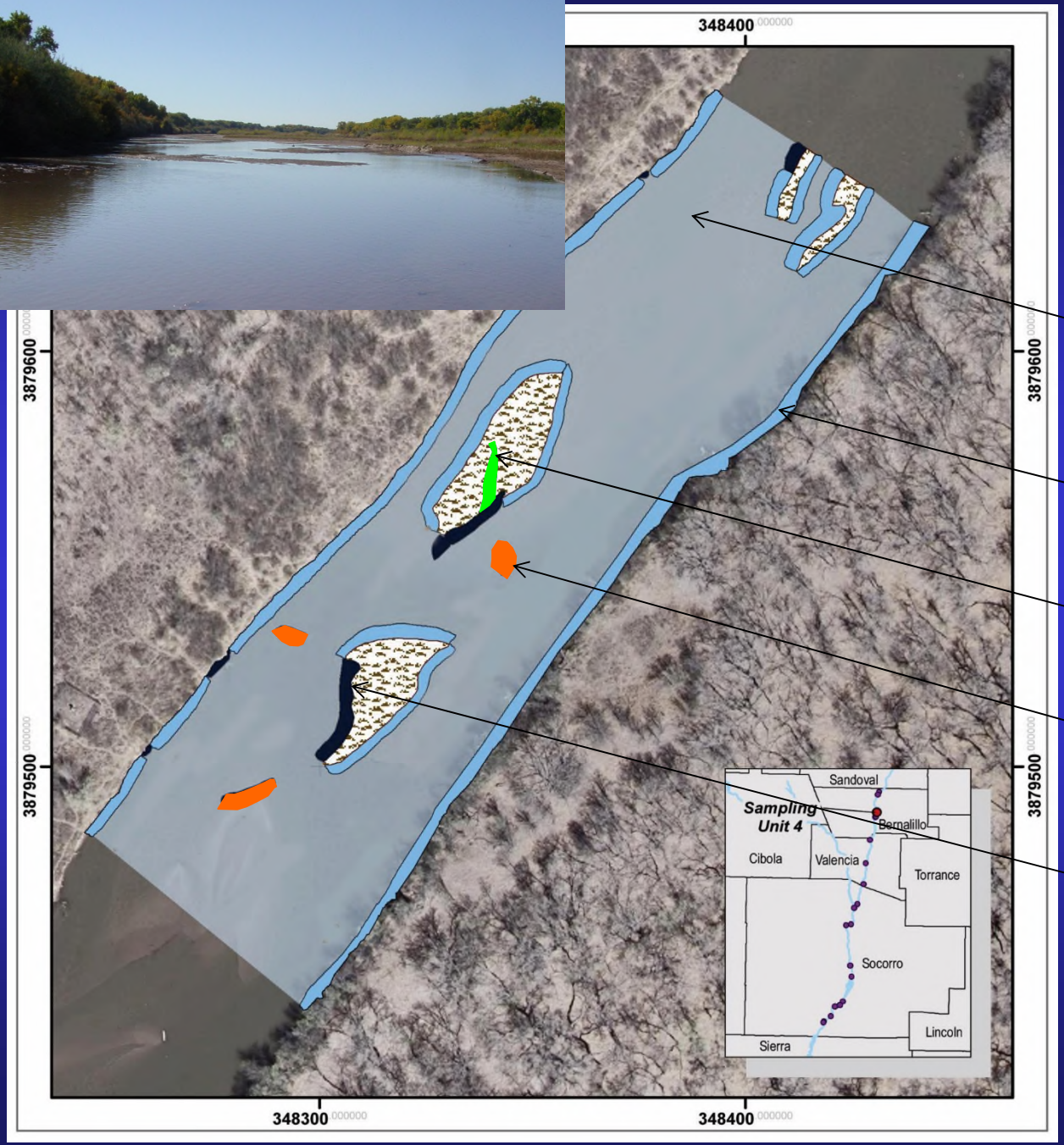
Angostura Reach sites (10)

Isleta Reach sites (10)

San Acacia Reach sites (10)

Mesohabitats





Runs (RU)

Shoreline runs (SHRU)

Backwaters (BW)

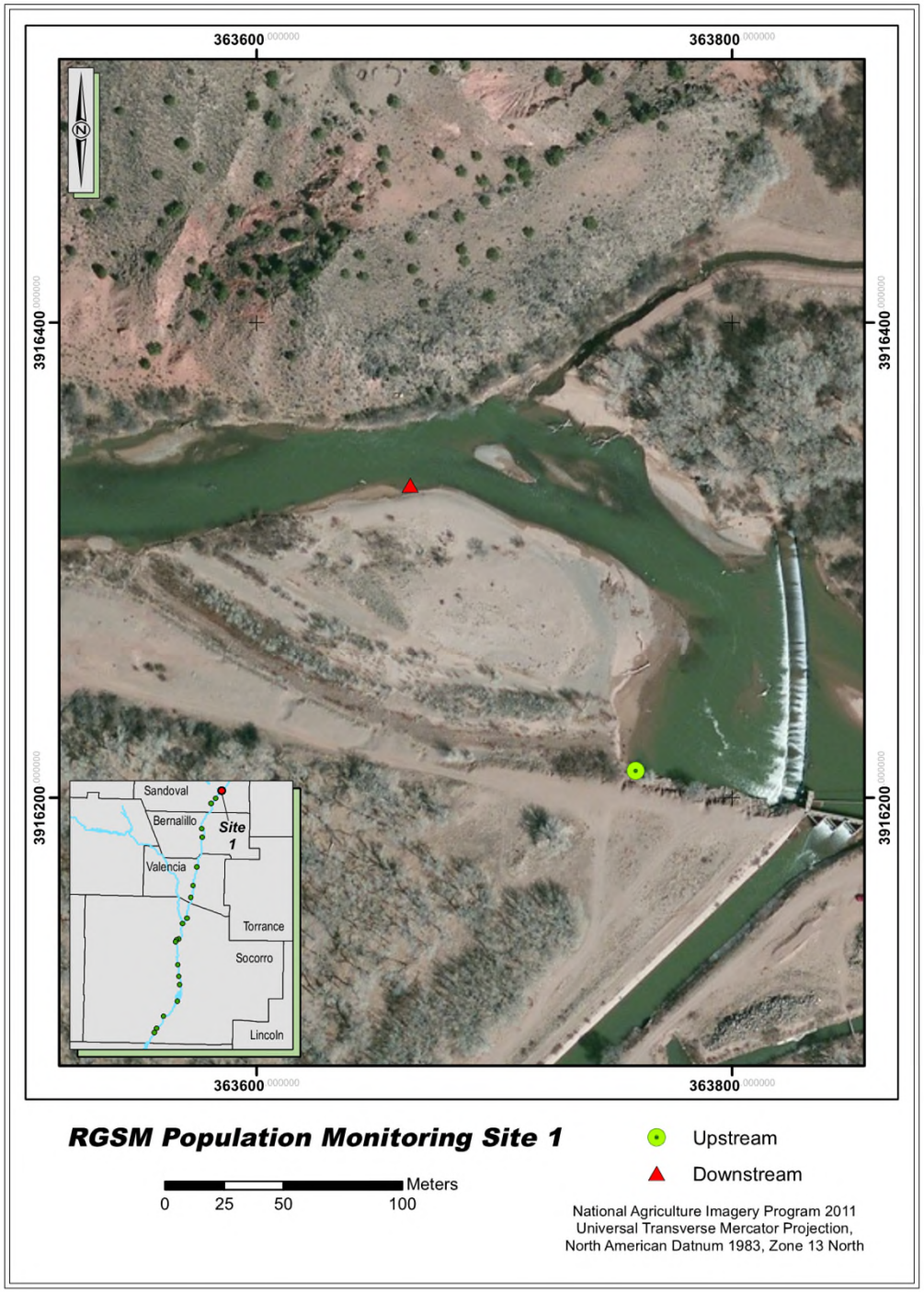
Pools (PO)

Shoreline pools (SHPO)









PM Sampling Methods

Seine hauls by mesohabitat:

- (BW/PO = 2, RU/SHPO = 4)
- (SHRU = 6–14)

Adult fish seining (18):

- (3.1 m x 1.8 m; small mesh)

Larval fish seining (2):

- (1.0 m x 1.0 m; fine mesh)

Twenty seine hauls per site:

- Mesohabitats standardized
- Similar sampling across flows
- Area sampled (ca. 500 m^2)

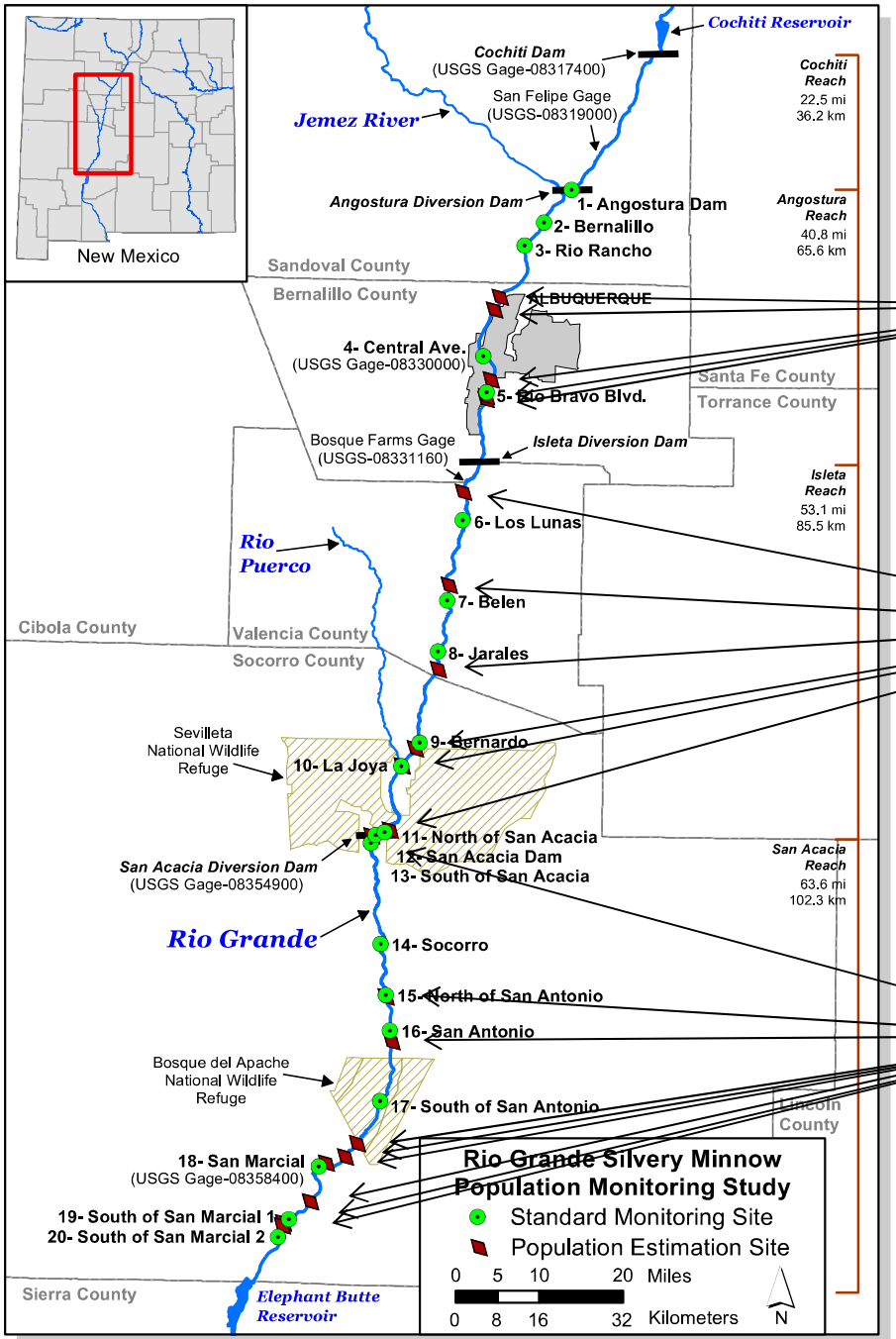
Evolution of PM Project Design

- The decline of RGSM during a prolonged drought (2000–2003), and formation of the MRGESCP, prompted notably increased sampling efforts (i.e., from quarterly to monthly).
- An external review, led by nationally-recognized experts, resulted in a workshop and a report (2004–2005).
- Most of the sampling recommendations and *research studies*, suggested by the experts, were initiated in 2006.
- The Population Monitoring Group (MRGESCP) produced a consensus report in 2006 on the desired protocols and objectives for this study.
- The most recent external review, led by nationally-recognized experts, resulted in a workshop and a report (2015–2016), along with several recommendations for increased sampling efforts.

Evolution of PE Project Design

- An external review, led by nationally-recognized experts, resulted in a workshop and a report (2004–2005).
- The experts suggested that additional research was needed to evaluate the feasibility of converting existing density data into an estimate of population size.
- Open (one-pass using seines) vs. closed (multiple-pass removals using seines or electrofishing) sampling techniques were extensively evaluated through a series of field experiments (2006–2007).
- Based on the revised/final field sampling methods (i.e., multiple-pass removals using electrofishing), the overall and reach-specific population size of RGSM during October was estimated from 2008 to 2011.

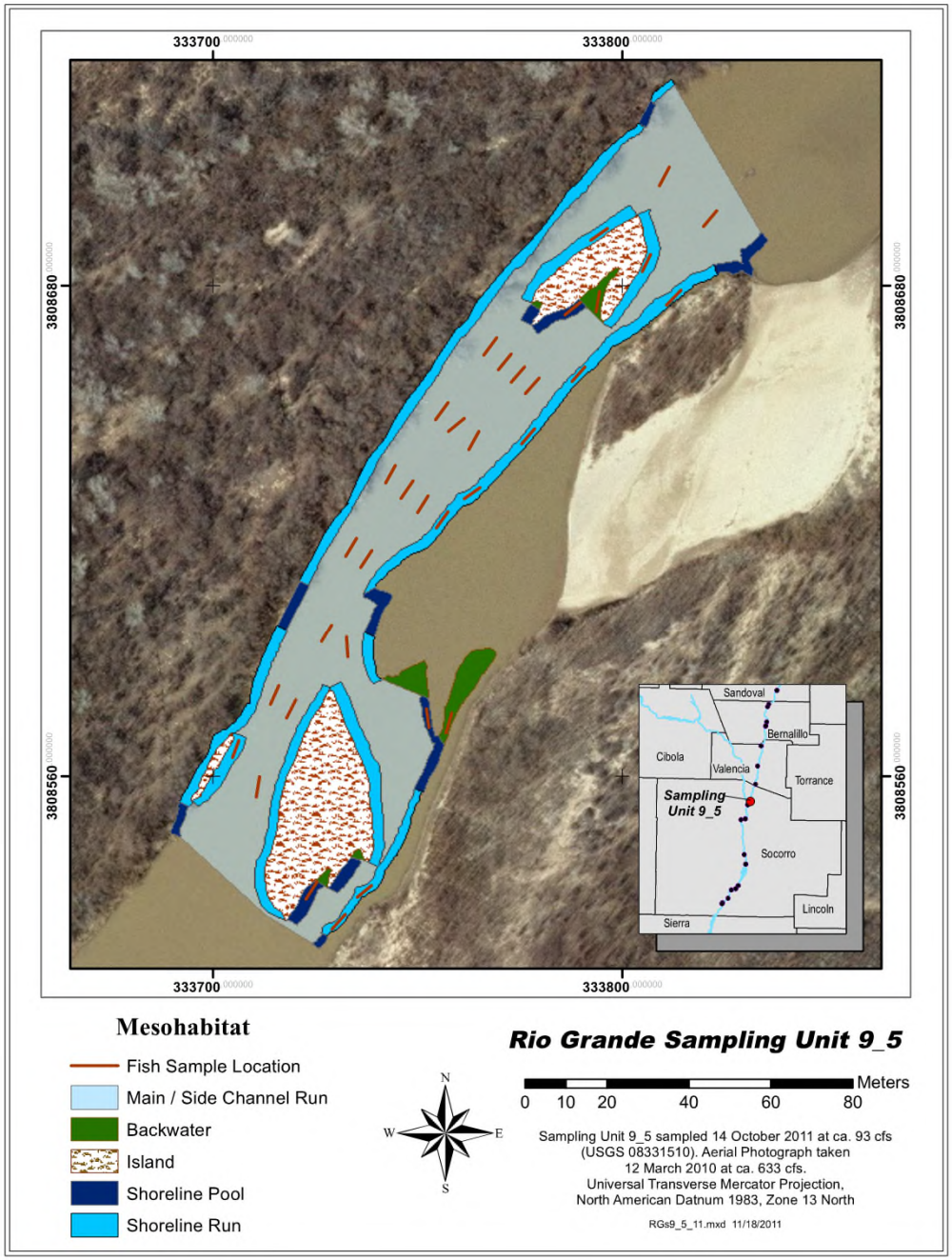
PE Sampling Sites



Angostura Reach sites (5)

Isleta Reach sites (6)

San Acacia Reach sites (9)



PE Sampling Methods

Mapping of all mesohabitats:

- Boundaries of all mesohabitats were marked with flags/posts
- Mapped with a GPS Pathfinder Receiver and a Ranger Data Collector

Removals by mesohabitat:

- Randomized sampling locations for both run and non-run habitats
- Removal-sampling was conducted in portable enclosures using electrofishing

About 30–50 samples per site:

- Mesohabitats standardized
- Similar sampling across flows
- Area sampled (ca. 500 m^2)

Open vs. Closed Sampling in Run Mesohabitats



Open vs. Closed Sampling in Non-Run Mesohabitats

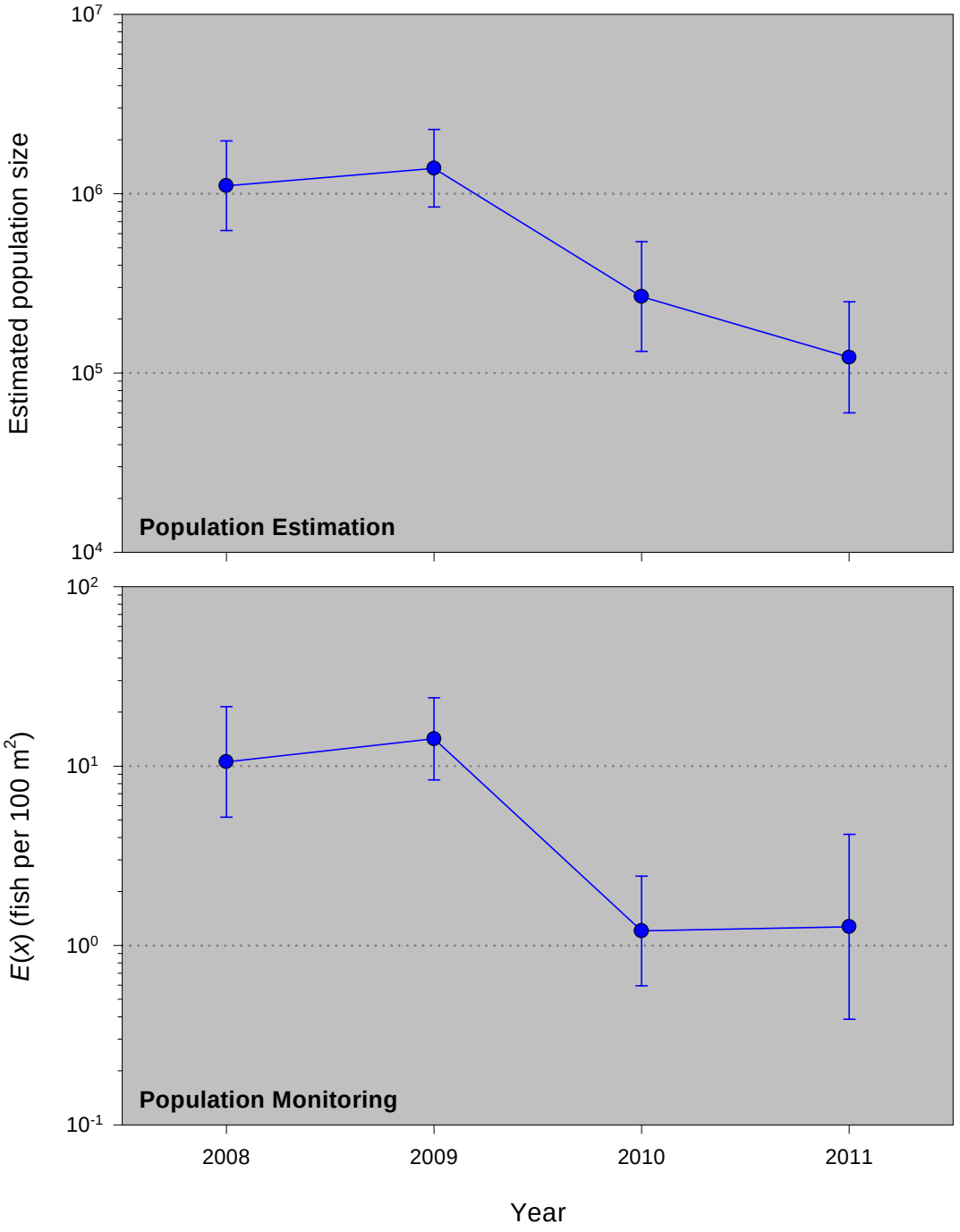


Population Trends
(Estimation vs. Monitoring)

- Similarities: Twenty sites, mesohabitats standardized, similar sampling across flows, area sampled (ca. 500 m^2)

- Differences: Random sites and mesohabitats, mapping of mesohabitats and samples, electrofishing removal-sampling in enclosures

- Despite notable differences in methodology and required effort, both studies indicated very similar trends over time.



Comparing Different Studies

Study strengths	Lower abundance	Higher abundance	Overall
Population monitoring	Early indication of decreased occurrence and abundance	Early indication of increased occurrence and abundance	Seasonal & annual trends in occurrence and abundance
Site occupancy	Robust measure of decreased occurrence (extinction)	Robust measure of increased occurrence (colonization)	Robust estimate of annual occurrence
Population estimation	Robust measure of decreased abundance	Robust measure of increased abundance	Robust estimate of annual abundance

Summary

1. The population monitoring and population estimation studies employed notably different sampling methodologies and required substantially different amounts of effort.

2. Despite these differences, both studies resulted in very similar estimates of Rio Grande Silvery Minnow population trends over time.

3. The population monitoring and population estimation studies each have their own unique set of strengths/weaknesses and costs/benefits.

4. More accurately determining changes in the conservation status of Rio Grande Silvery Minnow, using a variety of monitoring techniques, should aid in both the long-term management and recovery of this imperiled species.

Acknowledgements

- **Field, Data, & Laboratory:** Leiah Atchison, Adam Barkalow, Howard Brandenburg, Martinique Chavez, Stephani Clark-Barkalow, Michael Farrington, Tanner Germany, Anja Helfrich, Jacob Mortensen, Tessia Robbins, Andrea Urioste, and Aaron Wedemeyer (ASIR & Museum of SW Biology [Fishes], UNM)

- **Curation of Specimens:** Alexandra Snyder (Museum of SW Biology [Fishes], UNM)

- **Land Access & Sampling:** Dyane Sonier (City of Rio Rancho; Department of Parks, Recreation, and Community Services), Dionne Epps (City of Albuquerque; Open Space Division), Ray Gomez (Middle Rio Grande Conservancy District), Jon Erz (Sevilleta NWR), Bernard Lujan and Megan Goyette (Bosque del Apache NWR), and Susan Woods (U.S. Bureau of Reclamation [USBR])

- **Technical & Contract Support:** Jennifer Bachus, Eric Gonzales, and Mary Maestas (USBR)

- **Report Review:** Jennifer Bachus, Eric Gonzales, and James Wilber (USBR)

- **Fish Sampling & Collection Permits:** Handling and collection of Rio Grande Silvery Minnow was authorized by the USFWS (Permit TE001623-5). The N.M. Department of Game and Fish authorized our handling and collection of all other native and nonnative fishes (Permit 1896).

- **Support & Funding:** The Middle Rio Grande Endangered Species Collaborative Program has provided valuable scientific input on this research program since 2000. This study was funded by the USBR, and the Albuquerque Area Office and Salt Lake City Regional Office administered all funds (Contract 140R4019P0048: Requisition 0040418262).

February 26, 2020

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

Draft 1 Assimilation and Synthesis of Information and Data Related to the Rio Grande Silvery Minnow: Proposed Outline of Topics for the Population Monitoring Work Group Report [draft]

Draft 1 Table 1. Consolidated Recommendations From the Hubert et al. (2016) and Noon et al. (2017) Science Panels [draft]

Draft 1 Literature Cited [draft]

Population Monitoring Work Group Meeting [presentation]

Rio Grande Silvery Minnow Integrated Population Model [presentation]

Summary Table of Stakeholder Responses to Questions About the Integrated Rio Grande Silvery Minnow Model

Draft 1 Appendix A: Tables of Science Panel Recommendations [draft]

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
February 26, 2020
8:30 AM – 4:00 PM

U.S. Bureau of Reclamation
555 Broadway Blvd NE, Albuquerque, NM

Call-in Information:
712-451-0011; Access code 141544#

Meeting Agenda

8:30 – 8:45	**Welcome, Introductions, Agenda Review, Meeting Notes** ➢ **Decision:** Approval of February 26, 2020 meeting agenda ➢ **Decision:** Approval of November 6, 2019 PMWG meeting minutes	*PMWG Co-chairs*
8:45 – 9:00	**2020 Work Plan**	*PMWG Co-chairs*
9:00 – 10:00	**Progress on Integrated Population Model**	*Charles Yackulic, USGS*
10:00 – 10:15	**Break**	
10:15 – 12:00	**Progress on Integrated Population Model (cont'd)**	*Charles Yackulic, USGS*
12:00 – 1:30	**Lunch** (on own)	
1:30 – 2:30	**Consolidation of Science Panel Recommendations**	*Rich Valdez, Mike Marcus*
2:30 – 3:00	**PMWG Report on Assimilation and Synthesis of Information and Data**	*Rich Valdez*
3:00 – 3:15	**Break**	
3:15 – 3:30	**Status of Data** • Program Portal • Other data	*Shay Howlin, PST*
3:30 – 3:45	**Program Structure Planning** • Functions and tasks of the PMWG	*Facilitated discussion*

- Discussion how those functions and tasks will fit under new Program structure

3:45 – 4:00 **Wrap-Up** *PMWG Co-chairs*

- RGSM Habitat Suitability Modeling brown bag presentation in April *(date TBD)*
- Action Items
- Next Meeting

4:00 **Adjourn**

Population Monitoring Work Group (PMWG)
February 26, 2020

Meeting Decision Log and Action Items

Decisions:

- ✓ Approval of February 26, 2020 meeting agenda with amendments:
  - Move the work plan discussion to the afternoon before the Program structure conversation
  - Switch the order of Consolidation of Science Panel Recommendations and PMWG Report on Assimilation and Synthesis of Information and Data
- ✓ Approval of November 6, 2019 PMWG meeting minutes

Action Items:

WHO	WHAT	BY WHEN
Program Support Team (PST)	Doodle Poll the PMWG to schedule a meeting during one of the following weeks: March 23, April 6, April 13	February 28, 2020
Charles Yackulic	Revise presentation to include legends and titles on all charts	March 3, 2020
PST	Distribute Charles Y.'s revised presentation slides	ASAP after receiving slides
PST	Send out invitations to the Zotero library	February 28, 2020
PST	Develop a draft template for the 14 topical executive summaries	March 18, 2020
Charles Y.	Look further at data from the 1990s regarding egg production	Prior to next meeting

- ➢ Next Meeting: TBD

Meeting Minutes

Welcome, Introductions, Agenda Review, and Meeting Notes
The PMWG co-chairs, Rich Valdez, SWCA, and Joel Lusk, U.S. Bureau of Reclamation, opened the meeting and led introductions. They reviewed the agenda and the minutes from the November 2019 meeting.

- ➢ **Decision**: Approval of February 26, 2020 PMWG meeting agenda with amendments
- ➢ **Decision**: Approval of November 6, 2019 PMWG meeting minutes

Progress on Integrated Population Model
Rich V. shared a paper, "A quantitative life history of endangered humpback chub that spawn in the Little Colorado River: variation in movement, growth, and survival,"[1] as an example of the type of work that can come out of the integrated stock assessment model being developed in the PMWG.

[1] Yackulic, C. B., Yard, M. D., Korman, J., & Haverbeke, D. R. (2014). A quantitative life history of endangered humpback chub that spawn in the Little Colorado River: variation in movement, growth, and survival. Ecology and evolution, 4(7), 1006–1018. https://doi.org/10.1002/ece3.990

Charles Yackulic, U.S. Geological Survey, presented the progress on the model, and answered questions. He informed the group that all the code for the model will be available for the group to look at. During the discussion, the following points were made:

Model development

- Charles Y. did not have the data needed to explore capture probability related to mesohabitat type. The population estimation data did not reveal a significant difference in habitat types. A study will likely have to be designed specifically for that purpose.
- Charles Y. is exploring how to scale the model up based on the underlying abundance model. Having another dataset that looks at habitat and availability at a finer scale would be helpful.
- In Charles Y.'s experience, a negative binominal model is sufficient to adequately address inflated zeroes. It is possible to compare the negative binomial with simulated data to determine if a mixture model is needed.
- One of the next steps in model development is determining the appropriate flow covariate(s) to use.
- The model estimates abundance even when there was no sampling data, and data points were not included if there was too high a discharge in April, as that impacts ability to sample.
- If there is no data available, then the model assumes survival is like other intervals.

Spatial relationships

- There is a recent paper on RGSM dispersal, "Dispersal of Stocked Rio Grande Silvery Minnow (*Hybognathus amarus*) in the Middle Rio Grande, New Mexico."[2]
- The movement data being collected by Utah State University (USU) will be much higher quality data than anything currently in the model. The group should consider revisiting movement once USU has completed its analysis.

Adult survival and abundance

- The model is currently not showing much difference between years in adult survival. This could be either because (a) variability between years is mainly related to sampling, or (b) some of that variability is being erased using random effects analysis.
- Charles Y. is not seeing evidence of survival being linked to density dependence, but is seeing evidence that recruitment is linked to density dependence.
- Charles Y. expects the numbers of adult abundance to be a bit lower than just expanding catch per unit effort (CPUE) numbers, as CPUE is based on samples concentrated in pools.

RGSM reproduction

- Charles Y. has been assuming stocked fish have a lower fecundity than wild-spawned fish due to their smaller size.
- The model includes a parameter to take into account the survival of stocked fish impacting overall fecundity of stocked fish.
- The model wants to go higher than the 3000 maximum offspring per adult in the current parameters, which is based off of laboratory studies. This could be for two reasons: (a) RGSM can have more offspring in the wild so the laboratory estimates are on the low end, or

[2] Platania, S. P., Mortensen, J. G., Farrington, M. A., Brandenburg, W. H., & Dudley, R. K. (2020). Dispersal of stocked Rio Grande silvery minnow (*Hybognathus amarus*) in the Middle Rio Grande, New Mexico. The Southwestern Naturalist 64(1), 31-42. https://doi.org/10.1894/0038-4909-64-1-31

(b) there is something not being taken into account regarding adult abundance, particularly at low abundances. There are a couple of time periods in the 1990s which the model struggles with.
- Spawning later in the season may increase the numbers of eggs produced that year. Fish may be forced to spawn before they have achieved maximum readiness due to the spring runoff.

➢ **Action Item**: Charles Y. will look further at the data from the 1990s regarding egg production

RGSM augmentation
- RGSM have been stocked in February a few times, but that will not be happening again because there has not been any significant difference. Most RGSM are stocked in November after the October sampling, and not near sampling sites. If there are a large number of fish to be stocked, there will be two batches: one in October and one in November.
- The model is treated as three different time periods: before stocking, when stocking was occurring but without standardized timing and marking of fish, and stocking at standardized times and markings.
- The model has an estimated parameter for initial stocking mortality and then after that, assumes stocked fish behave like other age-1 fish. This assumption is based on mark-recapture studies and the survival of wild fish.

Habitat
- Charles Y. is lumping habitat types into pools and runs/riffles. Backwaters are considered a pool for the model.
- If there are enough data points on the relationship of depth and velocity to mesohabitat type, a statistical relationship can be developed.
    - There was a data collection effort completed in 1996 looking at habitat characteristics. There are notes on discharge measurements and the cross section surveys. However, these exist only in paper copy and will require a large data entry effort.
- While Charles Y. does think there are different discharge-habitat relationships by reach, there are not enough data to evaluate that.

The group then discussed how the integrated stock assessment model will or can interact with the other modeling efforts that are ongoing. Charles Y. noted that he has talked with some of the other modelers. Several participants supported having those developing the models meet together in a technical workshop to discuss the different efforts, the different management actions and options that could be implemented in the Middle Rio Grande, and options for how the different models can work together. The timing of this potential workshop will have to be determined, based on contracts and the model development schedule.

Another participant suggested the need for a workshop to discuss what the group wants out of the integrated stock assessment model.

Survey Results
Joel L. reminded PMWG participants that a survey was sent to managers in the fall 2019 that explained the types of management questions they would like the integrated stock assessment

model to address. He took the survey responses and binned them into categories. Based on the categories, Charles Y. informed the group that the model:

- Could partially be used to evaluate water management actions, to the degree that data can be separated out, and just to make predictions and forecasts
- Could mostly address questions related to population parameters, dynamics, or recovery
- Could mostly quantify various effects to population or individuals
- Is not currently treating reach metapopulations as distinct, but the group may want to look more at small population problems
- Can look at habitat in two different ways:
    - Residuals on the flow relationship, which he did not recommend
    - Within the context of a hypothesis of what flows matter, by reconstructing how much floodplain inundation would occur at a certain flow
        - There are a few ongoing or existing efforts looking at the relationship between floodplain inundation, elevation, and flow. Though a few participants noted that the area of inundated habitat has not been found to scale well with any CPUE, recruitment, or flow metrics.

Consolidation of Science Panel Recommendations & PMWG Report on Assimilation and Synthesis of Information and Data

Rich V. shared a history of some of the highlights of the PMWG and the RGSM Population Monitoring Program. He stated there have been a lot of good conversations and efforts, but they have not been archived. He introduced the concept of developing topical issue papers to the PMWG.

Mike Marcus, Assessment Payers Association of the Middle Rio Grande Conservancy District, provided some history in past efforts in the Program to synthesize and compile data, including the Water Acquisition and Management (WAM) committee and a habitat restoration plan for the Middle Rio Grande. He informed the group that he and Rich V. had taken the panel recommendations from both the Noon and Hubert reports and consolidated them by topic – these are the fourteen areas that are being proposed for developing papers around.

The group discussed the utility of developing papers, and agreed to focus these into executive summaries for each of the 14 topic areas, summarizing the published literature and noting alternative hypotheses where there are differences of opinion. During the conversation, the following points were made about the process in developing these executive summaries:

- There should be some conversation and review on each paper before they are finalized
- In prioritizing the topic areas for development, some of the topics are more informative in developing the integrated stock assessment model, and should likely be done first
- These executive summaries, by identified alternative hypotheses, could feed directly into development of Program activities and recommended studies

The group then walked through an example, Age Composition, and outlined what the executive summary might look like.

- **Action Item:** Kevin McDonnell and Catherine Murphy, PST, develop a draft template for the executive summaries

Status of Data

Shay Howlin, PST, informed the group that she has been working with Ashley Tanner to take over the responsibility around the datasets used by the group. The PST and the U.S. Army Corps of

Engineers have been working with the U.S. Geological Survey on getting the following datasets onto the Program Portal:

- Data collected by ASIR, including the Population Monitoring Program, Population Estimation, and Reproductive Monitoring
- RiverEyes data
- Habitat restoration compilation map, which are geospatial data with extensive attribute data
- Hink and Ohmart vegetation maps

In addition to the datasets above, the group suggested the following also be included on the Portal:

- RGSM augmentation – Thomas Archdeacon, U.S. Fish & Wildlife Service, has those data available
- RGSM salvage data – Thomas A. has these data in multiple spreadsheets, and they require a bit of work to get them useable
- RGSM egg data – These are collected by four different groups (ASIR, Albuquerque-Bernalillo County Water Utility Authority, the BioPark, and SWCA contracted through the N.M. Interstate Stream Commission [NMISC]) and could be standardized and compiled
- The Field Data Collection Report from Winter 1996 – These includes survey data that can inform habitat characterizations. These data are only in hard copy and require a lot of data entry and processing.
- Floodplain habitat monitoring data – This has been collected by SWCA under contract with NMISC

Next Steps

- Due to time, the conversations about Program structure and the PMWG's 2020 Work Plan will be on the next meeting's agenda.
- Agenda items for the next meeting:
    - PMWG 2020 Work Plan
    - Program structure
    - Executive Summary template
    - Next steps on the 14 topic documents

➢ **Action Item**: The PST will send out a doodle poll to schedule the next meeting for late March/April

Participants
Thomas Archdeacon, U.S. Fish and Wildlife Service
Trevor Birt, N.M. Interstate Stream Commission
Lynette Giesen, U.S. Army Corps of Engineers
Grace Haggerty, N.M. Interstate Stream Commission
Brian Hobbs, U.S. Bureau of Reclamation
Mo Hobbs, Albuquerque-Bernalillo County Water Utility Authority
Shay Howlin, Program Support Team
Debbie Lee, Program Support Team
Joel Lusk, U.S. Bureau of Reclamation
Mike Marcus, Assessment Payers Association
Anne Marken, Middle Rio Grande Conservancy District
Kevin McDonnell, Program Support Team
Catherine Murphy, Program Support Team
Michael Porter, U.S. Amy Corps of Engineers
Ashlee Rudolph, U.S. Bureau of Reclamation
Rich Valdez, SWCA
Charles Yackulic, U.S. Geological Survey
Stephen Zipper, SWCA

February 18, 2020

Assimilation and Synthesis of Information and Data Related To the Rio Grande Silvery Minnow

Proposed Outline of Topics for the Population Monitoring Workgroup Report

Draft 1: February 18, 2020

1. Relationship of CPUE and True Population Size of RGSM
2. Age-Specific Survival of RGSM
3. Size and Age-Specific Fecundity of RGSM
4. Effect of Augmentation on RGSM Population
5. Contribution of Salvaged RGSM to Population Dynamics
6. Effect of Environmental Cues on Spawning Onset and Activity
7. Age Composition of RGSM Population
8. Spatial Extent of Habitat and Hydraulic Quality Used by RGSM
9. Selectivity of Gears Used to Sample RGSM
10. Consolidation of Mesohabitats for Monitoring RGSM
11. Effect of Environmental Factors on Seine Capture Probability
12. Effect of Increased Sample Size on RGSM Monitoring
13. Mixture Model and Alternatives for Computing RGSM CPUE
14. Movement of RGSM

Table 1. Consolidated recommendations from the Hubert et al. (2016) and Noon et al. (2017) Science Panels.

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
Population Dynamics / Noon et al. = Priority 1						
1	1/1	--	A1	Clarify relationship between annual CPUE index and true population size.	• Dudley et al. (2011a, 2011b, 2011c, 2012) implemented population estimation. • Goodman (2012) evaluated Population Estimation Program. • Valdez (2018a) evaluated relationship between CPUE and true population size (presented to PMWG 6/20/2018).	Remains unresolved
2	1/3	--	A2	Determine which age-specific vital rates (survival, reproduction, etc.) most affect population change.	• Goodman (2010) did deterministic dynamics of environmental correlates. • Miller (2012) performed sensitivity analysis as part of PVA. • Yackulic (2018) model in progress (presented to PMWG 12/12/2018).	Ongoing
3	1/3	--	A3	Estimate age-specific survival rates.	• Goodman (2009) estimated survival from quarterly comparisons of CPUE. • Miller (2012) reconciled survival rates from PVA. • Valdez (2018b) estimated survival of wild RGSM (presented to PMWG 12/12/2018).	Ongoing
4	1/3	22	A4, B3	Estimate size and age-specific fecundities of wild fish.	• Platania and Altenbach (1996) did clutch and batch production and fecundity estimates in a lab. • Caldwell et al. (2019) evaluated reproductive potential of captive RGSM. • Archdeacon?	Information needed on wild RGSM

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
5	1/3	10	A5	Model relationships between demographic rates and hydrological factors (flow magnitude, duration, drying), abiotic factors (temp, turbidity, salinity), and biotic factors (predation, completion, prey).	• Miller (2012) related demographic rates to hydrological factors as part of PVA. • Archdeacon (2016) evaluated reduced spring flow. • Yackulic (2018) model in progress. • Walsworth and Budy (2020) model in progress. • Hatch and Cowley (2020)?	Ongoing
Population Dynamics / Noon et al. = Priority 2						
6	2/--	--	A6	Evaluate existence and strength of density-dependent factors that may limit population growth.	• Miller (2012) evaluated as part of PVA. • Goodman (2010) evaluated as part of PVA. • Yackulic (2018) model in progress.	Ongoing
Population Dynamics / Noon et al. = Other Important Studies						
7	Import/--	--	A7	Model potential effects of hatchery augmentation on population dynamics.	• Miller (2012) evaluated as part of PVA. • Archdeacon and Remshardt (2012). • Archdeacon (2015) provides annual reports on augmentation. • Yackulic (2018) model in progress. • Hatch and Cowley (2020)?	Ongoing
8	Import/--	--	A8	Determine if collection and translocation of salvaged RGSM during summery drying contribute to population dynamics.	• Archdeacon (2017) gave a presentation on Fish Rescue.	Ongoing
Reproductive Biology of Rio Grande Silvery Minnow / Noon et al. = Priority 1						
9	1/--	--	B1, E2	Develop and deploy "vertically-integrating" Moore egg collectors; determine vertical and horizontal distribution of RGSM eggs as a function of flow and location	• Porter (2018) designed a multi-level vertical egg collector.	Work initiated; more needed

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
10	1/--	--	B2, D2	Assess effect of environmental cues (flow, velocity, temp, flow change) on spawning onset and activity.	• Cowley et al. (2009) evaluated effect of salinity on specific gravity of eggs. • Krabbenhoft et al. (2014) evaluated phenology. • Valdez (2010, 2019, 2020a) evaluated temperature degree-days for hatching.	Ongoing
Age and Growth / Noon et al. = Priority 2						
11	2/--	--	C	Clarify annular marks on otoliths and firmly establish longevity of RGSM.	• Horwitz et al. (2018) used scales and otoliths for juveniles and adults. • Zipper et al. (2020a; 2020b) verified otolith age for larvae.	Unresolved
Physical Habitat Relations of RGSMs / Noon et al. = Other Important Studies						
12	Import/--	--	D1	Estimate spatial extent of habitat and hydraulic quality used by RGSM for key life-stages (spawning, larval, juvenile, adult).	• Tetra Tech (2014) evaluated habitat for occupied, feeding/rearing, spawning/ egg/larval habitat. • Walsworth and Budy (2020). • Colorado State University (2020)? • Yackulic (2020). • Hatch and Cowley (2020)?	Evaluation ongoing by several groups
13	Import/--	--	D3	Determine roles and relative contributions to fish production by age in channel and floodplain habitats.	• Tetra Tech (2014). • Walsworth and Budy (2020). • Colorado State University (2020)? • Yackulic (2020). • Hatch and Cowley (2020)?	Evaluation ongoing through modeling
14	Import/--	--	D4	Evaluate management potential for fish production (recruitment and survival of age 0 fish) in each reach if annual peak flow and available habitat is permanently limited below historic levels.	• Tetra Tech (2014). • Walsworth and Budy (2020). • Colorado State University (2020)? • Yackulic (2020).	Evaluation ongoing through modeling

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
Sampling Methodologies / Noon et al. Priority 1						
15	1/--	--	E1	Establish age composition of RGSM population, including application of distribution separation methods.	• Valdez (2018b) evaluated age composition using distribution separation methods (presented to PMWG 10/2/2018). • Winter (2018) provided a Bayesian analysis of von Bertalanffy growth function (presented to PMWG 12/12/2018).	Ongoing
16	1/--	--	E1	Evaluate size and age of fish captured by gear type with gear selectivity.	• Widmer et al. (2012) PP to Science Workgroup, 8/21/2012. • Gonzales et al. (2012) evaluated fyke-net catches. • Valdez et al. (2020b) evaluated gear selectivity (presented to PMWG 10/2/2018).	Ongoing
17	2/2	--	E3	Calculate revised CPUE values using most abundant high CPUE mesohabitats for assessment of trend in abundance at October sampling date.	• Valdez (2018c) computed CPUE at mesohabitat-specific levels (presented to PMWG 10/2/2018).	--
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 1						
18	--/1	1, 2, 3	--	Separate catch and effort data from small-mesh and fine-mesh seines and compute CPUE for each gear type and by age (larvae, age-0, age 1, age 2+).	• Dudley et al. (2020) have computed larval and standard seine CPUE annually since 2018.	Ongoing
19	--/1, 2	4, 5	--	Evaluate effect of zero catches on CPUE (zero as dry site, no fish captured).	• Dudley et al. (2020) have evaluated effect of zero catches on CPUE annually since 2018.	Ongoing
20	--/1, 2	6	--	Evaluate effect of sample design on zero CPUE.	Effect of sample design on zero CPUE has not been evaluated.	Not Initiated

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
21	--/3, 1	7, 8	--	Evaluate detection and catchability (*p*-hat) of RGSM in seines, including effect of environmental factors (turbidity, temp., substrate, depth, velocity, discharge) during sampling on CPUE.	• Archdeacon and Davenport (2013) evaluated detection and population estimation.	More work needed
23	--/1	11, 14, 17	--	Evaluate mixture model for computing RGSM CPUE, and other models, including Bayesian hierarchical models; consider using key drivers of mesohabitat variability (e.g., velocity, substrate, depth) to replace the mesohabitat factor in mixture models.	The mixture model has not been evaluated in this manner.	Not Initiated
24	--/1, 0	12, 13	--	Increase sample sites by 20-50 sites per reach, and evaluate effect on CPUE; add random sites to replace dry sites.	• Dudley et al. (2020) added sample sites starting in 2018. • Archdeacon et al. (2015) Compared fish communities at random and non-random sites.	Needs additional evaluation
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 1.5/2						
26	--/1.5	18	--	Use classification and regression trees, boosted regression trees, or random forests to examine relationships between hydrologic variables and CPUE for identifying thresholds above or below which CPUE exhibits changes.	This has not been implemented.	Not Initiated
25	--/2	16	--	Examine historical availability of mesohabitats relative to discharge. If linked, annual or monthly discharge may be surrogate for mesohabitat availability.	This has not been examined.	Not Initiated

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 3						
27	--/3	19	--	Implement studies using different sampling designs (multi-year, multi-site, before-after-control-impact [BACI]) to better understand population response to changes in river discharge, habitat rehabilitation projects, and mesohabitats.	This has not been implemented.	Not Initiated
28	--/3	21	--	Conduct stock-recruitment studies to determine how abundance of fall recruits relates to abundance of spring spawners.	• Miller (2012) • Walsworth and Budy (2020). • Yackulic (2020). • Hatch and Cowley (2020)?	Ongoing
30	--/3	24	--	Expand the analyses in Dudley et al. (2015) to assess flow regime and habitat fragmentation effects on RGSM occurrence and abundance and suggest preliminary flow regimes for rehabilitating the wild RGSM population.	• This has not been implemented.	
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 0						
22	--/0	9	--	Evaluate recovery standards by gear, sample design, techniques, data analysis, and life stage.	Is evaluating recovery standards the charge of the PMWG?	Not Initiated
29	--/0	23	--	Consider genetic fingerprinting and epigenetic studies, including bar-coding and gene-expression, of presumed wild and hatchery fish to help determine hatchery contributions to spring spawners and long-term risks to wild population.	Is this an issue for the Genetics Group?	Not Initiated

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Population Monitoring Workgroup Meeting

February 26, 2020
Albuquerque, New Mexico

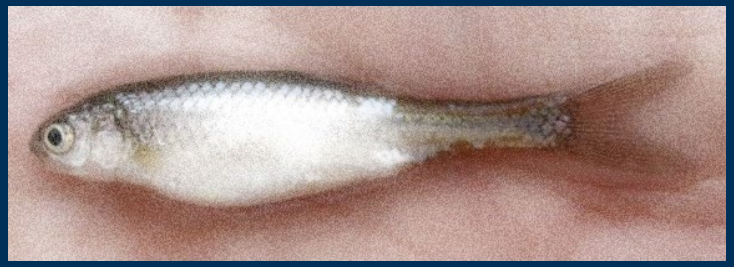
Meeting Agenda

8:30– 8:45	Welcome, Introductions, Agenda Review, Meeting Notes ➢ Decision: Approval of February 26, 2020 meeting agenda ➢ Decision: Approval of November 6, 2019 PMWG meeting minutes	PMWG Co-chairs
8:45– 9:00	2020 Work Plan	PMWG Co-chairs
9:00– 10:00	Progress on Integrated Population Model	Charles Yackulic, USGS
10:00– 10:15	Break	
10:15– 12:00	Progress on Integrated Population Model (cont d)	Charles Yackulic, USGS
12:00– 1:30	Lunch (on own)	
1:30– 2:30	Consolidation of Science Panel Recommendations	Rich Valdez, Mike Marcus
2:30– 3:00	PMWG Report on Assimilation and Synthesis of Information and Data Stakeholder Questions for Modeling Effort	Rich Valdez Joel Lusk
3:00– 3:15	Break	
3:15– 3:30	Status of Data • Program Portal • Other data	Shay Howlin, PST
3:30– 3:45	Program Structure Planning • Functions and tasks of the PMWG • Discussion how those functions and tasks will fit under new Program structure	Facilitated discussion
3:45– 4:00	Wrap-Up • RGSM Habitat Suitability Modeling brown bag presentation in April (date TBD) • Action Items • Next Meeting	PMWG Co-chairs
4:00	Adjourn	

Highlights of PMWG

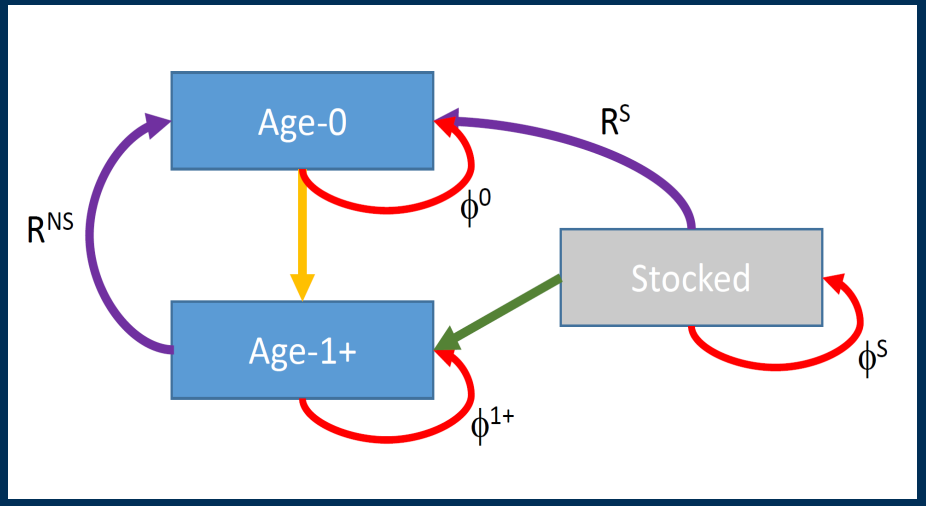
- July 13, 2012: EC Approved Charge for Task 1 (CPUE Workshop)
- May 2014: PMWG Sent a Survey to EC on Fish Population Monitoring Needs (Report in March 2015)
- Dec 8-10, 2015: Independent Science Panel Workshop on Population Monitoring (Hubert, Fabrizio, Hughes)
- April 13, 2016: Final Report on RGSM Population Monitoring (Hubert et al. 2016) (Task 1 Complete)
- July 12, 2016: PMWG forwards request to EC to Initiate Task 2 (Review Population Monitoring Plan)
- March 23, 2017: BOR incorporates Hubert Recommendations (8) into Pop Mon Contract
- June 2017: Final Report on RGSM Scientific Uncertainties (Noon et al. 2017; related to ACOE AM Project)
- Oct 4, 2017: PMWG Receives Additional Sites Protocol
- Oct 4, 2017: PMWG Decides to Develop an Integrated RGSM Model through Guest Biometrician
- Nov 29, 2017: PMWG Initiates Review/Prioritization of Hubert and Noon Recommendations
- Nov 29, 2017: PMWG Receives Replacement Sites Protocol
- Nov 11, 2018: Dr. Charles Yackulic Proposal for Integrated RGSM Population Model
- Oct 2019: Questionnaire Sent to PMWG Stakeholders on Possible Uses of Integrated RGSM Model

USGS
science for a changing world



Rio Grande Silvery Minnow integrated population model

Charles B. Yackulic, *U.S. Geological Survey*
email: cyackulic@usgs.gov



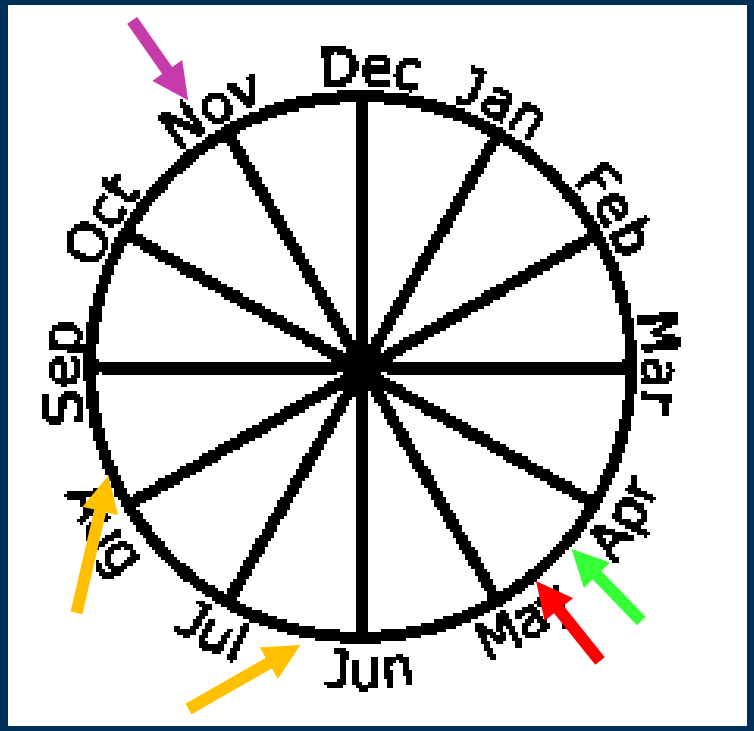
U.S. Department of the Interior
U.S. Geological Survey

Outline

- Refresher on assumptions & past progress
- Spatial scale – challenges and solutions
- Final (ish) model structure
- Model output
- Next steps

USGS

Timing of life history and other key events



Spring runoff, floodplain inundation

Spawning

Peak irrigation, drying, salvage.

Augmentation

USGS

Questions/assumptions

- Fecundity in wild?
- cpe to N?
- what role for variation in survival? (especially drying or increased water temperature)
- fate of augmented and salvaged fish?

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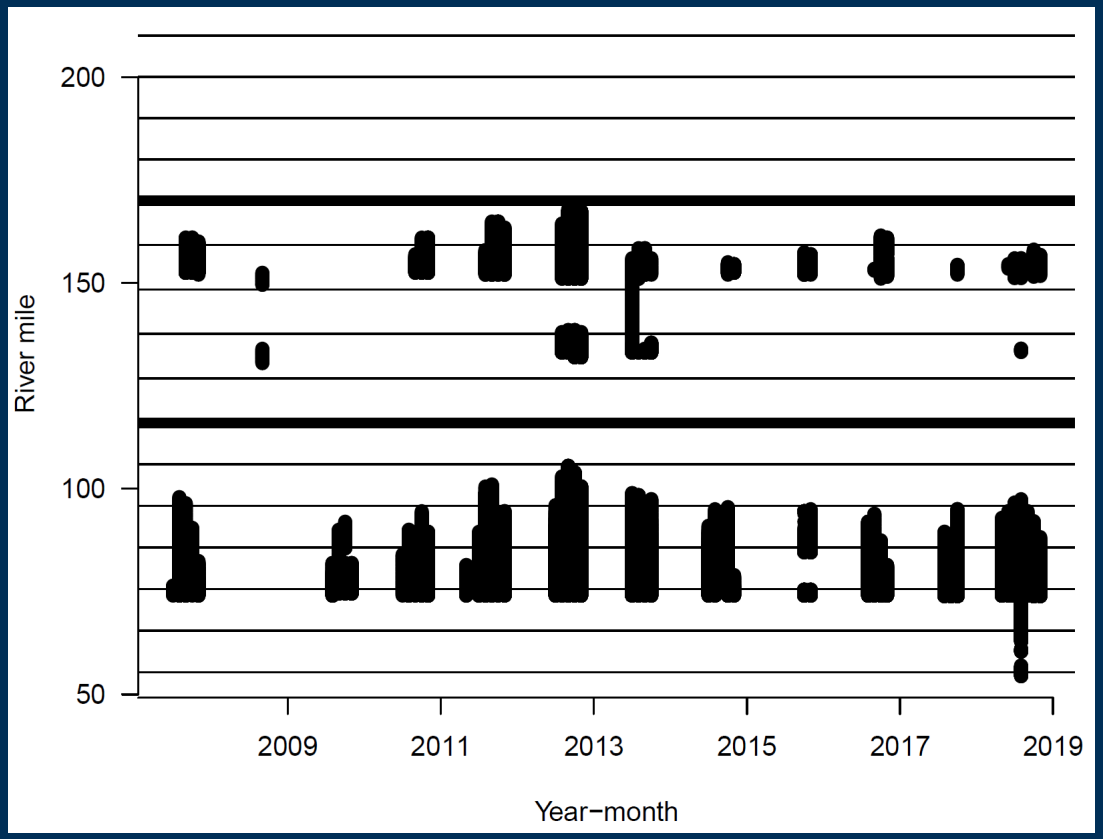
Data

- Abundance estimates from 4 years.
- Pop. monitoring data from 1993-2018
- Some habitat data
- Discharge
- Augmented (hatchery reared) & marked fish

USGS

Other data

- Salvage
- Repeat surveys
- Drying data

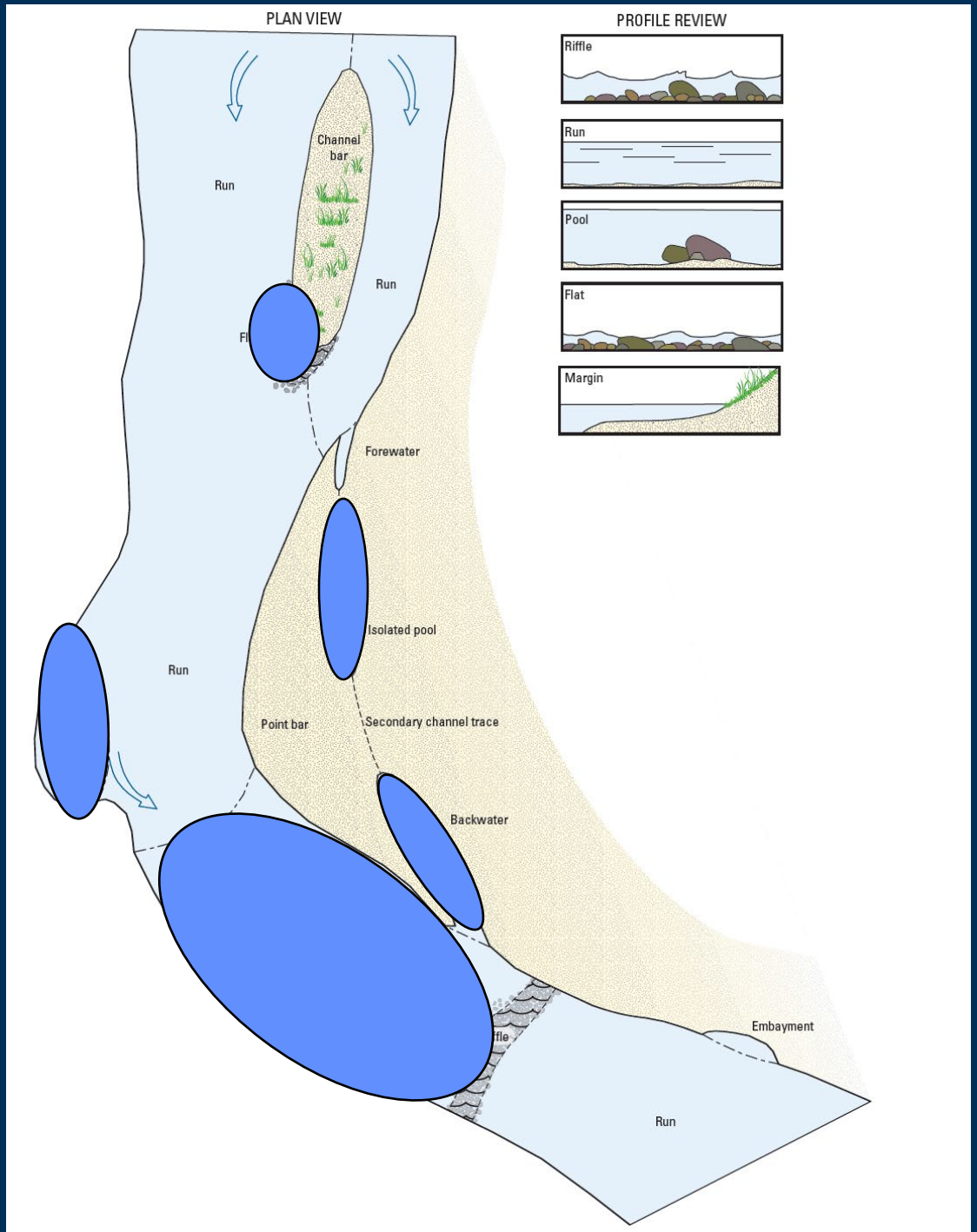


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Mesohabitat

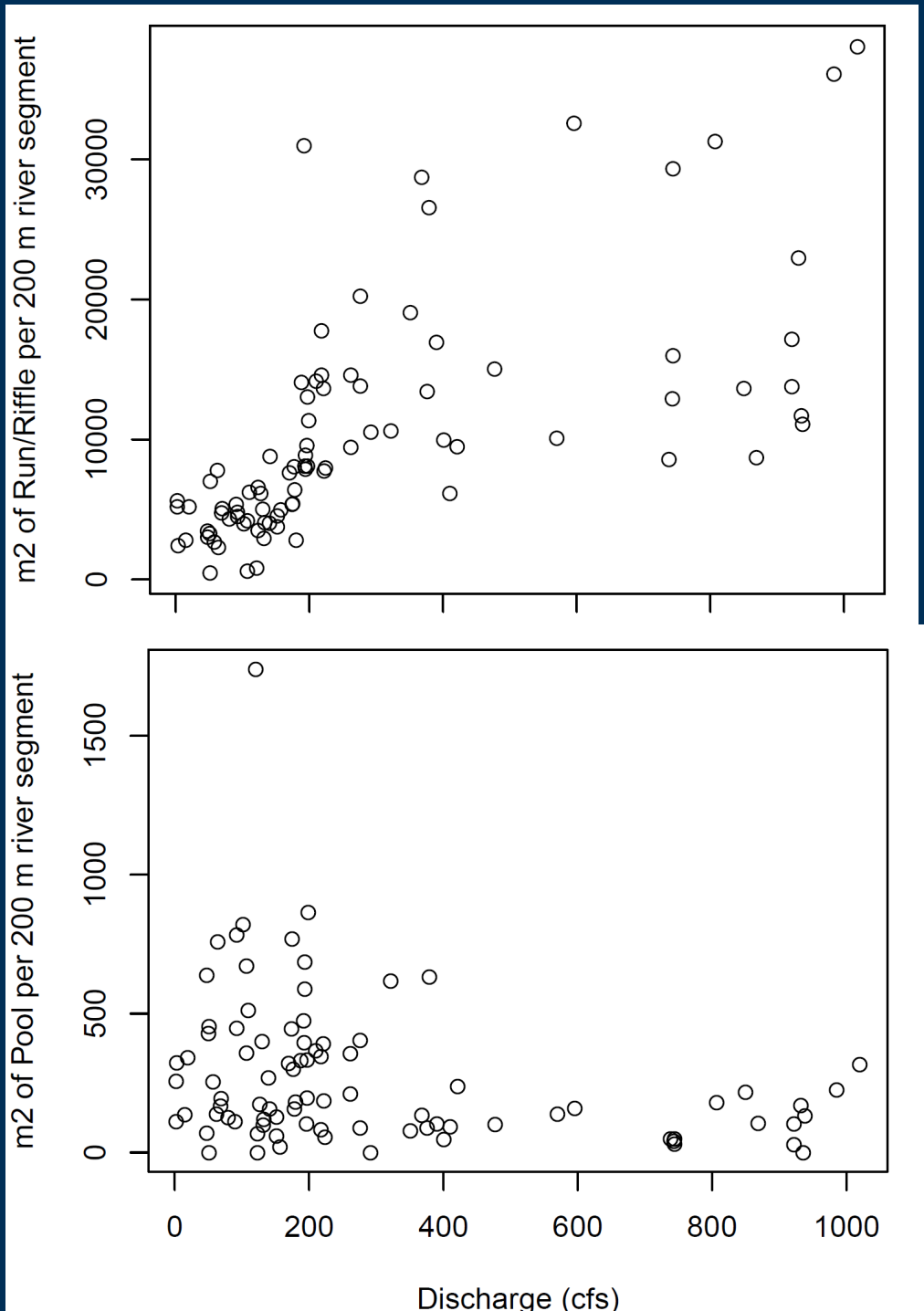
- Pool
  - ~4x catch rate of age-0
- ~25% of samples taken in pool type habitats



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Strata area

- For a stratified random design need to know strata area.



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Outline

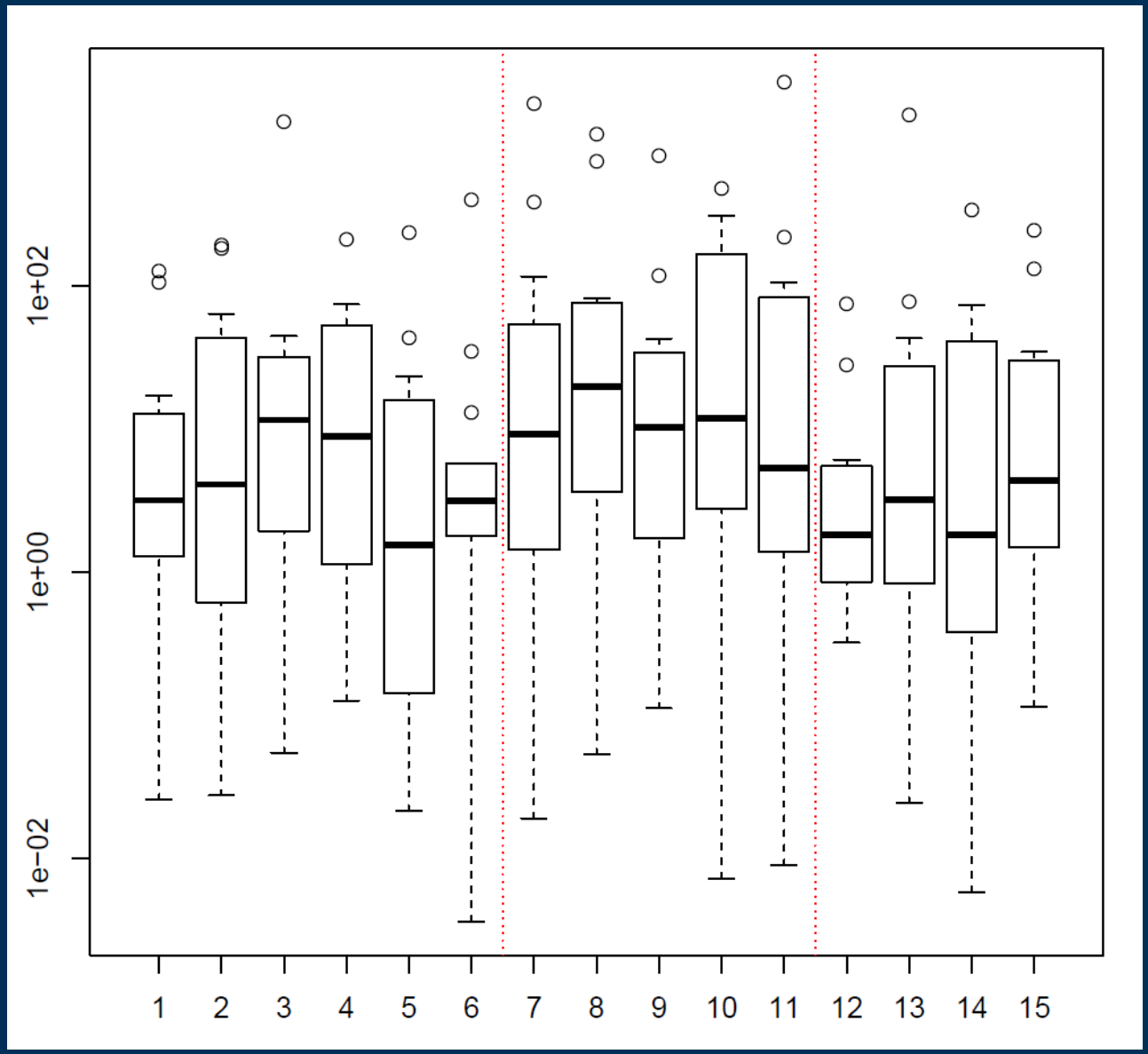
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Spatial questions

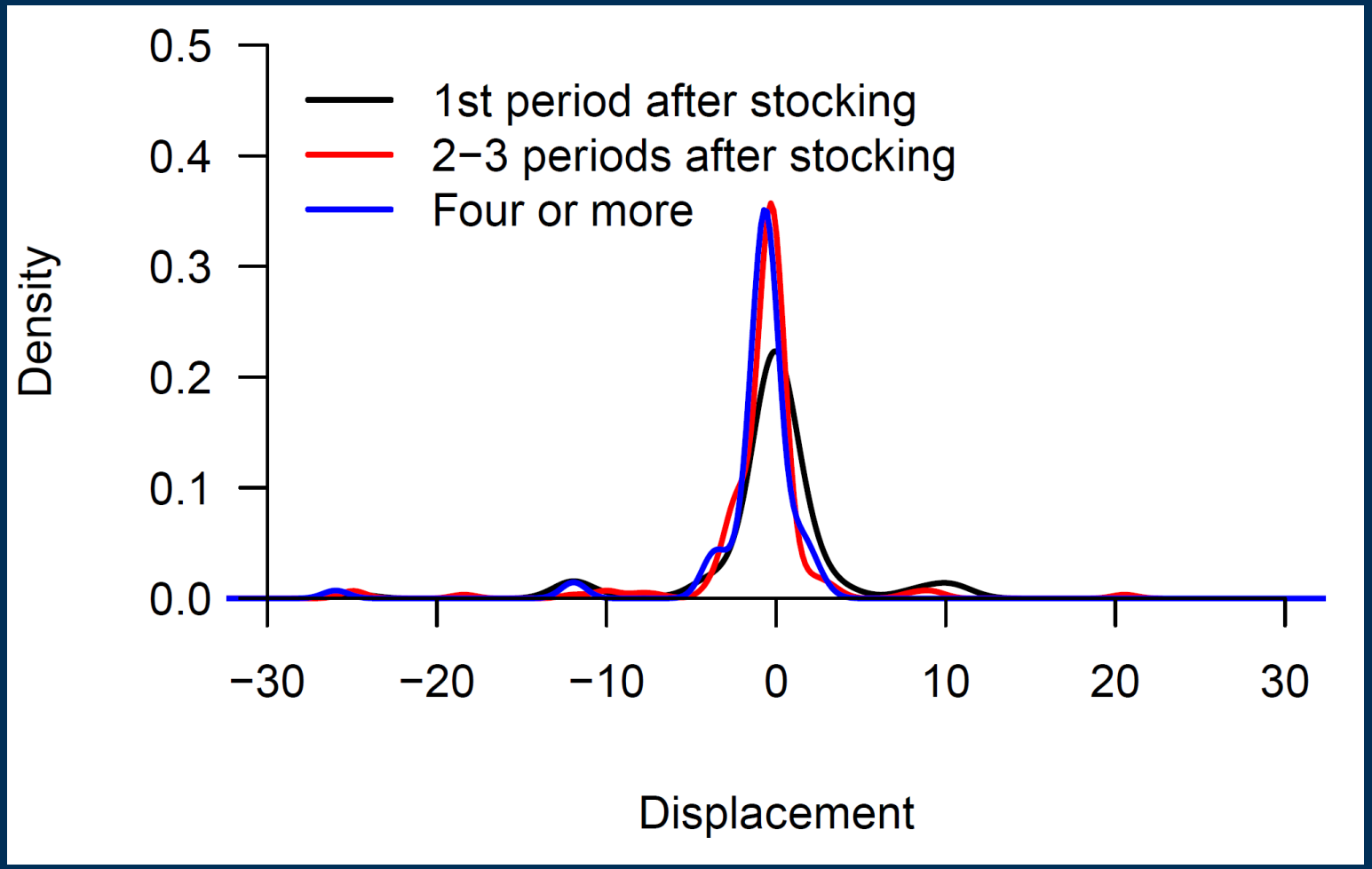
- How much do fish move? (to what degree are diversions barriers?)
- How much do stocked fish move? (difficult to interpret stocked fish data without this info)
- How much of reproduction is local vs. from upstream?

USGS



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Preliminary data, do not cite

Conclusion

- Not enough signal in these data to get at these spatial questions.
- Could revisit down the line if other data sources become available.
- Ended up taking very coarse approach (3 reaches)

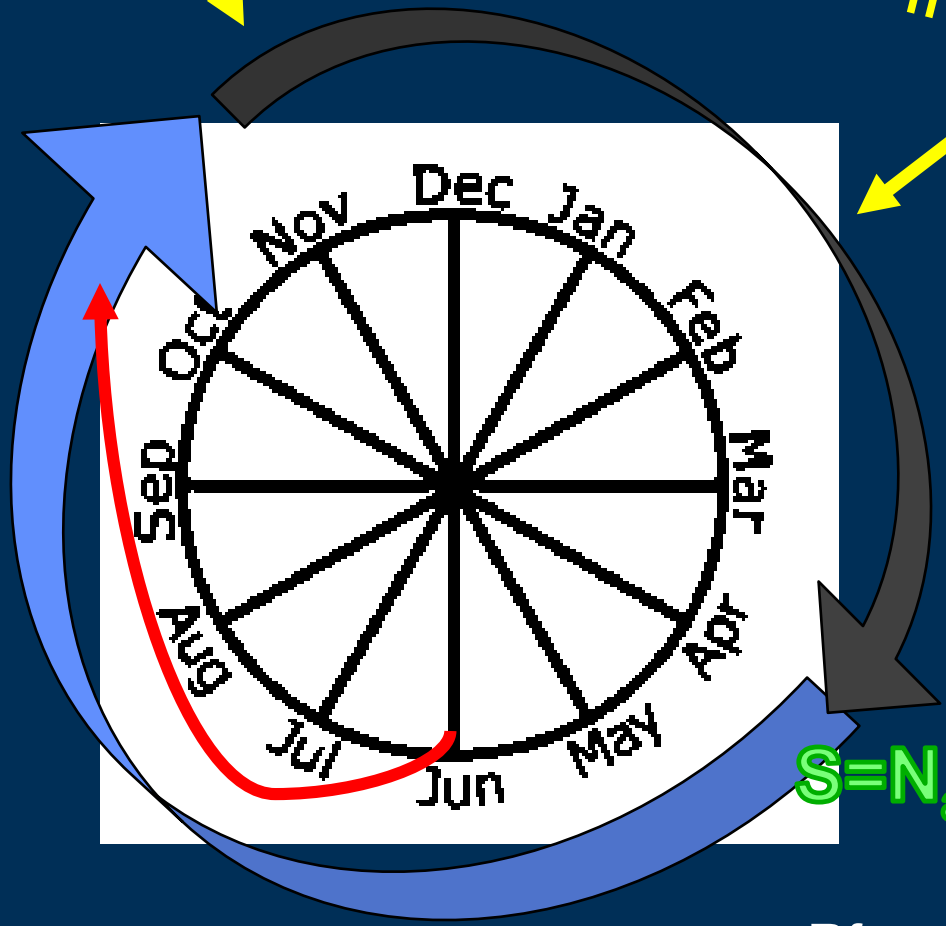
USGS

Outline

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USGS

Most stocking here or here – initial mortality



Survival assumed constant over "winter"

Monthly survival different until October

$S=N_{adults} + b*N_{stock}$

$R=aS/(1+aS/R_f)$

Rf – carrying capacity – function of flow/inundation

USGS

Underlying structure

- Project N over months in different categories (yoy, adult, and stocked) and different reaches (Angostura, Isleta, San Acacia)

- Catch (and effort) summarized by coarse habitat type and gear in each month for each category/reach.

- Predictions of catch (or N) compared between model and data

USGS

Details

- The amount of river that RGSM live in varies substantially, as does the proportion of run/riffle and pool habitat.
  - α – density in pools relative to run/riffle
  - Different for yoy and adult

- Model pool and run/riffle availability relative to discharge.

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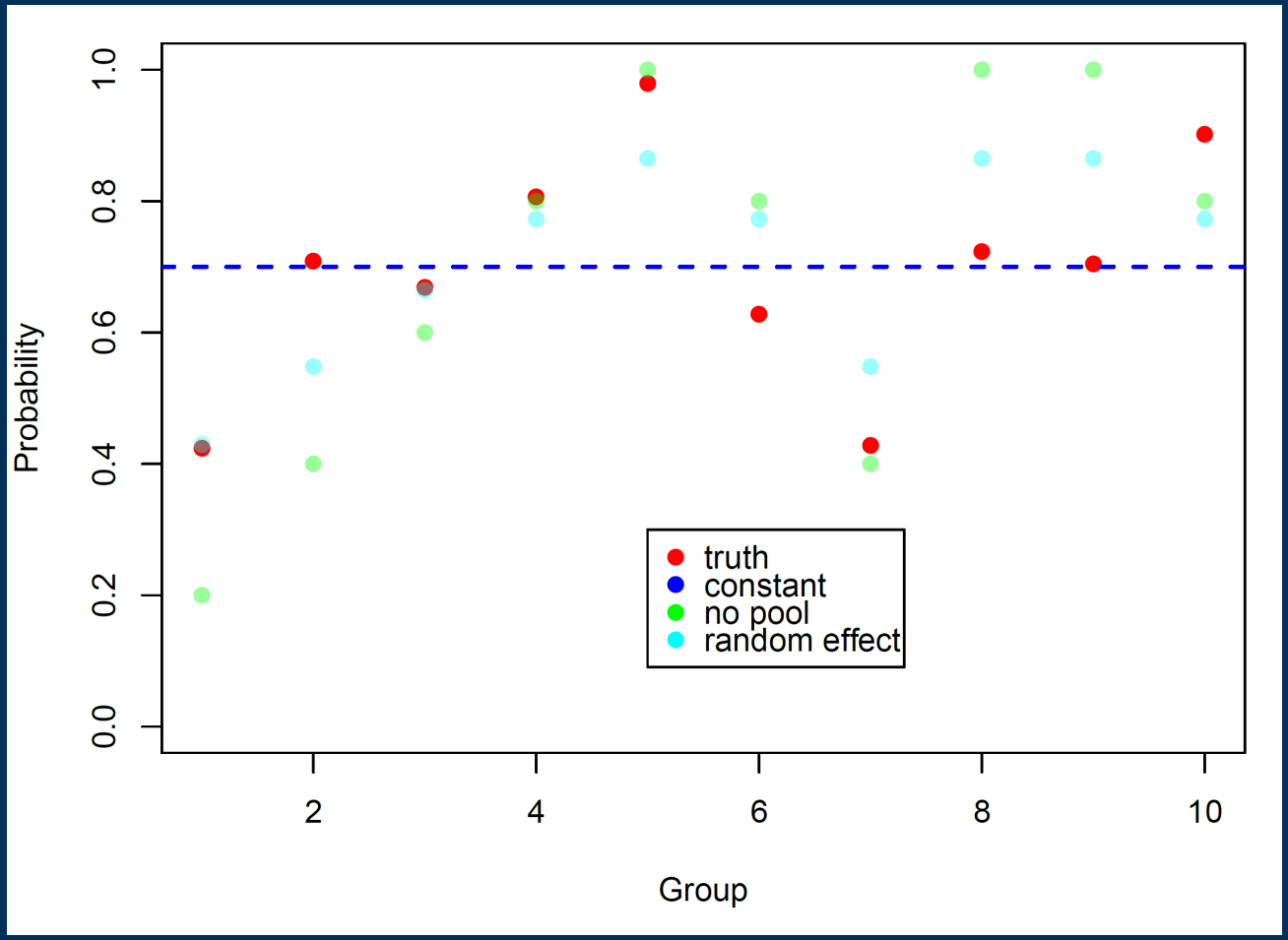
Details (continued)

- $N/(A_{rr}+\alpha A_p)$ – expected density in run/riffle
- $\alpha N/(A_{rr}+\alpha A_p)$ – expected density in pools
- Predicted catch = Density * p * area seined
- Use negative binomial to compare data to predicted catch

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Random effects and pooling

- Good option with sparse data.
- Can hide pattern if there insufficient statistical power.

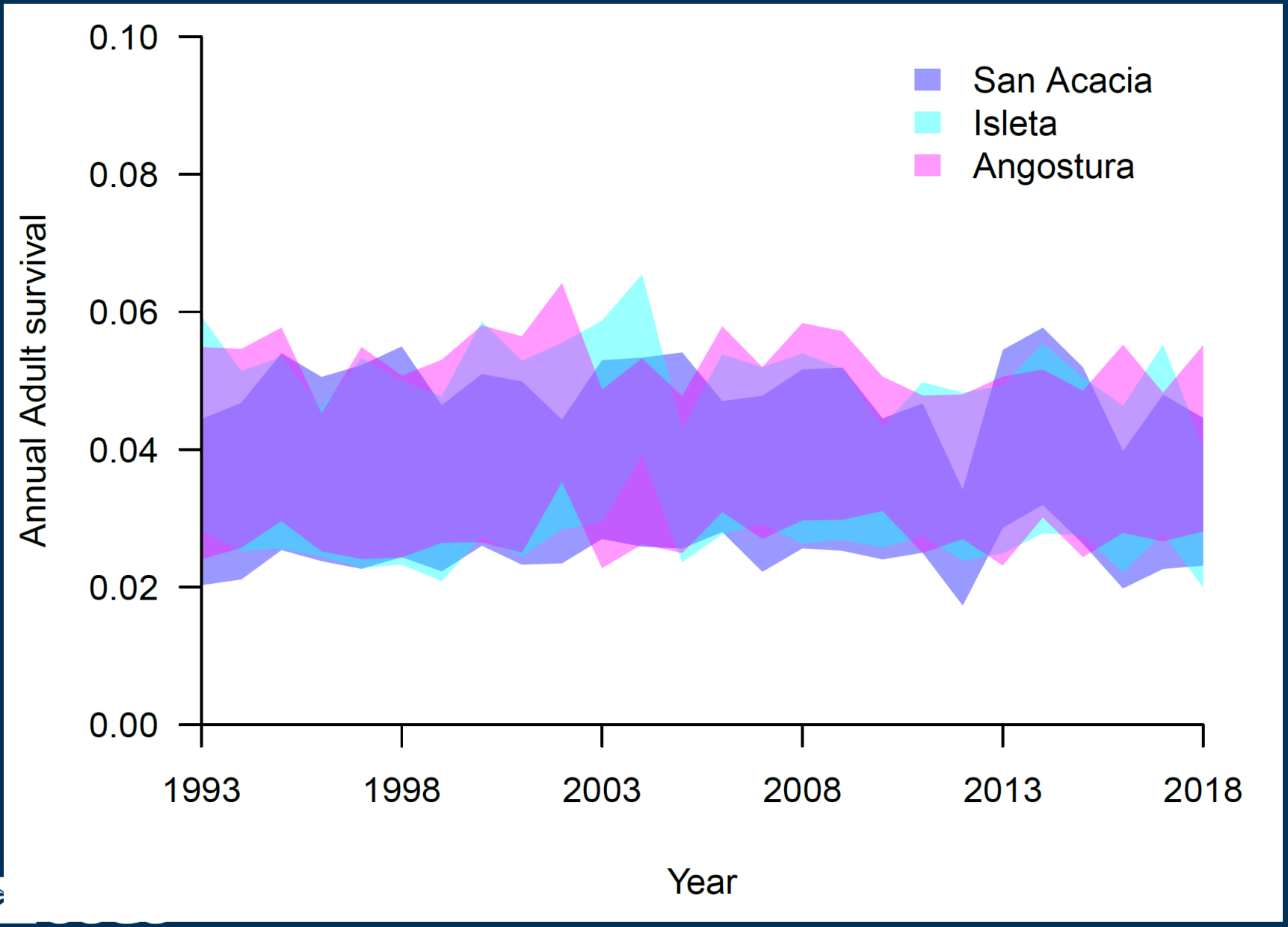


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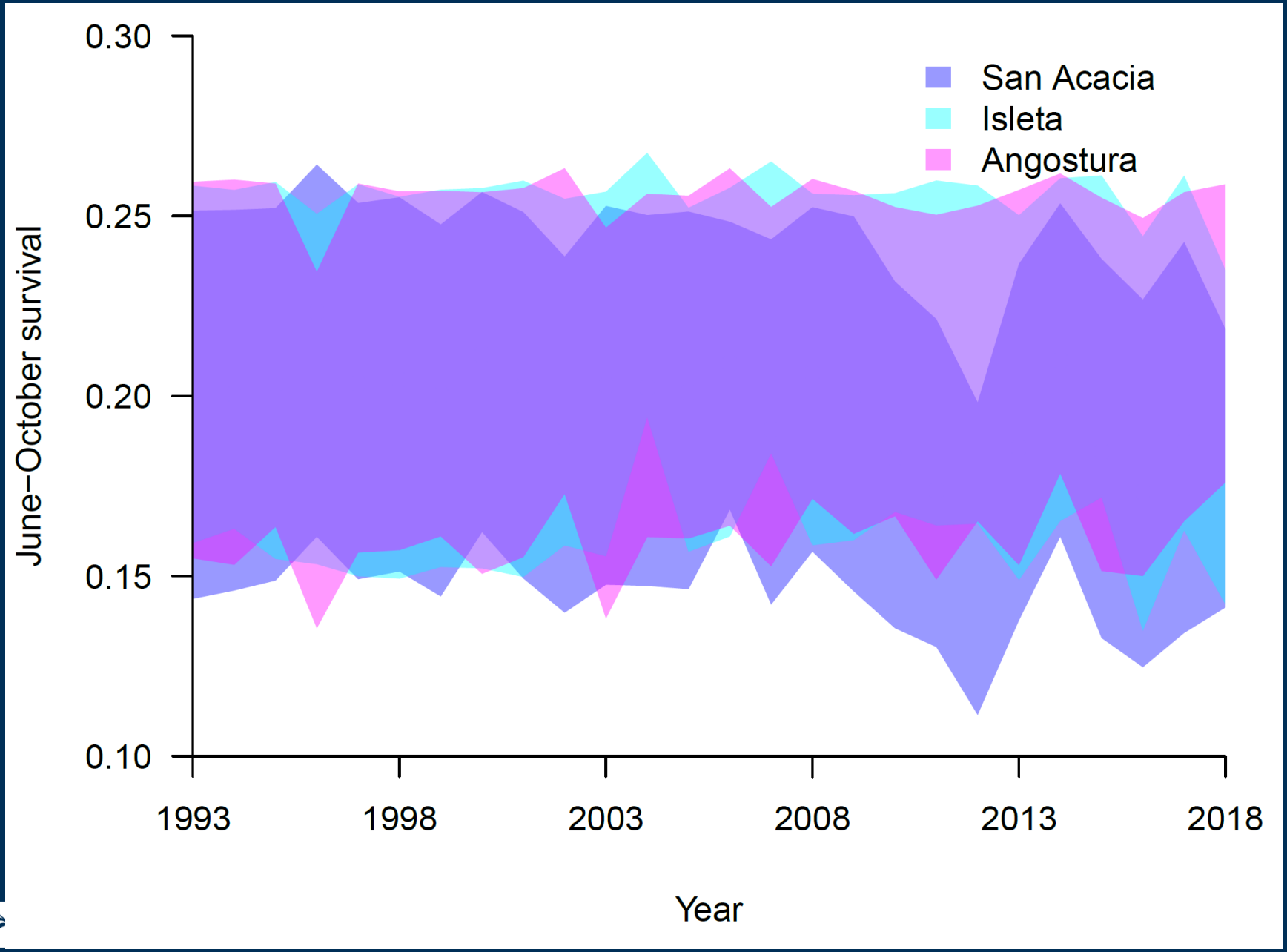
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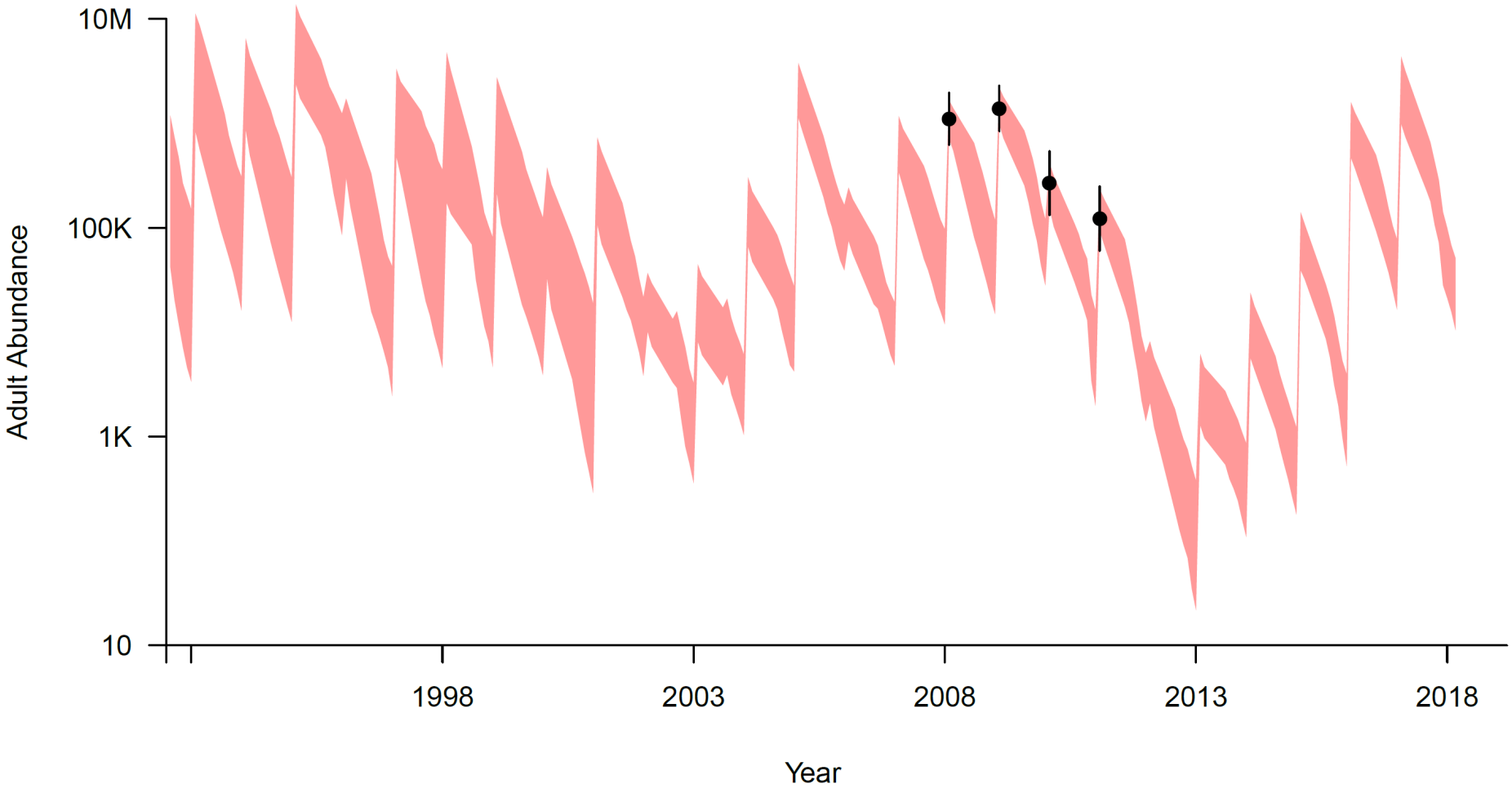


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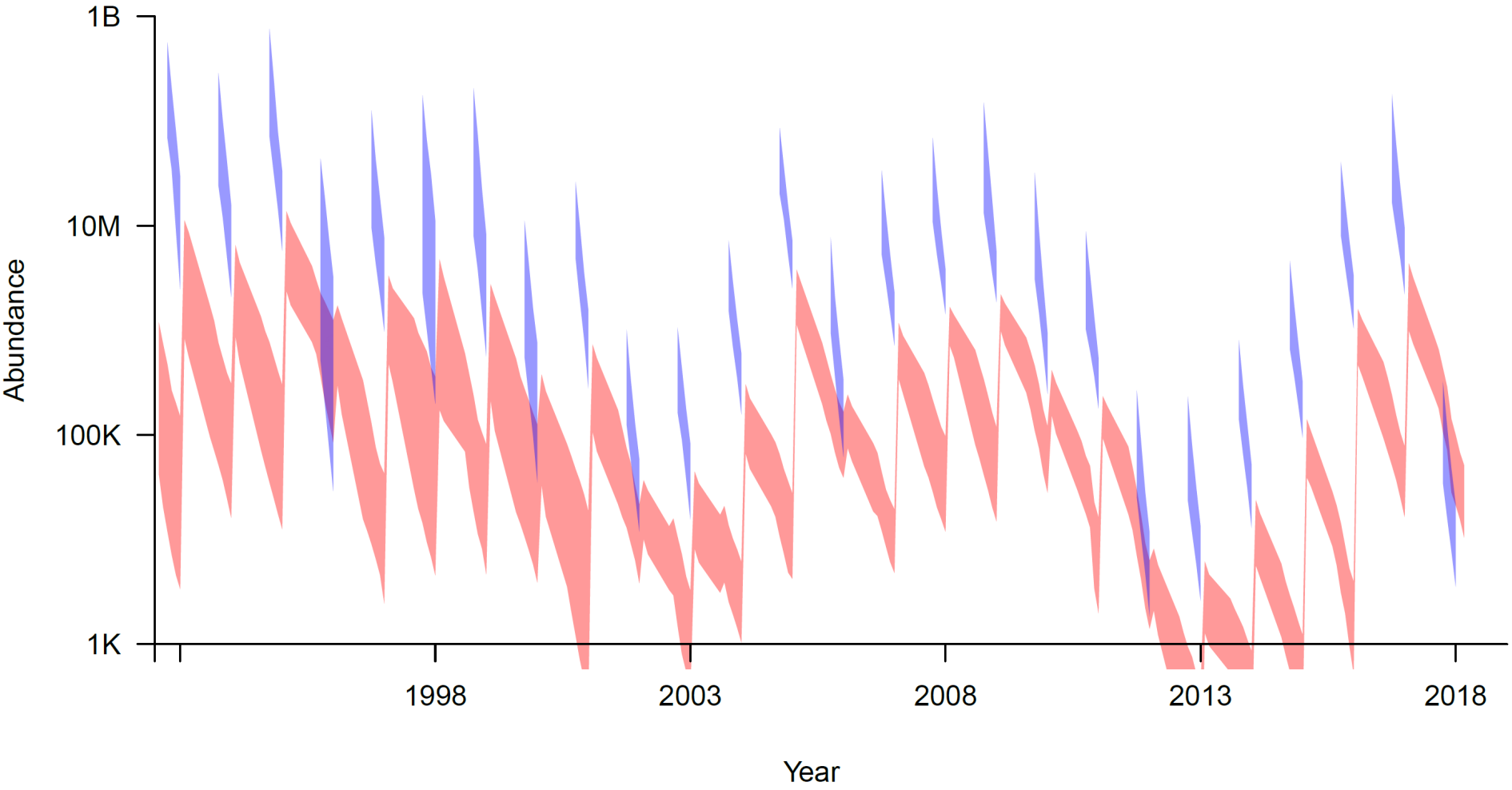
Black dots and standard errors are from population estimation program and are used as data in the model..increase each year occurs in October when age 0 are added to age 1+ population. Height of bars corresponds to 95% CI.



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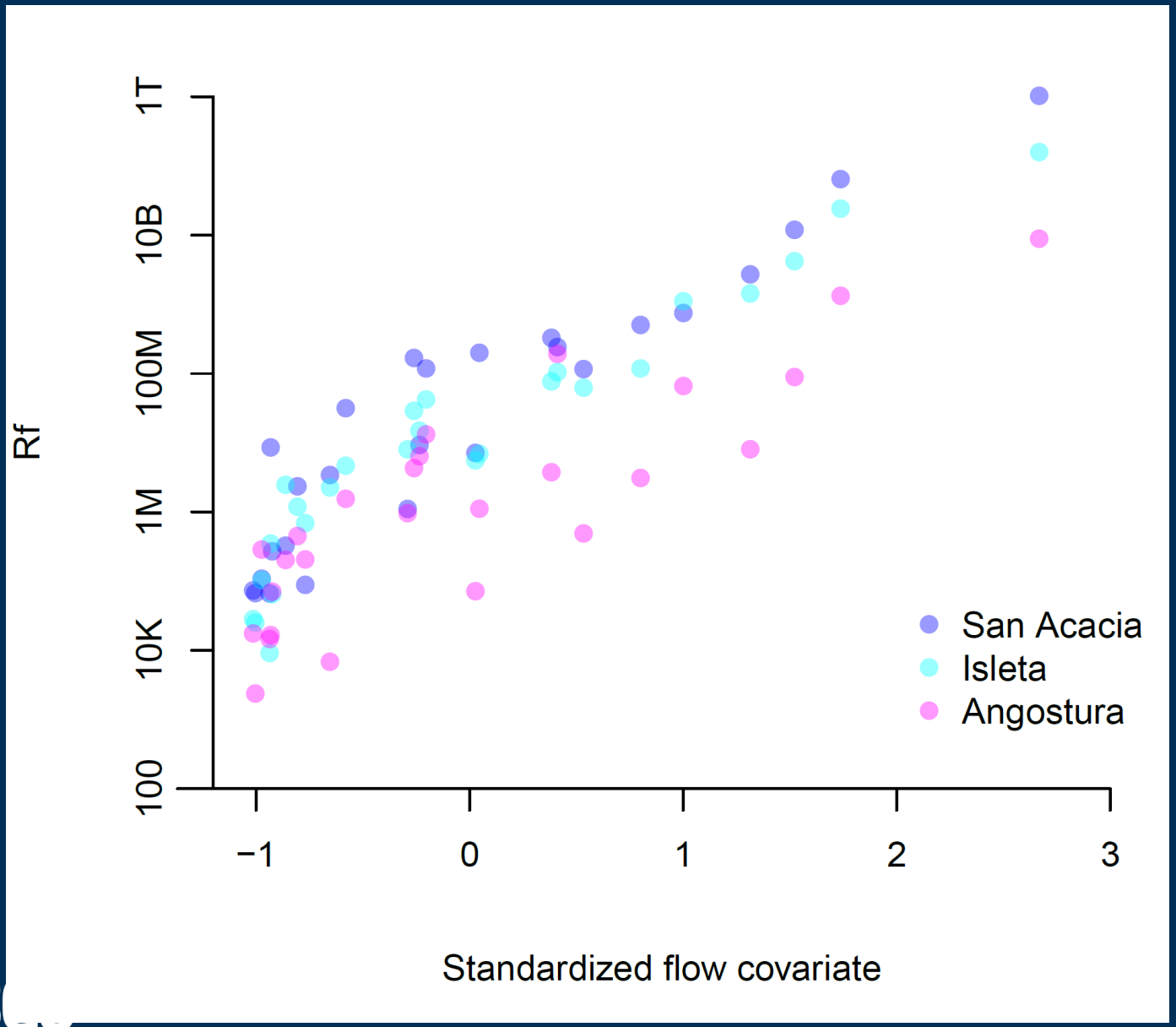
Red is same as last slide (age 1+), Blue are Age-0. Age-0 are only estimated from April to Sept and then transition to Age-1+.



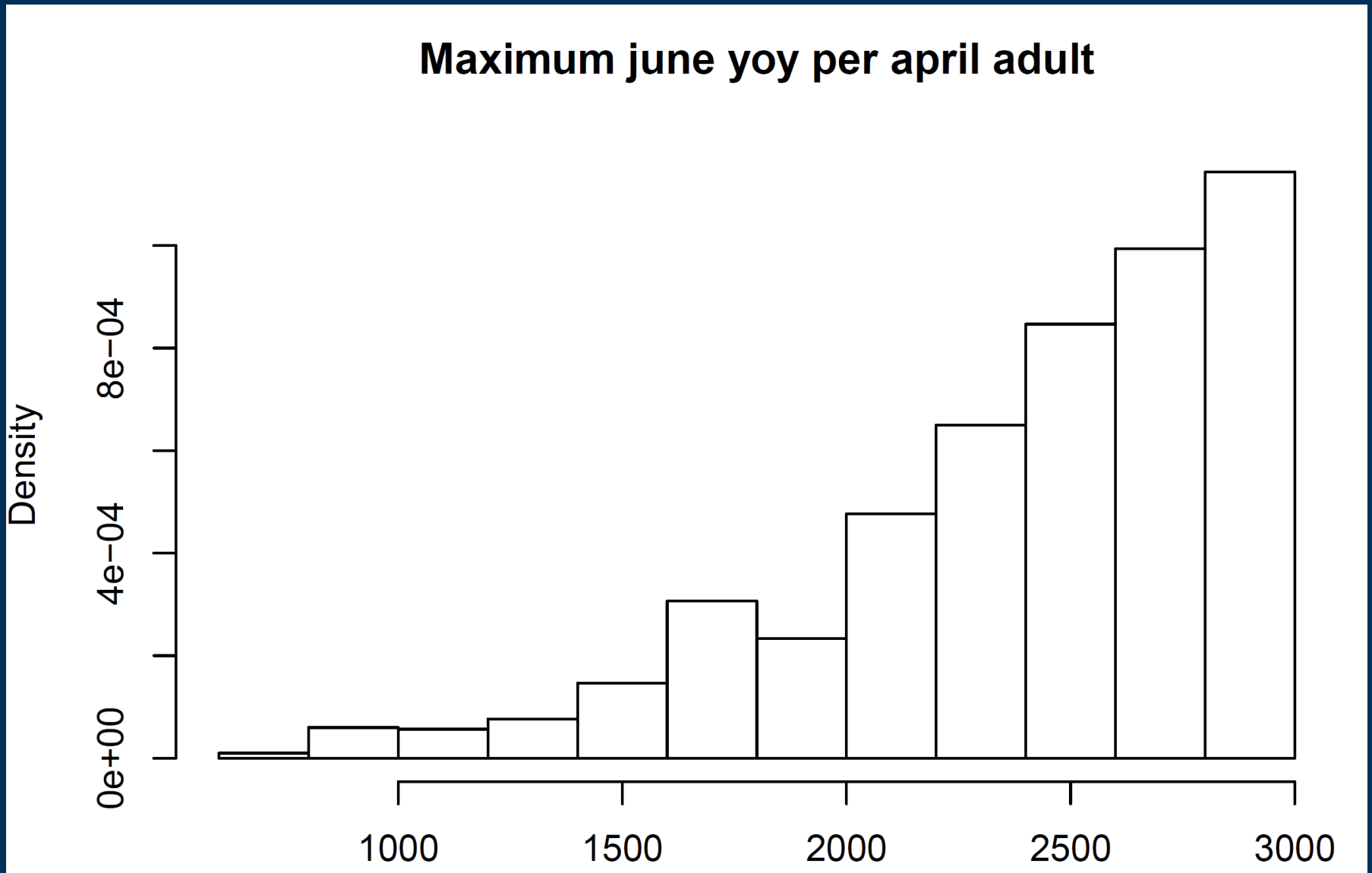
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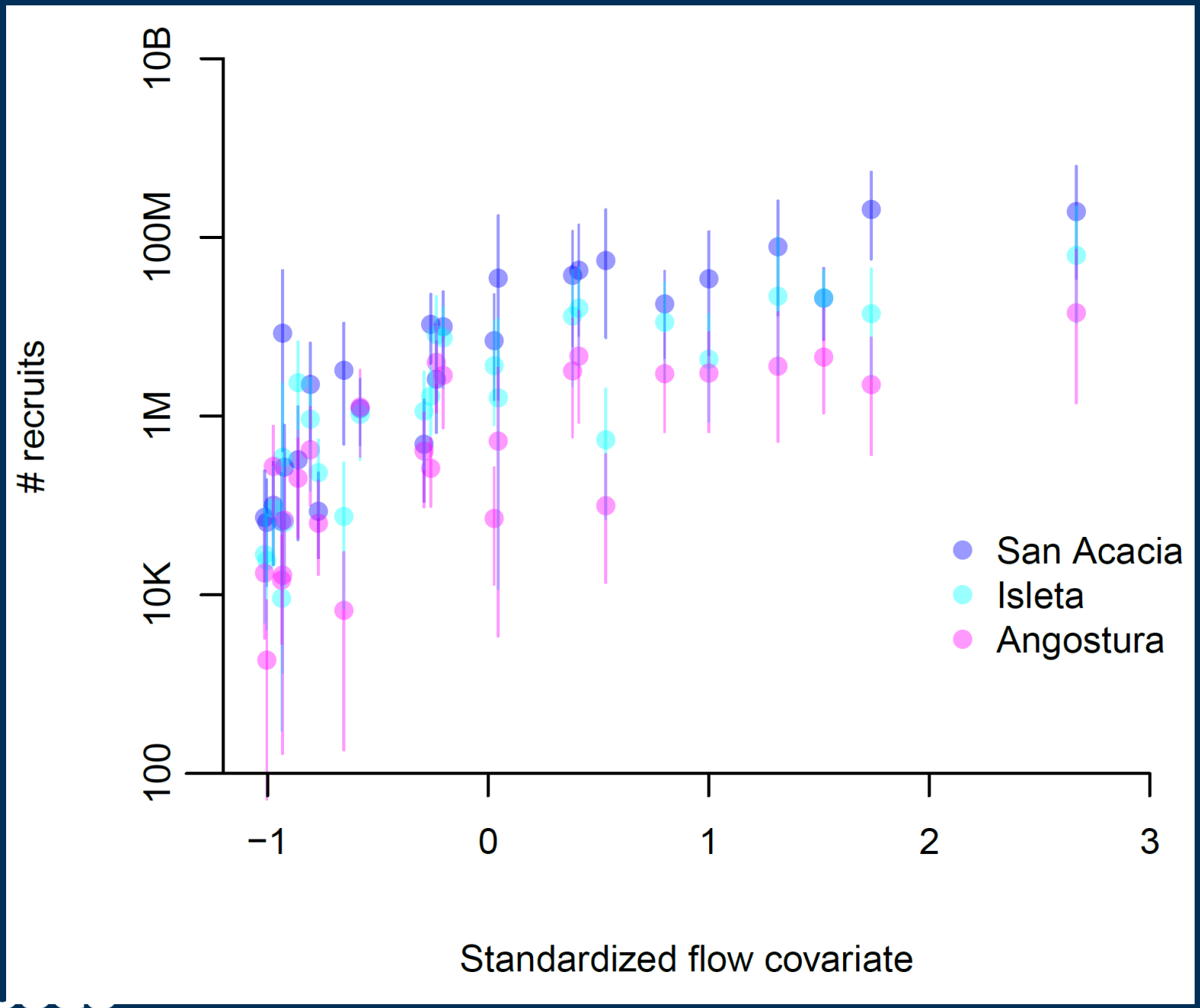
Rf is the reach and year specific carrying capacity.



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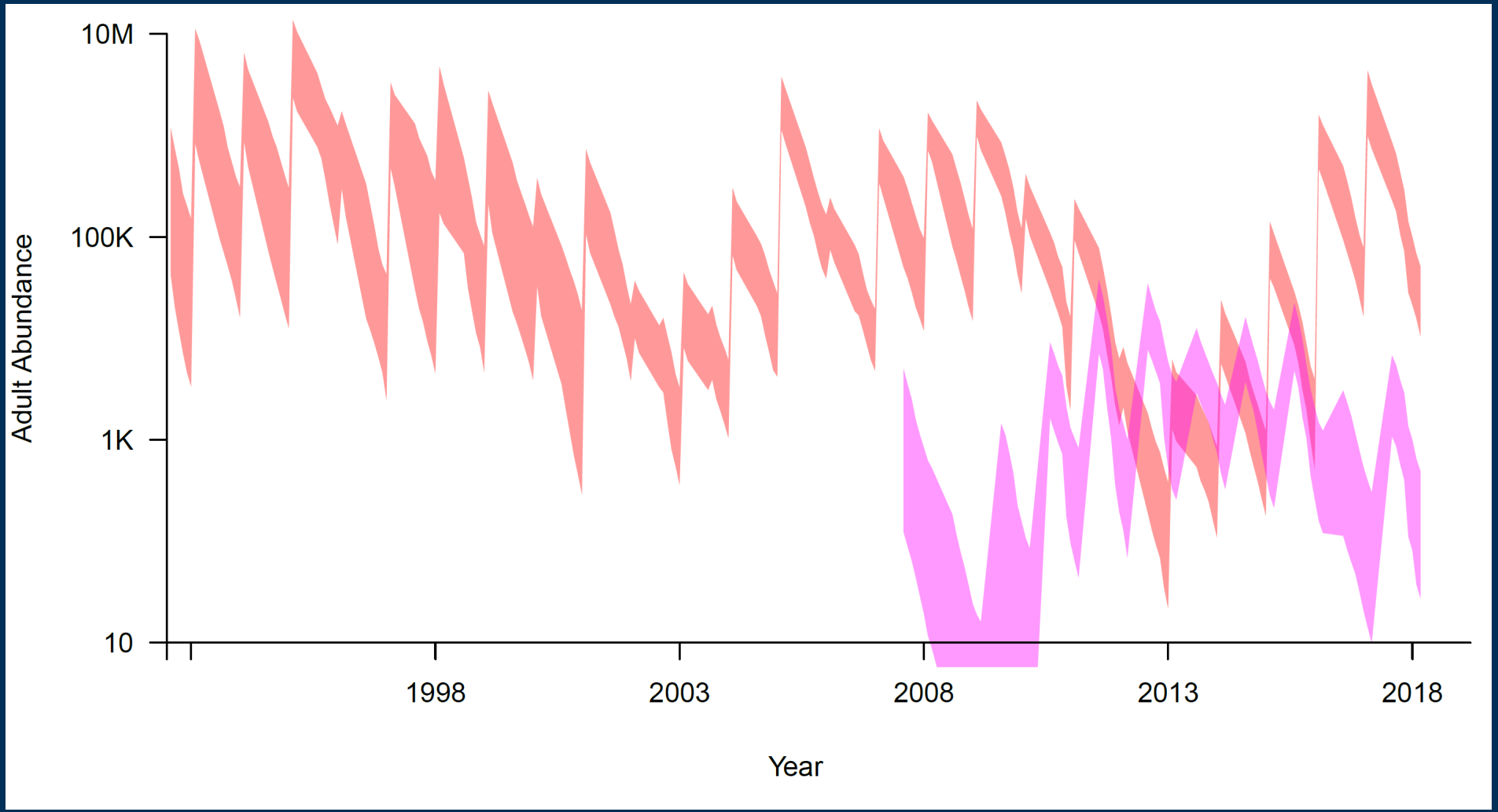


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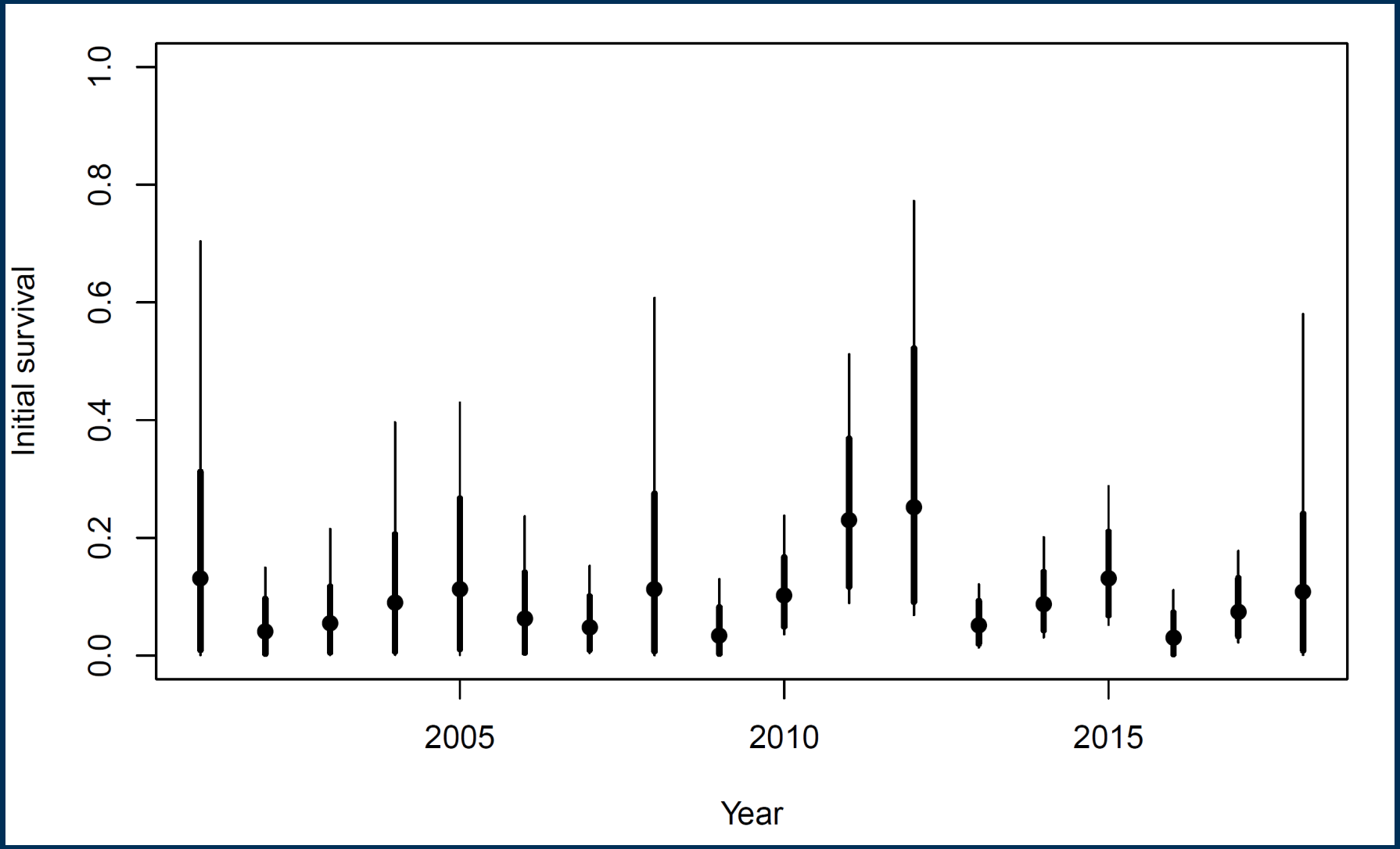
Pink is the number of stocked fish in the system (only added to model after they survive an interval so most stocked fish have to survive initial stocking mortality and overwinter mortality.



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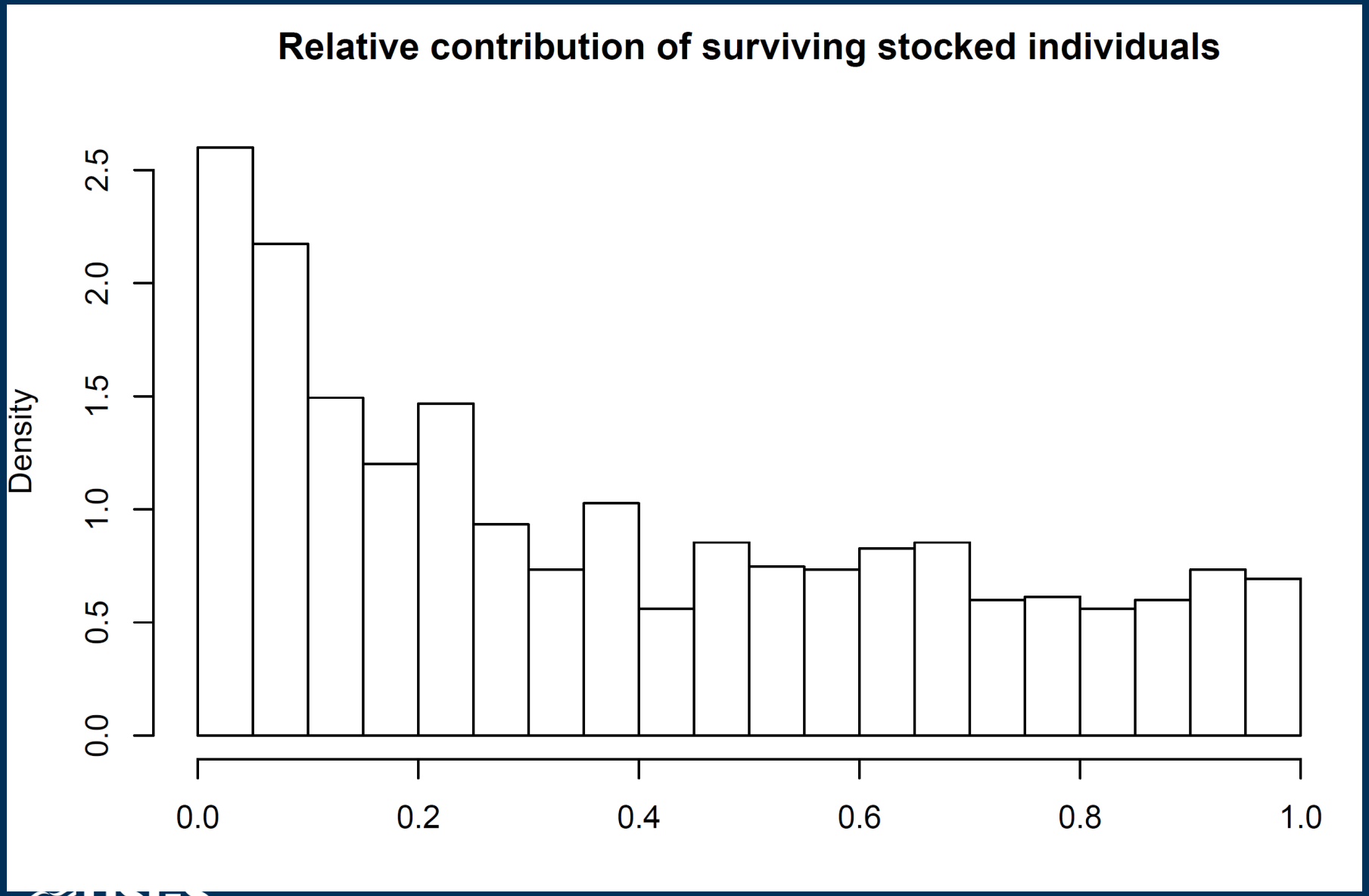
Preliminary data, do not cite

Initial stocking survival (potentially sensitive to spatial information and worthy of additional analysis).



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Preliminary data, do not cite



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Preliminary data, do not cite

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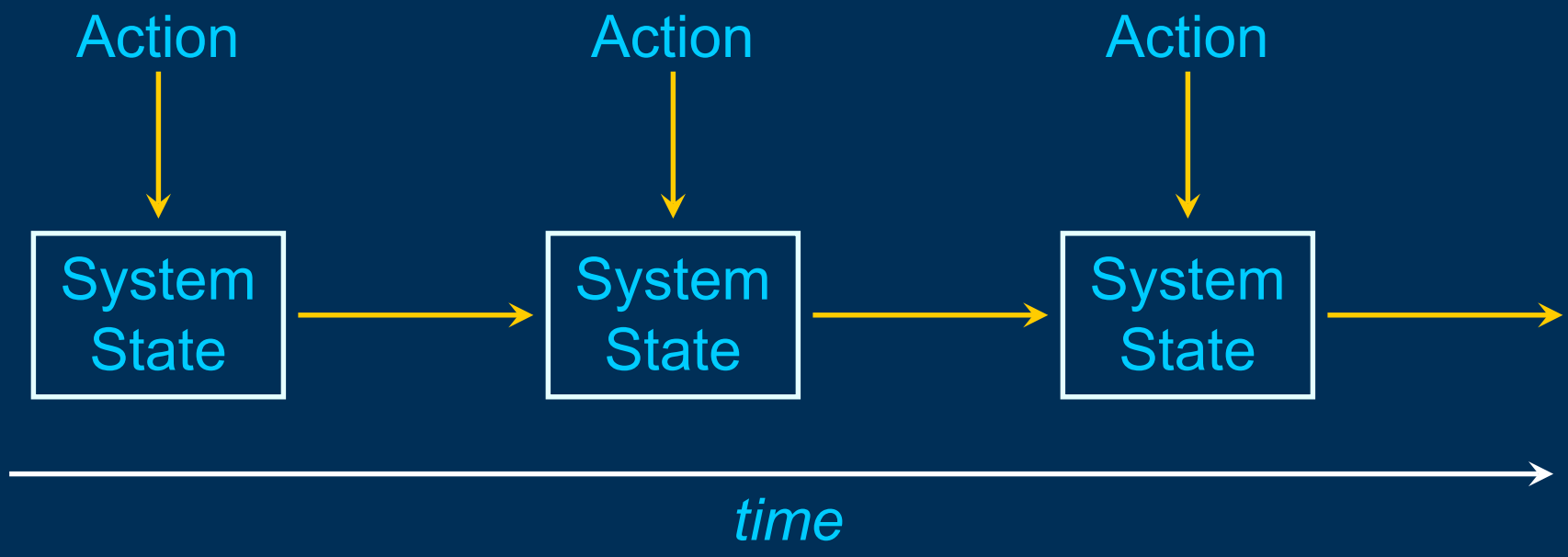
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Next steps

- Could improve habitat modelling – not using all the information.
- Could also improve analysis of stocked fish.
- At same time, don't want to wait for a "perfect model."
- "All models are wrong, some are useful" – Box

USGS

Science needs to improve predictions to be useful.
Process understanding (arrows)
State-dependent decisions (boxes)*



USGS

Prediction, models and management

- Very few ecological questions are definitely answered with single studies.
  - Biomedical studies –75-90% of published, preclinical results can be reproduced
  - Even worse when a single study with replication equal to 1 or 2

- But statistical significance shouldn't be basis for management decisions (Trends)

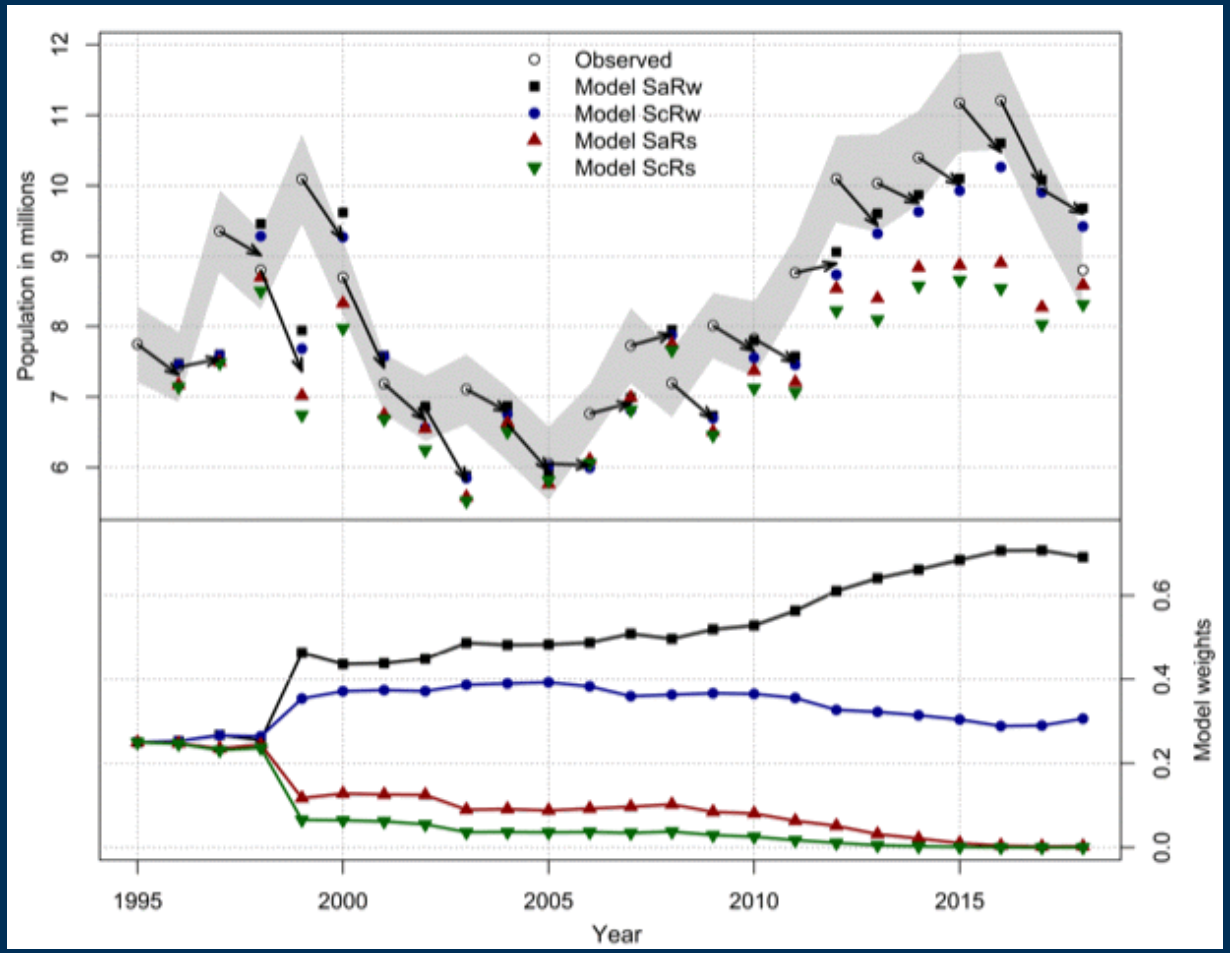
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A working example of Adaptive management: Mid-Continent Mallard Harvest

- Initiated 1995
- 4 distinct hypotheses
- Abundance estimated by aerial survey
- Model weights updated: comparison of estimate with predictions

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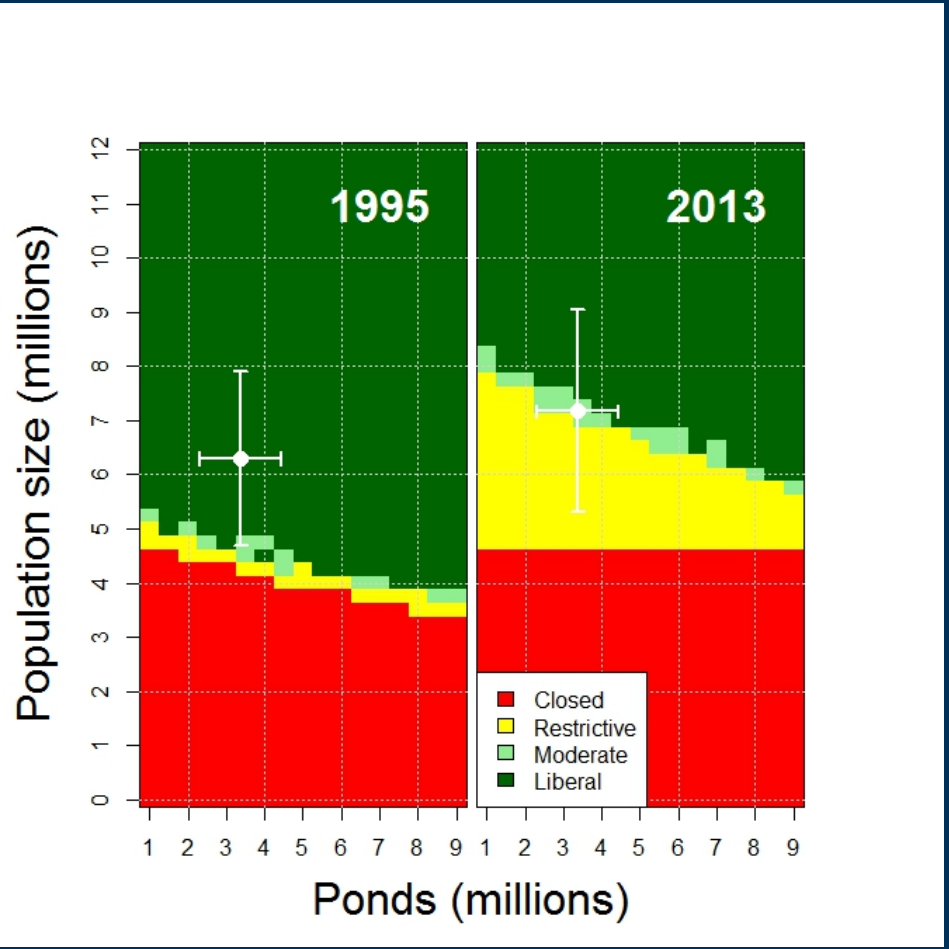
Mid-Continental Mallard Harvest has been informed by 4 models for over 20 years with model weights updated over time to reflect learning from data



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Nichols et al., 2019

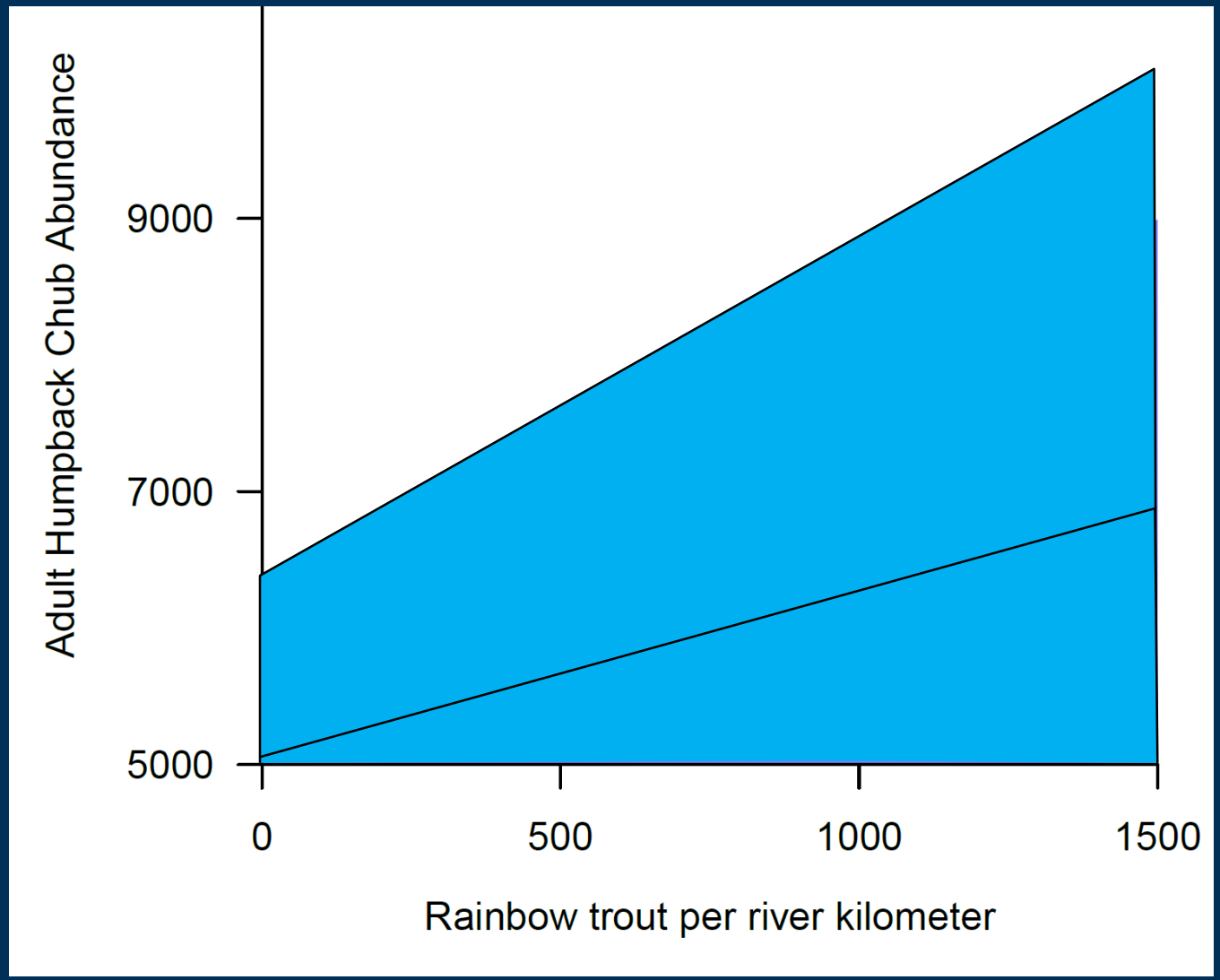
Harvest policy has been updated adaptively with differences in model weights



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Nichols et al., 2019

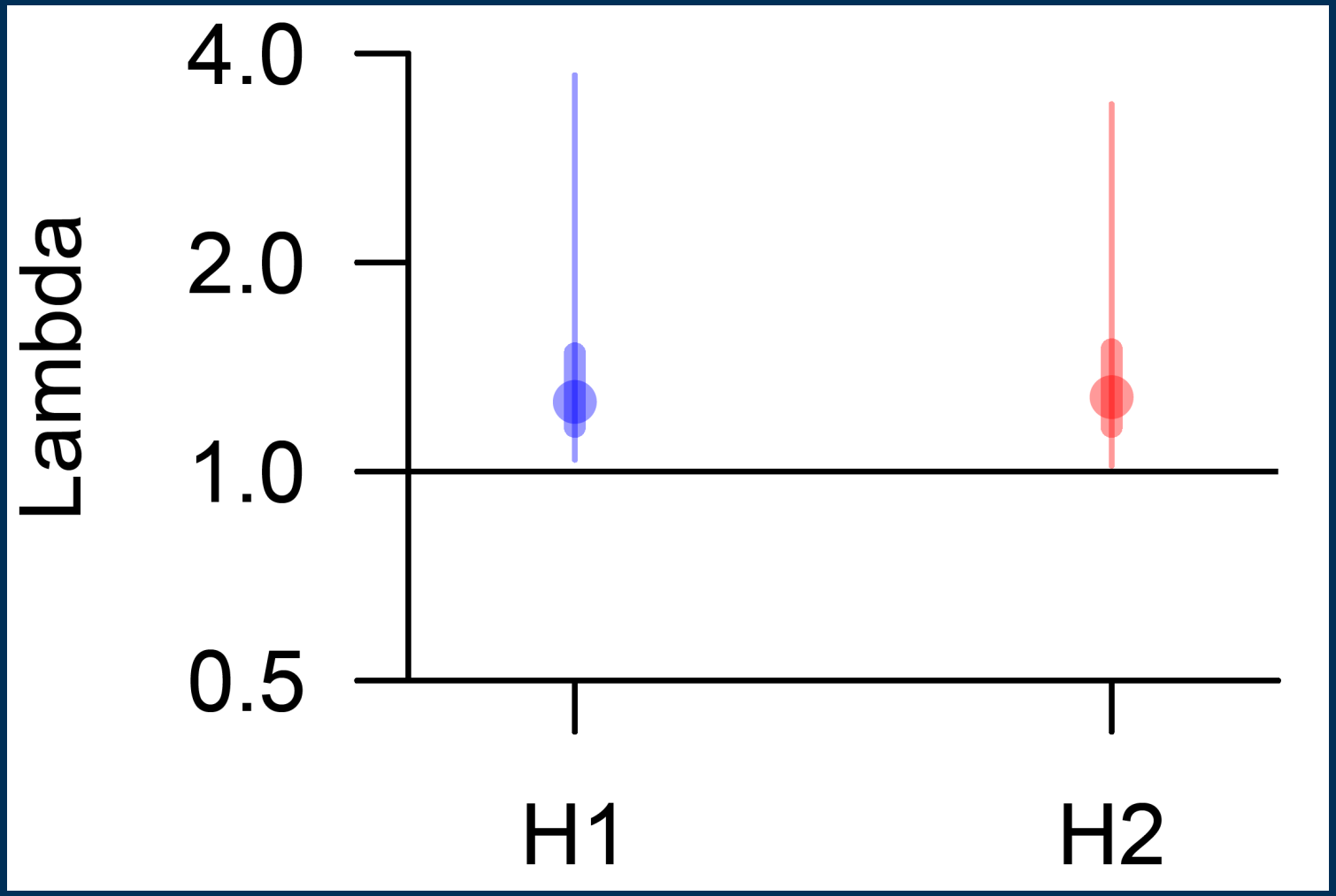
We have been working to develop similar approaches for updating decision rules with monitoring results



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Adapted from Donovan et al., 2019; Yackulic et al., 2019

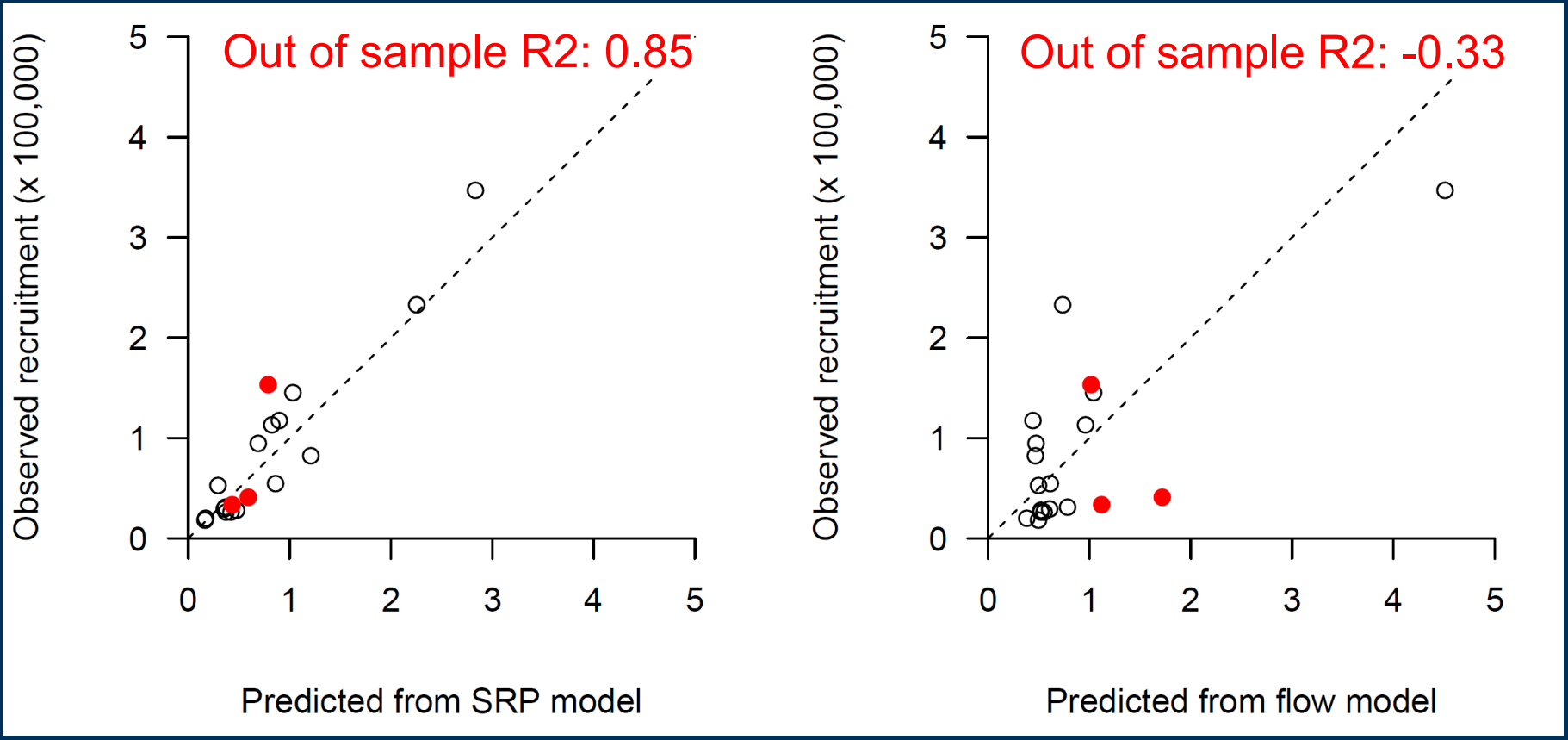
There is no doubt population growth will continue if things don't change



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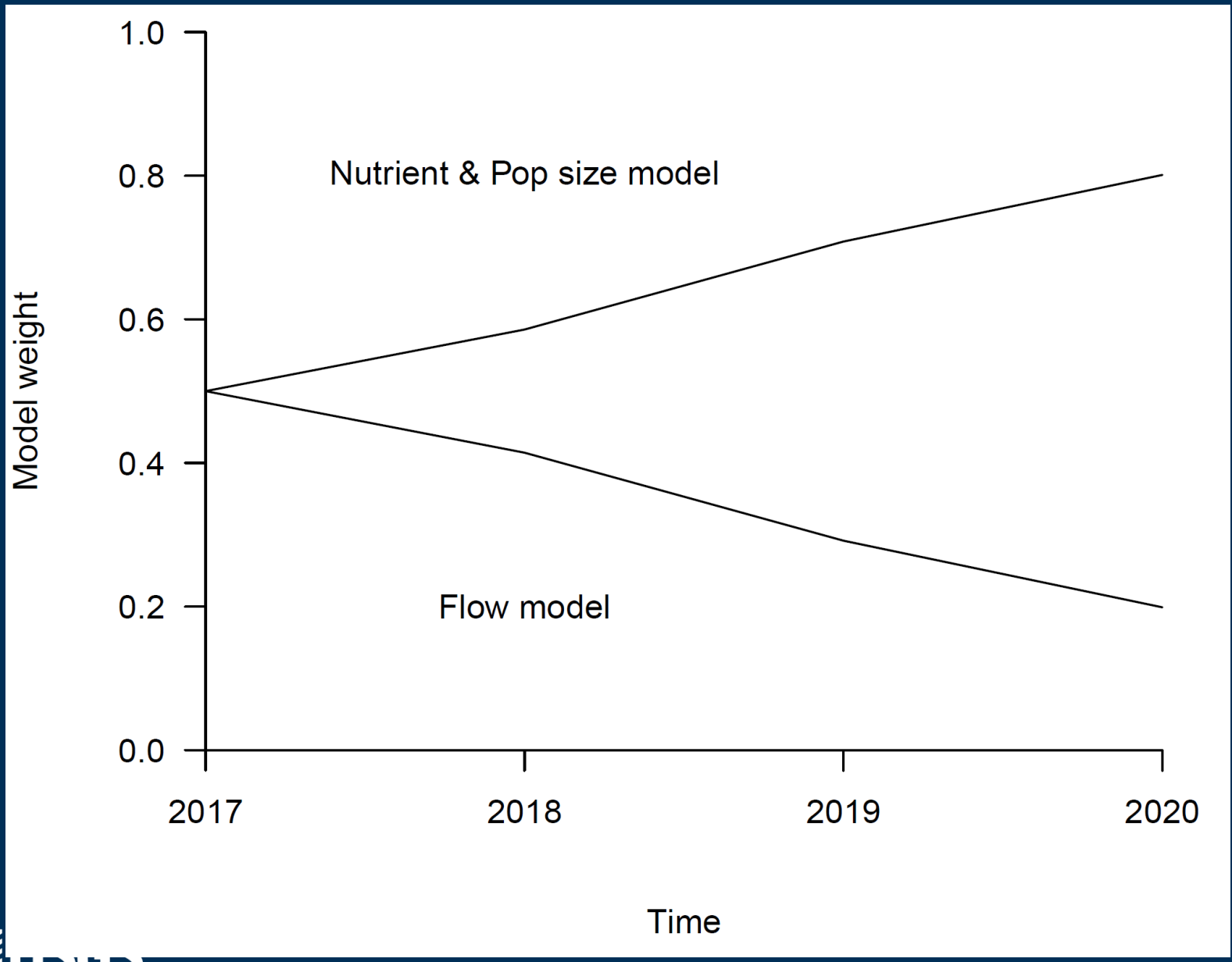
Rainbow trout recruitment models fit for 2017 annual reporting meeting



Model using SRP and existing rainbow trout population size as covariates previously outperformed model used in LTEMP EIS.

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Preliminary data, do not cite



Preliminary data, do not cite

Summary Table of Stakeholder Responses to Questions about the Integrated RGSM Model.
Compiled February 21, 2020 by Joel Lusk

Category->	Use Model to evaluate water management actions (spring mgt options, vs drying, costs)	Use Model to answer pop parameters, dynamics or recovery	Use Model to evaluate reach metapops	Use Model to quantify various effects to population or individuals	Use Model for evaluating augmentation or salvage activities	Use Model for evaluating habitat or habitat restoration	Use Model to evaluate CPUE confidence or other reliability
	11	8	2	4	4	7	2

The PMWG sent a survey to the MRGESCP stakeholders in October 2019 to elicit the more important questions of the model that stakeholders would like to see addressed. The following are responses to this survey, without attribution as to the identity of the stakeholder:

Example Questions from Survey:

1. What does a self-sustaining population of silvery minnows look like in the Middle Rio Grande according to this population model? How many individuals, sexes, and ages does the model predict are most likely present in the different reaches by season?
2. How does this modeled population respond to different types of water management actions? What is the expected measurable effect of intermittency, river drying, spring flow augmentation, or habitat restoration efforts on the modeled population?

Responses:

1. The questions in #2 above are the questions that I would like considered.
2. What does a self-sustaining population of silvery minnows look like in the Middle Rio Grande according to this population model?
3. Agree with above questions; also consider modeling response of salvage and augmentation management actions (inputs and removals from population).
4. For spawning: Is flowrate the important parameter, or is it really the amount of overbank flow? How do we balance flowrate with duration of peak flow, given that in years when the peak must be actively managed, water volume is limited? If water is very limited (as in 2018), what is the best balance to be struck between river continuity (i.e., drying) and some sort of pulse flow? general: Given that we have seen extremely high densities following years with zero or very low October densities, how much confidence do we have in the way we monitor and measure minnow density? And how low can density go and the minnow be able to recover? What are the impacts of things we have little to no control over, like water quality?
5. I have questions about the efficacy of river connectivity during the irrigation season, which is often maintained using very low flows, e.g., a few cfs due to pumping at the BDA south boundary pump channel. (1) Are these low flows supportive of minnow survival and, if so, how is that measured? (2) Is there an alternative to "low flow

connectivity" that would make better use of these small amounts of water for species survival?

6. Does fish rescue during summer affect the population in October?

   How does the model handle meta-populations in the existing reaches and future experimental populations?

   Does the model evaluate the reproductive contributions of the various age-classes?

   Will model outputs be suitable for matching with action costs for a cost benefit analysis?

7. The Water Authority would like to know the vital rates for the various age-classes of RGSM with a sensitivity and elasticity analysis to demonstrate which age-class will contribute the most to fitness and population growth. I believe this information is critical for making management decisions that require trade-offs.

   We would like to know estimates of variance from demographic and environmental stochasticity, and how that impacts vital rates for each age-class. Understanding these parameters could help with narrowing uncertainty when enacting different management decisions to maintain or improve vital rates, especially when trade-offs are involved.

   We would like to know how habitat availability affects vital rates for different age classes. There is a lot of evidence that inundated floodplain in spring is beneficial to larval survival, but what is the relationship between area of inundated habitat and successful recruitment? There is a lot of uncertainty with respect to which habitats may improve adult survival throughout the year. I would like the model to be able to test alternative hypotheses for habitat and adult survival through different seasons.

   Overall, we would like the model to be a tool for testing competing hypotheses with respect to population dynamics, population management, habitat restoration, and water management activities.

8. What is the RGSM population benefit for a unit volume of water?

   Is this an annual volume of water? Or a periodic requirement (2-3 year intervals)?

   What are the trade-offs for using water (volume) for recruitment flow versus reducing river drying?

Will the model support identifying alternative strategies for floodplain inundation for RGSM recruitment?

9. The habitat requirements for the silvery minnow throughout the year and how the availability of habitat affects the population of RGSM. On habitat we need to know the category of habitat we are discussing, for example in-stream vs off-channel type of habitat. This then relates to the time of year these habitats can be occupied. Also water quality, width-length-depth of wetted river channel, food sources, etc.

   The question above are good, are they achievable with this model?

   How much information and how reliable will modeling fish response to flows be?

Appendix A: Tables of Science Panel Recommendations

Table A-1. Recommendations and observations from the Hubert et al. (2016) Population Monitoring Science Panel. The Science Panel did not assign priorities to these recommendations and observations, but priorities were assigned by the Population Monitoring Work Group (PMWG) to the recommendations. Priority: 1 = high, 2 = moderate, 3 = low, 0 = no consideration by PMWG.

Number	Page	Recommendation	Panel Priority	PMWG Priority
1	28	Separate the catch and effort data from the small-mesh seine and the fine-mesh seine into two data sets and compute separate CPUE indices for each gear type, as well as for individual age classes captured in each gear type.	--	1
2	28	The CPUE from the small-mesh seine is primarily an index of the relative abundance of a single cohort of RGSM (i.e., the most recent cohort) that is recruited into the gear late in the summer and captured into the summer of the following year. The precision of the index can be improved by exclusion of older cohorts. A separate CPUE index can be computed for older cohorts. Consider the use of length-at-age data and frequency histograms to identify cohorts.	--	1
3	28	Only larval fish should be included in the computation of CPUE indices from the fine-mesh seine because of this gear's selectivity for this life stage.	--	1
4	28	An aspect of the CPUE data that warrants attention is the treatment of zero catches in data analyses. Inclusion of dry sample sites as zero CPUE values when analyzing CPUE data for RGSM in the MRG should be avoided. Field data records and the database in which the RGSM CPUE data are stored allow dry sampling sites to be distinguished from sites that were sampled and no RGSM were caught. The problem arises during statistical analyses because the naughty naughts (observations of zeros at dry sampling sites) are treated in the same manner as the zero catches at fished sites where no RGSM are caught.	--	1
5	28	Survey designs should strive to minimize false zeros resulting from: (1) an inappropriate sampling design (e.g., sampling in mesohabitats avoided by RGSM) and (2) ineffective survey methods (e.g., insufficient sampling effort to detect an organism when it is present).	--	1 and 2

Number	Page	Recommendation	Panel Priority	PMWG Priority
6	29	The proportions of various mesohabitat types sampled are likely to bias CPUE indices because the catchability coefficient probably differs among mesohabitat types and RGSM are likely to be selective for specific mesohabitat types. We recommend that better understanding of the influence of mesohabitat type on CPUE be developed and used to account for variability in CPUE indices. Further, we recommend that estimation of mean site-specific CPUE be improved by addressing the variable number of mesohabitats that are sampled at any given site and the amount of sampling in each mesohabitat type. We recommend estimation of mean site-specific CPUE from individual seine hauls (which are distinguishable in the database as of 2006); mean CPUE at each site is then computed from the individual CPUEs at each of the 18-20 mesohabitat units sampled per site.	--	1 and 2
7	29	Environmental factors (e.g., turbidity, water temperature, substrate size, depth, current velocity, and discharge) during sampling are likely to bias CPUE indices because of their influence on catchability. We recommend that better understanding of the influence of measurable environmental factors on the catchability of each seine type be developed and used to account for variability in CPUE indices.	--	3
8	29	Factors influencing detection and catchability of RGSM in seines need to be determined and incorporated into the sampling design to permit more robust estimation of CPUE.	--	1
9	29	Measures of CPUE for RGSM from the MRG are currently identified as recovery standards for the species. We recommend modification of recovery standards to be explicit regarding the gear, sampling design, sampling techniques, data analysis, and life stage, as well as protocols used to compute the CPUE index.	--	0
10	29	We recommend depiction of the relationship of hydrological covariates and estimates of the mean annual CPUE for RGSM derived from the mixture model. Those relationships should use the October data from 1993 to 2014. Further, we recommend that such analyses be repeated for catch data collected in 2006 to the present, but using the individual seine-haul approach to estimate CPUE.	--	1
11	29	We recommend that the assumptions of the mixture models be fully defined and that the results of analyses be interpreted with consideration of the assumptions and the effects of the potential violation of assumptions.	--	1

Number	Page	Recommendation	Panel Priority	PMWG Priority
12	29	A greater number of sampling sites would improve the accuracy and precision of status assessments and improve estimates of RGSM CPUE and spatial distribution, especially at the reach scale. A greater number of sampling sites in each of the three reaches would facilitate status and trend estimates at the reach scale. To make statistically rigorous reach-scale CPUE estimates, 20-50 sites per reach are recommended. A design with substantially more sites and longer site lengths should be more effective at detecting RGSM when they are at low densities or demonstrating patchy distributions.	--	1
13	29	When river flows decline so that dry sampling sites occur among the 20 fixed sites sampled by the Monitoring Program, the ability to make inference regarding CPUE of RGSM over the MRG is impaired. The current 20-fixed-site sampling is not adequate when dry sampling sites occur. An ancillary randomized sampling design is recommended at such times to be able to make inferences about RGSM abundance and distribution throughout the entire MRG. Such a random sampling design would entail sampling at many more sites over the length of the MRG. An ancillary design of this type would enhance the feasibility of assessing the abundance and distribution of RGSM in the MRG during years of low flows and when the species is likely to occur in low abundance.	--	0
14	30	Consider using key drivers of mesohabitat variability, such as current velocity, substrate size, and water depth at specific locations where seines are deployed, to replace the mesohabitat factor in the mixture models.	--	2
16	30	Examine the historical availability of mesohabitats in the MRG relative to discharge. If these two measures can be linked, then annual or monthly discharge may provide a good surrogate of mesohabitat availability.	--	2
17	30	Evaluate alternatives to the parametric mixture model, in particular, Bayesian hierarchical models, for estimating annual CPUEs.	--	2
18	30	Use classification and regression trees, boosted regression trees, or random forests to examine relationships between hydrologic variables and CPUE for identifying thresholds above or below which CPUE exhibits changes.	--	1.5

Number	Page	Recommendation	Panel Priority	PMWG Priority
19	30	Implement directed studies using different sampling designs, such as multi-year, multi-site, before-after-control-impact (BACI) designs to enhance understanding of the response of the population to changes in river discharge, habitat rehabilitation projects, and availability of mesohabitats.	--	3
21	30	Conduct stock-recruitment studies to determine how the abundance of fall recruits relates to the abundance of spring spawners. Investigate the effects of spring and summer discharges on the stock recruitment relationship to enhance understanding of the dynamics of RGSM. Implement a spring sampling protocol at spawning sites to estimate the number of spring spawners, and compare with October results for several years; such studies may provide useful data on RGSM population dynamics and limiting factors.	--	3
22	30	Complete a study of age-specific fecundity and survival rates based on pre-breeding (fall) population estimates, spring spawners, and hatchery supplementation. Results from this study could be used to estimate population recovery and extirpation potentials as a function of altered flow regimes and stocking.	--	3
23	30	Consider genetic fingerprinting and epigenetic studies, including bar-coding and gene-expression, of presumed wild and hatchery fish to help determine hatchery contributions to the spring spawners and the long-term risks to the wild population.	--	0
24	30	Expand the analyses in Dudley et al. (2015) to assess flow regime and habitat fragmentation effects on RGSM occurrence and abundance and suggest preliminary flow regimes for rehabilitating the wild RGSM population.	--	3
Observation Beyond the Scope 1	31	Attention to long-term climate-change issues and integration with climate-change planning efforts was not evident to the expert panelists (from the readings or from discussions at the December workshop) regarding how the Cooperative Program and Monitoring Program plan to address markedly lower flows and higher water temperatures.	--	--

Number	Page	Recommendation	Panel Priority	PMWG Priority
Observation Beyond the Scope 2	31	The MRG lacks minimum instream flow requirements to assure recovery. A major element of discussion by program scientists and interested parties during the workshop focused on low-flow periods and the potential for survival of RGSM during those periods when portions of the MRG have no observed surface flows or when there is no measurable discharge at gaging stations. It became evident to the external panelists that there are no specified minimum instream flow requirements or guidelines for the MRG. Minimum instream flow requirements or guidelines would not only enhance the potential for recovery of the RGSM in the MRG, but they would enable the current 20-site design of the Monitoring Program to be used to assess continuously status and trends of the RGSM stock in the MRG.	--	--
Observation Beyond the Scope 3	31	The Monitoring Program assesses relative abundance of the RGSM in October; the young-of-year fish encountered at this time are likely to include the progeny of hatchery fish that were stocked the previous year (in November), survived the winter, and successfully reproduced. As such, the Monitoring Program is measuring the ability of hatchery stocking to contribute to or maintain a population in the MRG. Understanding of the dynamics of the RGSM population and the effects of changes in water resources in the MRG is hindered by confounding of environmental and hatchery-fish effects. There is a need for Monitoring Program scientists to effectively disentangle the source of new recruits (Creel et al. 2015), in particular the relative contribution of hatchery-origin fish and naturally spawned wild fish. One suggestion is to apply individual-based models (IBMs) to simulate changes in the system (e.g., cessation of stocking, decreased discharge rates) and assess those effects on RGSM populations (see e.g., Rose et al. 2013a and b). IBMs are used to describe population outcomes by tracking the fate of the individual fish that compose the population. As such, these models allow individual fish to exhibit unique combinations of growth, survival, fecundity, and movement probabilities. Although this is a powerful approach for the study of animal populations, IBMs require large amounts of data. Thus, the feasibility of this approach will depend on the depth of knowledge of basic biological processes for RGSM in the 1186 MRG.	--	--

Number	Page	Recommendation	Panel Priority	PMWG Priority
Observation Beyond the Scope 4	31	In recent years, low RGSM abundance has led to salvaging fish from residual pools and the introduction of hatchery reared fish to supplement the RGSM population. This creates a dilemma of providing fish to preclude RGSM extinction versus creating a domesticated hatchery-dominated population ill equipped to survive the rigors of a highly stressed environment. Therefore, additional genetic fingerprinting and epigenetic studies of presumed wild, hatchery, and hatchery-originated progeny are needed to determine hatchery contributions to the spring spawners and the risks thereof to the wild population (Quinones et al. 2014; Trushenski et al. 2015; Carmichael et al. 2015)...The question of greatest concern here is the degree to which the population has become, or is becoming, a largely hatchery-derived population with reduced survivability in the face of climate change and other physical and chemical habitat alterations. This becomes of greatest concern when wild populations are naturally and anthropogenically constricted in numbers relative to the numbers of hatchery-origin fish added to the population. Because of such natural and anthropogenic pressures, the highly variable RGSM population likely will continue to be reduced and the wild population may be extirpated (Lawson 1993; Cowley 2006). Continuation of current hatchery augmentation practices should include a rigorous risk/benefit analysis.	--	--
Observation Beyond the Scope 5	32	Although not explicitly discussed during the December workshop, the current recovery plan and criteria for the RGSM (USFWS 2010) are based on the 20-fixed-site sampling protocol. Recovery criteria for the MRG include presence of unmarked and age-0 RGSM at 75% of all sites per reach in October; an October CPUE of >5 RGSM/100 m2 in all sites in a reach for five consecutive years; and age-0 RGSM in 75% of all sites in a reach for five consecutive years. To the degree that insufficient October flows limit sampling of all 20 sites, those recovery criteria cannot be met. In addition, the recovery plan implicitly assumes that genetic exchange is generally in a downstream direction, that the wild RGSM genetic composition has been preserved, and that unmarked fish have a wild genotype. However, those assumptions may be negated by ongoing hatchery practices as discussed above in Observation 4.	--	--

Number	Page	Recommendation	Panel Priority	PMWG Priority
Observation Beyond the Scope 6	32	The analyses in Dudley et al. (2015) could lead to quantitative instream flow and habitat studies and be used to assess flow regime and habitat fragmentation effects on RGSM occurrence and abundance and then used to set preliminary system-wide instream flow criteria for rehabilitating RGSM. This is because current rehabilitation actions such as salvage, stocking of hatchery fish, and local flow and physical habitat manipulations have only local or temporary effects compared with the system-wide effects of major diversion dams and basin-scale land use (e.g., Wang et al. 2003; Hughes et al. 2005, 2014). Normalizing flow regimes, improving fish passage, and extensively lowering floodplains would help rehabilitate a species such as the RGSM (Williams et al. 1999; Tockner et al. 2000; Dudley et al. 2015; Novak et al. 2015); admittedly, such rehabilitation measures may be costly. Although portions of the MRG have experienced periods of natural drying and flooding historically, anthropogenic increases in the frequency or extent of drying and anthropogenic decreases in the frequency and extent of flooding, together with passage barriers, likely reduce the potential of wild RGSM to persist and flourish in the MRG (Hughes et al. 2005; Novak et al. 2015).	--	--
Observation Beyond the Scope 7	33	During the workshop, the panelists noted that a number of organizations and agencies were engaged in research on RGSM in the MRG (i.e., US Fish & Wildlife Service, Bureau of Reclamation, and Army Corps of Engineers). However, the expert panelists did not identify whether formal procedures for sharing outcomes and results from these studies are in place, for example, via annual multi-day research review and discussion meetings with all Cooperative Program and Monitoring Program partners. In addition, models to describe the hydrodynamics of the MRG have been developed, but fish population studies do not appear to make use of these models. The water resource problems in the MRG are complex and water management actions affecting discharge and flow in the river affect the population of RGSM. An annual research review or similar activity may help to strengthen information exchange and advance scientific understanding of the issues in the MRG.	--	--

Number	Page	Recommendation	Panel Priority	PMWG Priority
Observation Beyond the Scope 8	33	An adaptive management program may help to improve understanding of the relationship between management actions in the MRG and the status of the RGSM population. We understand that such an approach will soon be implemented for the MRG and encourage the Collaborative Program to pursue a rigorous adaptive management program. Adaptive management is typically viewed as a partnership between management agencies and agencies engaged in research to address critical uncertainties in the system. Partnerships are key because new knowledge about the system will be obtained only when research and management work hand-in-hand. In adaptive management, (1) the science problems must be defined in a clear manner that permits design of targeted investigations; (2) conceptual and simulation models are then used to investigate responses of the system to potential management interventions; (3) direct, purposeful manipulations are implemented and the response of the system measured in a statistically reliable manner; and (4) analyses and synthesis of outcomes are completed in a timely manner to support robust decision-making. Adaptive management in the MRG would benefit from a conceptual model of the system that integrates water use, hydrodynamics, and fish population responses. It is unclear if such a model exists, but it is imperative to develop such models to ensure that management manipulations will provide sufficient contrast and ensure a measurable result.	--	--
Observation Beyond the Scope 9	33	In addition to adaptive management, Collaborative Program partners and collaborators may wish to consider other tools such as scenario planning (Baker et al. 2004; Hulse et al. 2004; Allen and Gunderson 2011; Rowland et al. 2014) and resilience building (NYC 2013; Norfolk 2014). Scenario planning may be an effective management approach when uncertainty about the system is high and factors that affect the system are not readily controlled (e.g., amount of snow pack available for replenishment of rivers). In this approach, alternative futures are explored with the goal of identifying improvements to current management actions. This may be a good strategy to pursue now, perhaps together with adaptive management. As uncertainty about the system declines (through learning derived from targeted research studies and adaptive management), we suggest implementing a resilience building approach. The approach is effective when driving factors remain uncontrollable and system uncertainty is low. Many coastal cities have adopted this approach in the face of rising sea levels (e.g., New York City [NYC 2013] and Norfolk, VA [Norfolk 2014]).	--	--

Number	Page	Recommendation	Panel Priority	PMWG Priority
Observation Beyond the Scope 10	33	The research done on the RGSM warrants publication in high-level peer reviewed journals. The Expert Panel was provided 14 documents to help it prepare for the December workshop. Of those 14, only 2 were published in, or submitted to, a peer-reviewed journal by a member of the Program; however, the results and interpretations included in the annual reports should be published in journals. Similarly, the Expert Panelists were shown agency reports at the Workshop that were not included in the preselected workshop reading materials that likely had received thorough agency review, but apparently had not yet been submitted for journal publication. In the scientific world, peer-reviewed journal publication is the standard by which research is judged. Publishing in such journals would add increased scientific credibility to the Collaborative Program, and funding the time needed to prepare and revise journal manuscripts should be included in the research grants of the Monitoring Program.	--	--

Table A-2. Recommendations from the Noon et al. (2017) Adaptive Management Science Panel. The Science Panel assigned priorities to these recommendations, and some priorities were assigned by the Population Monitoring Work Group (PMWG). Priority: 1 = high, 2 = moderate, 3 = low, 0 = no consideration by PMWG, Important = Recommendation is important, but not priority was assigned.

Number	Page	Recommendation	Panel Priority	PMWG Priority
A1	17	Clarify the relationship between the annual catch-per-unit-effort and true population size by estimating catchability.	1	1
A2	18	Determine the key, age-specific, life history sensitivities of the RGSM (that is, use Eigen- analysis methods to determine which vital rates [survival and/or reproduction] most affect rates of population change.	1	3
A3	18	Estimate age-specific survival rates	1	3
A4	19	Estimate age-specific fecundities of wild fish.	1	3
A5	19	Using statistical modeling, estimate the relationships between RGSM demographic rates and A.) hydrological factors (flow magnitude and duration, summer drying of the channel); and B.) abiotic environmental factors (temperature, turbidity, salinity); and C.) biotic factors (predation, completion, prey availability).	1	3
A6	20	Evaluate the existence and strength of any density-dependent factors that may be limiting population growth.	2	--
A7	20	Model the potential effects of hatchery augmentation on population dynamics and the significance of hatchery fish to achieving recovery objectives.	Important	--
A8	20	Determine if the collection and translocation of salvage fish during summery drying periods contributes significantly to population dynamics.	Important	--
B1	21	Development and deployment of "vertically-integrating" Moore egg collectors	1	--
B2	21	Improved assessments of relations between possible environmental cues that trigger spawning activity.	1	--
B3	21	Establish size-specific fecundities of natural-spawning RGSM.	2	--
C	22	Clarify the detail of annular mark formation on otoliths and firmly establish the longevity of RGSM	2	--

Number	Page	Recommendation	Panel Priority	PMWG Priority
D1	22	Estimate the spatial extent and hydraulic quality used by RGSM for key life-stages (spawning, larval rearing, juvenile and adult survival). Estimate how these habitats are distributed in the river channel and floodplain in each MRG reach under a range of discharges and seasonal flow regimes.	Important	--
D2	23	Establish the proximate trigger(s) for spawning by evaluating the effects of flow velocity, temperature, rate of increase in flow velocity, or some combination of these factors.	Important	--
D3	23	Determine the roles and relative contributions to fish production (age 0 recruitment and survival of all age-classes) of channel and floodplain habitat in a reach of channel and floodplain typical of the MRG.	Important	--
D4	24	What is the management potential for fish production (recruitment and survival of age 0 fish) in each reach of the MRG if the annual peak flow, and thus the nature and range of available habitats, is permanently limited below historic levels of availability?	Important	--
E1	24	Establish the age composition of the RGSM population, including A.) application of distribution separation methods to estimate age composition, and B.) gear selection study.	1	--
E2	25	Determine how the vertical and horizontal distribution of RGSM eggs in the MRG mainstream channel varies as a function of flow and location?	1	--
E3	25	Calculate revised CPUE values as mesohabitat-specific levels and do not combine across mesohabitat types. The meso-habitat specific CPUE calculated for the most abundant high density mesohabitat type should be used for assessment of trend in abundance of the RGSM population at the October sampling date.	2	2

Table A-3. Recommendations from the Fraser et al. (2016) Genetics Science Panel. The Science Panel assigned priorities to these recommendations, but priorities were not assigned by the Genetics Work Group (GWG). Priority: 1 = high, 2 = moderate, 3 = low.

Number	Page	Recommendation	Panel Priority	GWG Priority
Reporting Rec. 1	4	Sometimes it is not clear how Ne estimators relate to purpose. The reports could improve the explanations for why certain approaches were adopted.	1	--
Reporting Rec. 2	4	Develop a biological relevant and realistic benchmark for critically low levels of genetic diversity. One possible way to set a benchmark would be to estimate the 95% confidence interval (CI) for genetic diversity (expected heterozygosity [He] and number of alleles [Na]) using all samples across time and space. If the diversity falls below the CI, then more aggressive management actions may be warranted.	1	--
Reporting Rec. 3	4	There needs to be a clear statement of the hypothesis and predictions being tested. For example, a simple hypothesis is whether there is a difference in estimates of genetic diversity between the pre- and post-augmentation periods. If this is the case, one approach would be to use a linear model to compare the estimates pre- and post-augmentation. Although time should be included as a co-variate, there is no effect of augmentation on observed heterozygosity corrected for sample size (Hoc) ($t = 1.95$, $p = 0.071$).	2	--
Reporting Rec. 4	4	The authors need to redefine pre-augmentation (1987, 1999) and augmentation periods (post 1999) given the augmentation that took place in 2000 and 2001. They may not be able to conclude strongly whether genetic diversity of the natural spawning population has changed. However, the authors can say that augmentation has maintained genetic diversity throughout the augmentation period, with the provision that this conclusion is based on the nine microsatellite loci evaluated, which might not reflect genome-wide variation.	2	--

Number	Page	Recommendation	Panel Priority	GWG Priority
Reporting Rec. 5	4	Microsatellite loci may no longer be the most effective markers for the purpose as the cost of newer, genotyping-by-sequencing (GBS) approaches has become more affordable for largescale throughput of many individuals. The limitations of microsatellites relative to other genetic markers such as single nucleotide polymorphisms (SNPs), and trade-offs associated with different genetic markers in relation to RGSM genetic monitoring goals, are discussed in detail under Questions 2, 8, 9, 10, and 13 (particularly 13).	2	--
Reporting Rec. 6	4	The Genetic Project PIs may also wish to examine genetic diversity / Ne variation over time using a piecewise regression as these can be used to find any breakpoints in the data; also referred to as segmented regression. If a breakpoint is identified say for pre- versus post-augmentation, then separate regressions can be run for each section. This approach can also identify points in time where there are temporal changes in genetic diversity.	3	--
Question 13 Rec. 1a	16	The panel therefore recommends that both neutral and adaptive genetic variation be monitored over time in RGSM in the future using a larger, more diverse set of genetic markers. Genotyping-by-sequencing (GBS) or related equivalent would provide more confident estimates of genome-wide neutral genetic variation (Nac, Ho) in RGSM because it would more likely represent the entire genome (for more information on GBS and related NGS approaches and their practical benefits for conservation genetics monitoring, see the review of Allendorf et al. 2010)...thus we recommend examining phenotypic variation for important life history traits (size/age maturity, growth rate), behavioral traits (anti-predator behavior, risking taking behavioral syndromes) and morphology (body shape as it relates to flow regime).	2	--
Question 13 Rec. 1b	17	Sampling of floodplains should be considered and included where feasible to ensure that the genetic characteristics of RGSM are adequately represented in egg collection samples.	1	--

Number	Page	Recommendation	Panel Priority	GWG Priority
Question 13 Rec. 2a	18	Conduct random sampling of annual egg collections from nature, to include not only the main channel but also the floodplains, for subsequent hatchery rearing (e.g., current collections only come from the main channel of the Rio Grande River, not on floodplains).	1	--
Question 13 Rec. 2b	18	Rear RGSM in environmental conditions that resemble natural environmental conditions as much as possible. This will reduce relaxation of selection or non-random survival at egg/early life stages in relation to habitat selection/settlement, behavioral/physiological characteristics, anti-predator responses etc. Specific recommendations for RGSM hatcheries include: (i) early juvenile environmental enrichment that resembles critical floodplain habitat (temperature, substrate, flow, turbidity, pH, conductivity, food sources, natural daylight); and (ii) some exposure to natural predators, or at the very least, mimicking of predators to stimulate anti-predator conditioning.	1	--
Question 13 Rec. 2c	18	RGSM live longer in captivity and the breeding program uses 4-year old fish as brood stock. By contrast, in the wild the breeding population is comprised largely of 1-year old fish. Thus, it will be prudent to evaluate the phenotypic effects of older brood-stock. Also, because larger fish have about 4x as many eggs as younger adults (10,000 vs. 2,500), and there is also likely higher variance in egg production among 4-year old fish compared to the variation in egg production among 1-year old fish. This could undermine efforts to equalize family sizes. Thus, using younger fish as brood stock will reduce the likelihood of un-intentional domestication selection, and also result in higher effective population sizes (due to reduced variance in egg production among females).	1	--
Question 13 Rec. 2d	18	Equalize contributions of different adults in the captive broodstock to new broods/lots as much as possible.	1	--

Number	Page	Recommendation	Panel Priority	GWG Priority
Question 13 Rec. 2e	18	Rear RGSM so as to maintain the growth trajectories typical of wild-raised fish (i.e., Age 1 fish in captivity should exhibit the same range of sizes of Age 1 fish in the wild). At present, either faster growing individuals may be unintentionally selected for, or other fish phenotypes (e.g., size, condition, body shape) may not match natural sizes upon release.	1	--
Question 13 Rec. 2f	19	Rear RGSM on natural diet if possible; diet appears natural at early life stages, but diet appears supplemented in later life stages (pellet feed).	1	--
Question 13 Rec. 2g	19	Minimize the duration in captivity as much as possible before release; domestication selection is reduced with less captive exposure (see Frankham 2008 and Fraser 2008).	1	--
Question 13 Rec. 3a	19	Maximize the information gained from re-stocking efforts of hatchery-raised fish back into the river in order to test particular scientific hypotheses and inform adaptive management.	2	--
Question 13 Rec. 3b	19	In addition (or alternatively if resources are limited), the genetics survey could focus on characterizing whether the year classes maintained in the hatcheries change over time in their genetic constitution as a consequence of differential mortality.	2	--
Question 13 Rec. 3c	20	Monitoring of domestication selection could include DNA fingerprinting (GBS) of wild-caught egg collections. An investigation into whether non-random changes to genome-wide variation were occurring at successive early life stages relative to the same stages in the wild would provide evidence that the hatchery environment is resulting in domestication selection.	3	--

Number	Page	Recommendation	Panel Priority	GWG Priority
1	23	A flow chart should be constructed for each year that gives detailed numbers for: eggs and dates taken, disposition of eggs/larvae to specific rearing sites, broodstock maintained, actual breeding strategy, disposition of eggs/larvae to specific rearing sites, pooling of larvae prior to stocking, stocking sites, source of juveniles, and dates. These data should be standardized and collected for each hatchery engaged in fish production and the data should be made available electronically to all interested parties. Deviations from planned methodologies (such as the inclusion of approximately 10,000 eggs from unplanned spawning in a broodstock tank) should be noted in the flow chart.	1	--
2	23	When deviations from planned methodologies result in the production of offspring, those offspring should not be released into the wild. Release of these offspring into the river could have a negative effect on the overall genetic diversity of the population. Providing flexibility in the next recovery permit should allow such surplus fish to be properly handled, whether used for research or held until natural death in the hatchery.	1	--
3	23	All broodstock and sufficient subset of the pre-release juveniles should be genotyped and the contribution of each broodstock individual determined. These results can be used to gain a more accurate, precise and biologically relevant estimate of Ne for each year class. This approach avoids the inherent assumptions and excessive variance associated with the Ne estimators currently employed. This should be done every year. Developing a high throughput method would facilitate more rapid genotyping.	1	--
4	24	The Genetics Management and Propagation Plan and/or the Augmentation Plan should have a detailed methodology as to what will be done should a drought lasting more than three/four years occurs or all four year classes of broodstock are lost to a major hatchery accident.	1	--

Number	Page	Recommendation	Panel Priority	GWG Priority
5	24	The Science Workgroup (led by the Program) and the Genetics Workgroup (led by the USFWS) should integrate the genetics data and the decision-making more carefully. Specifically, there should be more translation of the genetics research into the adaptive management process, hatchery broodstock practices, and the integration of the past 15 years of research (genetics and ecology combined).	1	--
6	24	A more stable, consistent funding stream for the genetics research (e.g. an extended funding cycle) would ensure that all critical, temporally important genetic studies are accomplished each year (e.g., broodstock genotyping, pre-release juvenile genotyping). Cost will vary depending on the analysis and goal. At the time of writing this report, the RGSM program can expect to require approximately $50-150/individual for GBS or RAD-seq if outsourced to a genomics facility (including individual sample preparation, but not including salary for a research associate for sample preparation, data filtering and data analysis); a minimum of 30-40 individuals per year is recommended. Other genetic assessments do not require the amount of genetic data generated from GBS; any parentage assignments of offspring generating from mixed matings in the hatchery, for example, would be expected to cost approximately $5-10/individual (not including personnel salaries), and so could be (and should be) conducted on larger numbers of individuals (1000s).	1	--
7	24	The use of only four year fish as broodstock may compromise the maintenance of genetic diversity because of the possibility of non-random, differential survival of individuals in the hatchery. Crosses should include younger fish. As a consequence of using younger fish as broodstock with lower fecundity, more fish will be needed to produce the quota of eggs and this will increase the effective number of breeders.	1	--
8	24	It will be useful to conduct an evaluation of whether domestication selection is occurring in the hatcheries. This could be done using an appropriate genetic analysis and/or measuring quantitative traits to assess phenotypic variation of each captive cohort during each year in captivity.	1	--

Number	Page	Recommendation	Panel Priority	GWG Priority
9	24	We recommend the use of the term “naturally spawned” in place of the term “wild” to refer to fish captured in the river that do not have an elastomeric tag; this assumes that all augmentation fish received a tag. It is likely that all fish captured in the wild have experienced some hatchery influence in their ancestry.	2	--
10	25	If possible, the augmentation team should consider artificially spawning broodstock in a one female by one male mating scheme, all the while maintaining the same total number of broodstock adults spawned (or increasing this number). This would allow equalizing family size as families are combined.	2	--
11	25	Relatedness should be calculated for broodstock prior to use to choose specific crosses that avoid inbreeding. If group spawning continues, relatedness estimates could be used to ensure that potential spawners in a group have low kinship.	2	--
12	25	To facilitate adaptive management, experimental studies comparing the survival and reproductive success of subsets of RGSM from different stocking strategies and hatchery facilities in nature would also shed light on the extent to which domestication selection is a concern in the recovery program.	2	--
13	25	A study using next-generation sequencing technology (e.g., GBS, RAD-seq) should be done with pre-augmentation samples and post-augmentation year classes to determine how the genome as a whole has changed over time. At the time of writing this report, the RGSM program can expect to require approximately $50-150/individual for such an assessment (more for RAD-seq) if outsourced to a genomics facility (including individual sample preparation, but not including salary for a research associate for sample preparation, data filtering and data analysis); a minimum of 30-40 individuals per year is recommended.	2	--

March 25, 2020

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

Draft Middle Rio Grande Endangered Species Collaborative Program Population Monitoring Work Group 2020 Work Plan [draft]

Draft Assimilation and Synthesis of Information and Data Related to the Rio Grande Silvery Minnow [draft]

Draft 1 Consolidated Recommendations of Two Expert Science Panels on Monitoring of the Rio Grande Silvery Minnow [draft]

Next Steps in Modeling Process - Ideas From Dr. Yackulic Memo

Follow-Up Questions on Integrated Model for Rio Grande Silvery Minnow

Follow-Up Questions on Integrated Model for Rio Grande Silvery Minnow - Responses From Charles Yackulic

Revised Middle Rio Grande Endangered Species Collaborative Program Population Monitoring Work Group 2020 Work Plan [revised]

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
March 25, 2020
1:00 PM – 5:00 PM

Zoom Information:
https://west-inc.zoom.us/j/8983593120
Call-In: +1-669-900-6833
Meeting ID: 898-359-3120

Meeting Agenda

1:00 – 1:15	**Welcome, Introductions, Agenda Review, Meeting Notes** ➢ **Decision:** Approval of March 25, 2020 meeting agenda ➢ **Decision:** Approval of February 26, 2020 PMWG meeting minutes Read aheads: ☐ March 25, 2020 meeting agenda ☐ February 26, 2020 meeting minutes	*PMWG Co-chairs*
1:15 – 1:45	**Program Structure Planning** • Functions and tasks of the PMWG • Discussion how those functions and tasks will fit under new Program structure	*Facilitated discussion*
1:45 – 2:15	**Review of Executive Summary Template** Read ahead: ☐ Assimilation and Synthesis of Information and Data Related to the Rio Grande Silvery Minnow	*Kevin McDonald* *Catherine Murphy*
2:15 – 2:30	**Break**	
2:30 – 3:00	**Steps Forward with Integrated Model** • Follow-up Questions on Model Framework • Questions of Model Utility Read aheads: ☐ Follow-up Questions on Integrated Model for Rio Grande Silvery Minnow ☐ Memo: Next Steps in Modeling Process – Ideas from Dr. Yackulic	*Rich Valdez*

3:00 – 4:15	**Consolidation of Science Panel Recommendations** • Concurrence on Research Topics • Prioritization Process • Assignments to Address Research Topics Read ahead: ☐ Consolidated Recommendations of Two Expert Science Panels on Monitoring of the Rio Grande Silvery Minnow	*Rich Valdez, Mike Marcus* *Catherine Murphy*
4:15 – 4:45	**2020 Work Plan** Read aheads: ☐ Population Monitoring Work Group 2020 Work Plan ☐ Revised Population Monitoring Work Group 2020 Work Plan	*Joel Lusk*
4:45 – 5:00	**Wrap-Up** • Announcement • Action Items • Next Meeting	*PMWG Co-chairs*
5:00	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
Meeting Minutes

March 25, 2020 1:00 – 4:00 PM
Location: Zoom Meeting

Decisions:

- ✓ Approval of the March 25, 2020 meeting agenda, with the following amendment:
  - Move the Steps Forward with Integrated Model discussion to first on the agenda
- ✓ Approval of the February 26, 2020 meeting minutes

Action Items:

WHO	WHAT	BY WHEN
Program Support Team (PST)	Re-send invitations to the Zotero library	March 27, 2020
PST	Send the 2003 Remshart and Tashjian report to Charles Yackulic	March 27, 2020
Charles Y.	Share results of evaluating capture probability based on seine type	March 27, 2020
PST	Convert the table of topics into a spreadsheet with additional columns for tracking	March 27, 2020
Mike Marcus	Draft language on how priority numbers have evolved for the panel recommendations	April 1, 2020
Eric Gonzales & Michael Porter & PMWG	Send Mike M. the scopes of work for the ASIR/Utah State University mesohabitat study, the U.S. Geological Survey evaluation of mesohabitat data, and any other data or literature to be included in the mesohabitat executive summary	April 1, 2020
Charles Y. & Shay Howlin	Determine if the 1996 FLO data should be digitized	April 1, 2020
PMWG	Send any comments on Charles Y.'s proposed next steps on the integrated model to Rich Valdez (cc Debbie Lee and Charles Y.)	April 3, 2020
PMWG	Send any additional questions or comments for the integrated model to Rich V. (cc Debbie L. and Charles Y.)	April 3, 2020
PST	Revise past PMWG meeting minutes to identify the notetaker	April 3, 2020
PST	Populate table of topics with citations from existing literature reviews and bibliographies	April 3, 2020
PMWG	Sign up on table of topic areas to be the initiating author for a topic, provide literature on the topic, or review the draft executive summary	April 3, 2020

PST	Coordinate with co-chairs of Genetics group on if/when the group should reconvene	April 7, 2020
Mike M.	Complete an executive summary for consolidation of mesohabitats for monitoring Rio Grande silvery minnow using the template	April 20, 2020
Joel Lusk, Rich V., & PST	Revise PMWG work plan to have more details on subtasks and deadlines	April 20, 2020

- Next Meeting: April 28, 2020, 1:00 – 4:00 PM

Welcome, Introductions, Agenda Review, and Meeting Notes

The PMWG co-chairs, Rich Valdez, SWCA, and Joel Lusk, U.S. Bureau of Reclamation, opened the meeting and led introductions. They reviewed the agenda and the minutes from the February 2020 meeting.

- **Decision**: Approval of March 25, 2020 PMWG meeting agenda with amendments
- **Decision**: Approval of February 26, 2020 PMWG meeting minutes
- **Action Item**: The PST will re-send invitations to the Zotero library
- **Action Item**: The PST will revise past PMWG meeting minutes to identify the notetaker

Steps Forward with Integrated Model

Rich V. noted that since the last PMWG meeting, Charles Yackulic, U.S. Geological Survey, provided some thoughts on next steps for the integrated stock assessment model, which are shared in a memo. Charles Y. proposed two next steps: (1) consider revisions to the model inputs, and (2) develop future modeling scenarios.

The group discussed the proposed next steps. During the discussion, the following points were made:

RGSM Physical Characteristics

- Caldwell et al. found a significant relationship between the size of RGSM and the average temperature across a two year study.

- **Action Item**: PST share the Caldwell et al. study with Charles Y.

Data Availability

- The FLO 1996 data are in hardcopy data sheets. These include depth, velocity, and mesohabitat type from two sets of studies: eight transects during the winter of 1996 release, and twenty-six transects during spawning releases in 1996. Shay Howlin, PST, estimated it would take approximately fifteen hours to enter the data.
- Remshardt and Tashjian (2003) did deliberately biased sampling and randomized sampling of habitats, and recorded depth, velocity, and mesohabitat type.
- One PMWG member suggested that Charles Y. be cautious at using salvage data prior to 2003 because those numbers were not as accurate. Another member noted that the data from the years Mike Hatch was doing salvage, 2004-2006, were pretty accurate.
- Thomas Archdeacon, U.S. Fish and Wildlife Service, had provided Charles Y. with salvage data, but the data needs to be converted into a consistent format.

- **Action Item**: Shay H. and Charles Y. determine if the 1996 FLO data should be digitized

- **Action Item**: PST send Charles Y. the Remshart and Tashjian (2003) report

RGSM Population and Survival

- By looking at salvage data, Charles Y. is hoping to get a better estimate on how much habitat is available by reach. Salvage data can give a minimum population estimate for that river section.
- Salvaged fish have a different survival rate from regular fish, and should be temporarily treated differently in the model. There is a paper from Caldwell looking on RGSM survival and stress.

Future Scenarios

The group discussed how to best develop future scenarios which can be inputted into the model. Charles Y. noted that the PMWG may not be the appropriate group to come up with those scenarios, or suggested additional people may need to be brought into the process. One member cautioned against moving too fast on scenarios until there is a better understanding of the model's capabilities. Charles Y. noted that this may be a parallel process, as knowing what the questions the model would be expected to answer would be useful.

The following individuals volunteered to be part of a small group to work on developing scenarios, when the timing is appropriate: Rich V., Michael Porter, Grace Haggerty, Catherine Murphy, Joel L., and Kevin McDonnell.

There is also another effort going on with Tim Walsworth and Phaedra Budy's, Utah State University (USU), reanalysis of the Hydrobiological Objective (HBO). In the HBO, the U.S. Fish & Wildlife Service put forth eight hydrographs that USU is currently analyzing. NM Interstate Stream Commission and Reclamation are working on convening a small group of the modelers together to coordinate efforts. This small technical group would include Tim Walsworth, Phaedra Budy, Charles Y., Kevin M., Shay H., Rich V., and Joel L.

- **Action Item**: PMWG members send any comments on Charles Y.'s proposed next steps on the integrated model to Rich Valdez (cc Debbie Lee and Charles Y.)

Questions on Model Development

Rich V. had provided Charles Y. with a series of questions related to the model development. Both the questions and the responses were sent out as read-aheads for the meeting. One PMWG member asked about developing a capture-probability based on seine type.

- **Action Item**: Charles Y. will share the results of evaluating capture probability based on seine type
- **Action Item**: PMWG members send any additional questions or comments for the integrated model to Rich V. (cc Debbie L. and Charles Y.)

Program Structure Planning

Debbie L. noted that the Executive Committee had asked each work group to note their functions and think about how those functions could be integrated into the new adaptive management framework being developed. She observed that much of that has been already been laid out in the introduction to the executive summary template.

Catherine M. and Kevin M., Program Support Team, had been tasked at the previous meeting with developing a template for topical executive summaries. The draft template was included with the

meeting read-aheads. The assimilation and synthesis of information was directly applicable to the Program's adaptive management process.

The panel recommendations used to develop the topic areas fell into the following categories: scientific uncertainties, data analysis actions, and modifications to sampling design. In addition to the panel recommendations, uncertainties and testable hypotheses will also be coming from the conceptual ecological models and other processes. The executive summaries were designed to take the recommendations that the PMWG thought were most important and develop a formal internal review process in order to move those forward. Through this process, testable hypotheses will be developed, and will be integrated into the larger Program planning.

One participant noted that the PMWG efforts were unique from others in the Program as it includes monitoring and species status, and that at some point, the different efforts will need to integrate. Catherine M. responded that there will be a hierarchy of models, such as an ecosystem model with life history models underneath that feed into population models. The ultimate goal is to have all the different models inform one another and work together.

Review of Executive Summary Template

The PMWG discussed the draft executive summary template. During the discussion, the following points were made:

- One of the functions of these templates is to be a communication tool. The executive summaries are meant to be in narrative form, with tables as the last resort. That way, the technical experts are translating data and information with minimal technical jargon. The Science and Adaptive Management Committee (SAMC) is the audience for these summaries, and the more the summary authors and contributors can make conclusions, the easier it will be for the SAMC to use the summaries. Tables and figures need to be interpreted.
- The reasoning behind including both uncertainties and hypotheses is because they are not necessarily the same. Uncertainties do not necessarily lead to hypotheses; they could be addressed with data analyses.

➢ **Action Item**: PMWG members send additional comments on the executive summary template to Catherine M. and Kevin M. (cc Rich V. and Debbie L.)
➢ **Action Item**: Mike Marcus will complete an executive summary for consolidation of mesohabitats for monitoring Rio Grande silvery minnow using the template
➢ **Action Item**: Eric Gonzales and Michael Porter send Mike M. the scopes of work for the ASIR/Utah State University mesohabitat study, the U.S. Geological Survey evaluation of mesohabitat data, and any other data or literature to be included in the mesohabitat executive summary

Consolidation of Science Panel Recommendations

Rich V. and Mike M. reviewed the revised document noting the different topic areas, and how those topic areas were developed. In response to a question, Mike M. noted that the priority numbers have changed over time.

➢ **Action Item**: Mike M. will draft language on how priority rankings have evolved for the panel recommendations

The group discussed the table of topics, and the following suggestions were made:

- Revise the header of the first column to "Science Topic"
- Include an identifier for each topic (e.g., numbering)

- Put the table in a spreadsheet with tracking columns

- **Action Item**: The PST will convert the table of topics into a spreadsheet with additional columns for tracking
- **Action Item**: PMWG members will sign up on the table of topic areas to be the initiating author for a topic, provide literature on the topic, or review the draft executive summary
- **Action Item:** The PST will populate the table of topics with citations from existing literature reviews and bibliographies

2020 Work Plan
Joel L. reminded the group that at the last Executive Committee meeting there were questions raised around the PMWG's work plan and the progress of the group. To address those concerns, Joel had rewritten the work plan to incorporate measurable and assignable tasks. During the discussion, members voiced the desire for more detail, noting subtasks and deadlines for each subtask. The following specific suggestions were made:

- Include progress reports to the Executive Committee
- Include a task of developing a synthesis report
- Target two executive summaries to be completed by December 2020, with two others in progress
- Restructure the work plan so that the first task is the integrated stock assessment model, with subtasks to support that

- **Action Item**: The PMWG co-chairs and the PST revise the work plan to have more detail on subtasks and deadlines

Wrap-Up and Adjourn
It was suggested that the Genetics work group may need to reconvene soon.

- **Action Item**: The PMWG will Coordinate with co-chairs of Genetics group on if/when the group should reconvene

The next PMWG meeting will be a virtual meeting on April 28, 2020 from 1-4 PM. The following topics will be on the agenda:

- Revisit the PMWG work plan
- Review of the executive summary example(s) using the template
- Advancing the consolidation of science panel recommendations document
- Updates on integrated stock assessment model

Meeting Participants
Trevor Birt, N.M. Interstate Stream Commission
Lynette Giesen, U.S. Army Corps of Engineers
Eric Gonzales, U.S. Bureau of Reclamation
Grace Haggerty, N.M. Interstate Stream Commission
Mo Hobbs, Albuquerque-Bernalillo County Water Utility Authority
Shay Howlin, Program Support Team
Debbie Lee, Program Support Team
Joel Lusk, U.S. Bureau of Reclamation
Mike Marcus, Assessment Payers Association of the Middle Rio Grande Conservancy District

Anne Marken, Middle Rio Grande Conservancy District
Kevin McDonnell, Program Support Team
Catherine Murphy, Program Support Team
Michael Porter, U.S. Army Corps of Engineers
Rich Valdez, SWCA
Charles Yackulic, U.S. Geological Survey

Notetaker: Debbie Lee, PST

Middle Rio Grande Endangered Species Collaborative Program
Population Monitoring Work Group
2020 Work Plan

The Population Monitoring Work Group (PMWG) was tasked with providing technical review, focused assessment, and recommendations related to monitoring of fish populations in the Middle Rio Grande (MRG), as impacted by water management and river dynamics.

The PMWG plans to complete the following tasks in 2020:

Task	Subtasks	Target Completion Date
1. Integrate and prioritize recommendations from the science panels	a) Evaluate recent modifications to RGSM population monitoring program	Currently on hold with development of the RGSM Integrated Stock Assessment model
	b) Gear selectivity study	December 2020
	c) Track progress in addressing panel recommendations	Ongoing in 2020
2. Analyze RGSM data to support modeling efforts	a) Survival, age composition, recruitment, and other analyses as identified	December 2020
3. Develop and review a RGSM Integrated Stock Assessment Model		December 2020
4. Development of PMWG report(s)	a) Scientific report documenting the data and methods of the RGSM Integrated Stock Assessment Model	December 2020
	b) USGS Open File Report	Ongoing in 2020
5. Give a progress update to EC		December 2020/January 2021

These tasks support the completion of Task 2 under the original PMWG charge approved by the EC in May 2016.

Assimilation and Synthesis of Information and Data Related to the Rio Grande Silvery Minnow

Introduction

Members of the Population Monitoring Work Group (PMWG) identified 22 topic areas for review, and will complete an Executive Summary for each. The 22 topic areas were consolidated from the existing independent science panel recommendations (Hubert et al. 2016; Noon et al. 2016). The Executive Summaries will help assimilate and synthesize relevant information about the Rio Grande silvery minnow (RGSM) for each topic area so that uncertainties and research questions can be identified and addressed.

Topic Areas

A consolidated review of the aforementioned Hubert et al. and Noon et al. science panels' recommendations was completed by the Population Monitoring Work Group. These recommendations were subsequently organized by category, according to subject matter and work group priority. The following steps were taken to consolidate the science panel recommendations:

1. Recommendations were copied verbatim and listed in separate tables for each of the science panel reports; recommendation number and report page number were added to facilitate referencing each in its respective report.
2. The prioritizations for the recommendations within each science panel report were added as the last two columns of in each table. Prioritizations included those assigned by the work group and by the Noon et al. panel, as the Hubert et al. panel did not assign priority.
3. The recommendations were consolidated and categorized by subject matter.
4. Science topics were extracted from the consolidated recommendations and presented as a list to the work group.

Executive Summaries

Assembling Executive Summaries serves the following purposes:

1. Provides a reference list of relevant literature on each topic to identify and document knowledge gaps and non-consensus areas on available RGSM population information.
2. Helps inform the Collaborative Program's recommendation of studies and projects designed to resolve key scientific uncertainties related to the RGSM.
3. Documents the PMWG's progress in addressing the panel recommendations and provides a brief synopsis by topic to the Science and Adaptive Management Committee (SAMC) and Collaborative Program signatories.

Each Executive Summary will highlight current, relevant literature that provides evidence in support of the summarized statements. This exercise will identify consensus, alternative hypotheses, and uncertainties by topic. Understanding what is currently known and what

remains unknown is crucial to prioritizing key scientific uncertainties and developing effective management alternatives.

The SAMC will use the Executive Summaries to direct activities that reduce key scientifice uncertainties. These may include additional literature reviews, modeling exercises, monitoring activities, or field studies. Documenting progress on addressing the science panel recommendations will support the larger Science and Adaptive Management Strategy effort the Collaborative Program is currently undertaking.

DRAFT

Executive Summary Development & Review Process

The following outlines the Executive Summary development and review process and timeline:

1. Choose a work group member volunteer to develop an Executive Summary for one topic area
    - Choose a topic area
    - Assign an initiating author
    - Assign a deadline for submitting the initial draft to the PST (up to 45 days, with extension to 60 days if necessary)
2. The Program Support Team (PST) will ensure the initial draft Summary is on topic, clear, and complete, and if necessary, will work with the author to finalize the draft
    - Assign deadline for distribution of initial draft to subject matter experts (up to 15 days)
3. Choose 1-2 subject matter experts (SMEs) to review the Summary and return it to the PST
    - Assign subject matter expert reviewer(s) (up to 2)
    - Assign deadline for submitting the SME reviews to the PST (up to 15 days)
4. The PST incorporates SME comments into the Summary and distributes the document to all interested parties
    - Create a distribution list of all interested parties
    - Assign deadline for distribution to interested parties (up to 15 days)
    - Assign deadline for submitting these comments to the PST (up to 10 days)
5. The PST incorporates remaining comments into the Summary
    - Assign deadline for re-distribution of the final product to the work group (up to 15 days)
    - Set a work group meeting date (one week after re-distribution)
6. Hold a work group meeting to develop recommendations, if appropriate, for the SAMC based on the Executive Summary.

DRAFT

Executive Summary Development Guidelines

The following guidelines are intended to standardize the information provided in each Executive Summary:

- Executive Summaries briefly present the topic in 2 to 5 pages (not including citations)
- Follow a concise and standardized format; Executive Summaries are not meant to provide an exhaustive literature review
- Back up all statements with references and provide full citations
- Use the most current and relevant sources for information, noting peer reviewed literature
- Rather than using figures and tables, summarize the messages conveyed by a figure or table in the form of a statement and include citations
- The SAMC is the audience for these summaries; limit use of technical statements and jargon, unless they have direct relevance to management implications

DRAFT

Executive Summary Template

Topic Area Title:

Program Goal Relevance:

Brief Summary of Available Literature:

List the Uncertainties:

List the Hypotheses Identified from Literature:

Management Implication(s) of Hypotheses (if any):

Potential Approaches to Test Hypotheses:

Literature Cited:

Contributors:

Reviewers:

DRAFT

Consolidated Recommendations of Two Expert Science Panels on Monitoring of the Rio Grande Silvery Minnow

Richard A. Valdez and Mike Marcus
Population Monitoring Workgroup
Draft 1, March 16, 2020

Overview

The Population Monitoring Workgroup (PMWG) is charged by the Executive Committee (EC) of the MRGESCP with evaluating the monitoring program for the Rio Grande Silvery Minnow (RGSM) in the Middle Rio Grande, NM. In July 2012, the EC approved the first of three tasks—that the PMWG convene a science panel and conduct a workshop to evaluate the monitoring program. The following is a summary of actions taken by the PMWG pursuant to Task 1 (workshop) and the transition to Task 2 (review monitoring plan):

- July 13, 2012: EC approves charge for Task 1 (CPUE Workshop; PMWG 2012).
- May 2014: PMWG sends survey to EC on fish population monitoring needs (DBSA 2015).
- Dec 8-10, 2015: PMWG holds Independent Science Panel Workshop on Population Monitoring, Isleta Casino and Resort, Albuquerque, NM (Hubert et al. 2016).
- Apr 13, 2016: Final Report of Science Panel to PMWG on RGSM Population Monitoring (Hubert et al. 2016).
- July 12, 2016: PMWG forwards request to EC to initiate Task 2 (Review Population Monitoring Plan), and initiates evaluation and prioritization of Hubert recommendations.
- Mar 23, 2017: PMWG requests that Bureau of Reclamation incorporate eight Hubert recommendations into Population Monitoring Contract.
- Jun 2017: Final Report on RGSM Scientific Uncertainties (Noon et al. 2017[1]).

[1] The Noon science panel was convened as part of the development of an adaptive management framework for the Middle Rio Grande—unrelated to the PMWG—and contains substantive information relative to the Rio Grande silvery minnow monitoring program.

- Nov 29, 2017: PMWG initiates consolidated review and prioritization of panel recommendations from Hubert (22, Table A-1) and Noon (19, Table A-2).
- Jun 15, 2018: Members of PMWG begin analyses of specific panel recommendations (e.g., Valdez 2018).
- Nov 11, 2018: Contracted biometrician initiates Integrated RGSM Population Model to assist evaluation of panel recommendations (Yackulic 2018).
- Feb 18, 2020: Consolidated review of Hubert and Noon panel recommendations completed and organized by category, according to subject matter and priority (Table A-3).
- Feb 26, 2020: PMWG agrees to write short summaries of scientific topics identified from prioritized consolidated recommendations (Table 1).

Consolidation Process

The following steps were taken to consolidate the science panel recommendations:

1. Each recommendation was copied verbatim from the science panel report and listed in Table A-1 for the Hubert panel and A-2 for the Noon panel; recommendation number and report page number were added to facilitate locating each in the respective report.
2. The prioritizations for each recommendation within each science panel report were added as the last two columns of Tables A-1 and A-2. Prioritizations include those assigned by the PMWG and by the Noon panel; the Hubert panel did not assign priorities.
3. The recommendations were consolidated into a single table (Table A-3) and categorized by priority.
4. Science topics were extracted from the consolidated recommendations and listed in Table 1.

Summary Writeups

A short write-up will be provided by members of the PMWG for each of the science topics identified in Table 1. Each write-up will be formatted as follows:

<<Kevin and Catherine will provide format>>

Table 1. List of recommended science topics from the Hubert and Noon science panels.

Recommended Science Topic	Recommendation Number[1]		Responsible Person
	Hubert	Noon	
Relationship of CPUE and true population size of RGSM	--	A1	
Age-specific survival of RGSM	--	A2, A3	
Size and age-specific fecundity of RGSM	22	A4, B3	
Relationship of demographic rates and abiotic and biotic factors	10, 24	A5	
Evaluate existence and strength of density dependence to limit population	21	A6	
Effect of augmentation on RGSM Population	--	A7	
Contribution of salvaged RGSM to population dynamics	--	A8	
Develop and deploy "vertically-integrating" Moore egg collectors	--	B1, E2	
Effect of environmental cues on spawning onset and activity	--	B2, D2	
Age composition of RGSM population	--	C, E1	
Selectivity of gears used to sample RGSM	--	E1	
Spatial extent and historical availability of habitat and hydraulic quality used by RGSM	16	D1	
Roles and relative contributions to fish production by age in channel and floodplain habitats	--	D3	
Evaluate management potential for fish production by reach	--	D4	
Consolidation of mesohabitats for monitoring RGSM	--	E3	
Compute CPUE from larval and standard seines by age	1, 2, 3	--	
Evaluate effect of zero catches on CPUE and sample design	4, 5, 6	--	
Effect of environmental factors on seine capture probability	7, 8	--	
Mixture model and alternatives for computing RGSM CPUE	10, 11, 14, 17	--	
Use classification and regression trees, boosted regression trees, or random forests to examine relationships between hydrologic variables and CPUE	18	--	
Effect of increased sample size on RGSM monitoring	12, 13	--	
Implement studies using different sampling designs	19	--	

[1]see Tables A-1 and A-2 for Recommendation Numbers

Literature Cited

Daniel B. Stephens and Associates, Inc. (DBSA) 2015. Survey of the Executive Committee on fish population monitoring needs. Summary Report, Middle Rio Grande Endangered Species Collaborative Program. Albuquerque, NM.

Hubert, W.A., M.C. Fabrizio, and R. Hughes. 2016. Summary of findings by the External Expert Panelists: Rio Grande silvery minnow population monitoring workshop Isleta Casino and Resort, 8-10 December 2015. U.S. Bureau of Reclamation, Albuquerque, NM.

Noon, B., D. Hankin, T. Dunne, and G. Grossman. 2017. Independent Science Panel Findings Report: Rio Grande silvery minnow key scientific uncertainties and study recommendations. Prepared for the U.S. Army Corps of Engineers, Albuquerque District on Behalf of the Middle Rio Grande Endangered Species Collaborative Program. Prepared by GeoSystems Analysis, Inc. Albuquerque, NM. June 2017. Contract No. W912PP-15-C-0008.

Population Monitoring Workgroup (PMWG). 2012. Approval of the 1st task for review of the collaborative program fish monitoring program for the Rio Grande silvery minnow. A Proposal for a CPUE Metrics and Methodologies Workshop, Submitted to The Executive Committee of the Middle Rio Grande Endangered Species Collaborative Program July 13, 2012, Albuquerque, NM.

Valdez, R.A. 2018. Age composition of Rio Grande silvery minnow: Application of distribution separation methods to estimate age composition. A data analysis done for and in collaboration with the Data Analysis Team of the Population Monitoring Workgroup, Albuquerque, NM.

Yackulic, C.B. 2018. Developing an integrated population model for Rio Grande silvery minnow in the Middle Rio Grande. U.S. Geological Survey, Southwest Biological Science Center, Flagstaff, AZ.

Appendix A: Tables of Science Panel Recommendations

Table A-1. Recommendations and observations from the Hubert et al. (2016) Population Monitoring Science Panel. The Hubert Science Panel did not assign priorities to these recommendations and observations, but priorities were assigned by the Population Monitoring Work Group (PMWG) to the recommendations. Priority: 1 = high, 2 = moderate, 3 = low, 0 = no consideration by PMWG.

Number[1]	Page	Recommendation	Panel Priority	PMWG Priority
1	28	Separate the catch and effort data from the small-mesh seine and the fine-mesh seine into two data sets and compute separate CPUE indices for each gear type, as well as for individual age classes captured in each gear type.	--	1
2	28	The CPUE from the small-mesh seine is primarily an index of the relative abundance of a single cohort of RGSM (i.e., the most recent cohort) that is recruited into the gear late in the summer and captured into the summer of the following year. The precision of the index can be improved by exclusion of older cohorts. A separate CPUE index can be computed for older cohorts. Consider the use of length-at-age data and frequency histograms to identify cohorts.	--	1
3	28	Only larval fish should be included in the computation of CPUE indices from the fine-mesh seine because of this gear's selectivity for this life stage.	--	1
4	28	An aspect of the CPUE data that warrants attention is the treatment of zero catches in data analyses. Inclusion of dry sample sites as zero CPUE values when analyzing CPUE data for RGSM in the MRG should be avoided. Field data records and the database in which the RGSM CPUE data are stored allow dry sampling sites to be distinguished from sites that were sampled and no RGSM were caught. The problem arises during statistical analyses because the naughty naughts (observations of zeros at dry sampling sites) are treated in the same manner as the zero catches at fished sites where no RGSM are caught.	--	1
5	28	Survey designs should strive to minimize false zeros resulting from: (1) an inappropriate sampling design (e.g., sampling in mesohabitats avoided by RGSM) and (2) ineffective survey methods (e.g., insufficient sampling effort to detect an organism when it is present).	--	1 and 2

Number[1]	Page	Recommendation	Panel Priority	PMWG Priority
6	29	The proportions of various mesohabitat types sampled are likely to bias CPUE indices because the catchability coefficient probably differs among mesohabitat types and RGSM are likely to be selective for specific mesohabitat types. We recommend that better understanding of the influence of mesohabitat type on CPUE be developed and used to account for variability in CPUE indices. Further, we recommend that estimation of mean site-specific CPUE be improved by addressing the variable number of mesohabitats that are sampled at any given site and the amount of sampling in each mesohabitat type. We recommend estimation of mean site-specific CPUE from individual seine hauls (which are distinguishable in the database as of 2006); mean CPUE at each site is then computed from the individual CPUEs at each of the 18-20 mesohabitat units sampled per site.	--	1 and 2
7	29	Environmental factors (e.g., turbidity, water temperature, substrate size, depth, current velocity, and discharge) during sampling are likely to bias CPUE indices because of their influence on catchability. We recommend that better understanding of the influence of measurable environmental factors on the catchability of each seine type be developed and used to account for variability in CPUE indices.	--	3
8	29	Factors influencing detection and catchability of RGSM in seines need to be determined and incorporated into the sampling design to permit more robust estimation of CPUE.	--	1
9	29	Measures of CPUE for RGSM from the MRG are currently identified as recovery standards for the species. We recommend modification of recovery standards to be explicit regarding the gear, sampling design, sampling techniques, data analysis, and life stage, as well as protocols used to compute the CPUE index.	--	0
10	29	We recommend depiction of the relationship of hydrological covariates and estimates of the mean annual CPUE for RGSM derived from the mixture model. Those relationships should use the October data from 1993 to 2014. Further, we recommend that such analyses be repeated for catch data collected in 2006 to the present, but using the individual seine-haul approach to estimate CPUE.	--	1
11	29	We recommend that the assumptions of the mixture models be fully defined and that the results of analyses be interpreted with consideration of the assumptions and the effects of the potential violation of assumptions.	--	1

Number[1]	Page	Recommendation	Panel Priority	PMWG Priority
12	29	A greater number of sampling sites would improve the accuracy and precision of status assessments and improve estimates of RGSM CPUE and spatial distribution, especially at the reach scale. A greater number of sampling sites in each of the three reaches would facilitate status and trend estimates at the reach scale. To make statistically rigorous reach-scale CPUE estimates, 20-50 sites per reach are recommended. A design with substantially more sites and longer site lengths should be more effective at detecting RGSM when they are at low densities or demonstrating patchy distributions.	--	1
13	29	When river flows decline so that dry sampling sites occur among the 20 fixed sites sampled by the Monitoring Program, the ability to make inference regarding CPUE of RGSM over the MRG is impaired. The current 20-fixed-site sampling is not adequate when dry sampling sites occur. An ancillary randomized sampling design is recommended at such times to be able to make inferences about RGSM abundance and distribution throughout the entire MRG. Such a random sampling design would entail sampling at many more sites over the length of the MRG. An ancillary design of this type would enhance the feasibility of assessing the abundance and distribution of RGSM in the MRG during years of low flows and when the species is likely to occur in low abundance.	--	0
14	30	Consider using key drivers of mesohabitat variability, such as current velocity, substrate size, and water depth at specific locations where seines are deployed, to replace the mesohabitat factor in the mixture models.	--	2
16	30	Examine the historical availability of mesohabitats in the MRG relative to discharge. If these two measures can be linked, then annual or monthly discharge may provide a good surrogate of mesohabitat availability.	--	2
17	30	Evaluate alternatives to the parametric mixture model, in particular, Bayesian hierarchical models, for estimating annual CPUEs.	--	2
18	30	Use classification and regression trees, boosted regression trees, or random forests to examine relationships between hydrologic variables and CPUE for identifying thresholds above or below which CPUE exhibits changes.	--	1.5

Number[1]	Page	Recommendation	Panel Priority	PMWG Priority
19	30	Implement directed studies using different sampling designs, such as multi-year, multi-site, before-after-control-impact (BACI) designs to enhance understanding of the response of the population to changes in river discharge, habitat rehabilitation projects, and availability of mesohabitats.	--	3
21	30	Conduct stock-recruitment studies to determine how the abundance of fall recruits relates to the abundance of spring spawners. Investigate the effects of spring and summer discharges on the stock recruitment relationship to enhance understanding of the dynamics of RGSM. Implement a spring sampling protocol at spawning sites to estimate the number of spring spawners, and compare with October results for several years; such studies may provide useful data on RGSM population dynamics and limiting factors.	--	3
22	30	Complete a study of age-specific fecundity and survival rates based on pre-breeding (fall) population estimates, spring spawners, and hatchery supplementation. Results from this study could be used to estimate population recovery and extirpation potentials as a function of altered flow regimes and stocking.	--	3
23	30	Consider genetic fingerprinting and epigenetic studies, including bar-coding and gene-expression, of presumed wild and hatchery fish to help determine hatchery contributions to the spring spawners and the long-term risks to the wild population.	--	0
24	30	Expand the analyses in Dudley et al. (2015) to assess flow regime and habitat fragmentation effects on RGSM occurrence and abundance and suggest preliminary flow regimes for rehabilitating the wild RGSM population.	--	3

[1]numbers 15 and 20 are missing in the original report by Hubert et al. (2016), apparently as an inadvertent error in numbering

Table A-2. Recommendations from the Noon et al. (2017) Adaptive Management Science Panel. The Noon Science Panel assigned priorities to these recommendations, and some priorities were assigned by the Population Monitoring Work Group (PMWG). Priority: 1 = high, 2 = moderate, 3 = low, 0 = no consideration by PMWG, Important = Recommendation is important, but not priority was assigned.

Number	Page	Recommendation	Panel Priority	PMWG Priority
A1	17	Clarify the relationship between the annual catch-per-unit-effort and true population size by estimating catchability.	1	1
A2	18	Determine the key, age-specific, life history sensitivities of the RGSM (that is, use Eigen- analysis methods to determine which vital rates [survival and/or reproduction] most affect rates of population change.	1	3
A3	18	Estimate age-specific survival rates	1	3
A4	19	Estimate age-specific fecundities of wild fish.	1	3
A5	19	Using statistical modeling, estimate the relationships between RGSM demographic rates and A.) hydrological factors (flow magnitude and duration, summer drying of the channel); and B.) abiotic environmental factors (temperature, turbidity, salinity); and C.) biotic factors (predation, completion, prey availability).	1	3
A6	20	Evaluate the existence and strength of any density-dependent factors that may be limiting population growth.	2	--
A7	20	Model the potential effects of hatchery augmentation on population dynamics and the significance of hatchery fish to achieving recovery objectives.	Important	--
A8	20	Determine if the collection and translocation of salvage fish during summery drying periods contributes significantly to population dynamics.	Important	--
B1	21	Development and deployment of "vertically-integrating" Moore egg collectors	1	--
B2	21	Improved assessments of relations between possible environmental cues that trigger spawning activity.	1	--
B3	21	Establish size-specific fecundities of natural-spawning RGSM.	2	--
C	22	Clarify the detail of annular mark formation on otoliths and firmly establish the longevity of RGSM	2	--

Number	Page	Recommendation	Panel Priority	PMWG Priority
D1	22	Estimate the spatial extent and hydraulic quality used by RGSM for key life-stages (spawning, larval rearing, juvenile and adult survival). Estimate how these habitats are distributed in the river channel and floodplain in each MRG reach under a range of discharges and seasonal flow regimes.	Important	--
D2	23	Establish the proximate trigger(s) for spawning by evaluating the effects of flow velocity, temperature, rate of increase in flow velocity, or some combination of these factors.	Important	--
D3	23	Determine the roles and relative contributions to fish production (age 0 recruitment and survival of all age-classes) of channel and floodplain habitat in a reach of channel and floodplain typical of the MRG.	Important	--
D4	24	What is the management potential for fish production (recruitment and survival of age 0 fish) in each reach of the MRG if the annual peak flow, and thus the nature and range of available habitats, is permanently limited below historic levels of availability?	Important	--
E1	24	Establish the age composition of the RGSM population, including A.) application of distribution separation methods to estimate age composition, and B.) gear selection study.	1	--
E2	25	Determine how the vertical and horizontal distribution of RGSM eggs in the MRG mainstream channel varies as a function of flow and location?	1	--
E3	25	Calculate revised CPUE values as mesohabitat-specific levels and do not combine across mesohabitat types. The meso-habitat specific CPUE calculated for the most abundant high density mesohabitat type should be used for assessment of trend in abundance of the RGSM population at the October sampling date.	2	2

Table A-3. Consolidated and categorized recommendations from the Hubert et al. (2016) and Noon et al. (2017) Science Panels.

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
Population Dynamics / Noon et al. = Priority 1						
1	1/1	--	A1	Clarify relationship between annual CPUE index and true population size.	• Dudley et al. (2011a, 2011b, 2011c, 2012) implemented population estimation. • Goodman (2012) evaluated Population Estimation Program. • Valdez (2018a) evaluated relationship between CPUE and true population size (presented to PMWG 6/20/2018).	Remains unresolved
2	1/3	--	A2	Determine which age-specific vital rates (survival, reproduction, etc.) most affect population change.	• Goodman (2010) did deterministic dynamics of environmental correlates. • Miller (2012) performed sensitivity analysis as part of PVA. • Yackulic (2018) model in progress (presented to PMWG 12/12/2018).	Ongoing
3	1/3	--	A3	Estimate age-specific survival rates.	• Goodman (2009) estimated survival from quarterly comparisons of CPUE. • Miller (2012) reconciled survival rates from PVA. • Valdez (2018b) estimated survival of wild RGSM (presented to PMWG 12/12/2018).	Ongoing
4	1/3	22	A4, B3	Estimate size and age-specific fecundities of wild fish.	• Platania and Altenbach (1996) did clutch and batch production and fecundity estimates in a lab. • Caldwell et al. (2019) evaluated reproductive potential of captive RGSM. • Archdeacon?	Information needed on wild RGSM

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
5	1/3	10	A5	Model relationships between demographic rates and hydrological factors (flow magnitude, duration, drying), abiotic factors (temp, turbidity, salinity), and biotic factors (predation, completion, prey).	• Miller (2012) related demographic rates to hydrological factors as part of PVA. • Archdeacon (2016) evaluated reduced spring flow. • Yackulic (2018) model in progress. • Walsworth and Budy (2020) model in progress. • Hatch and Cowley (2020)?	Ongoing
Population Dynamics / Noon et al. = Priority 2						
6	2/--	--	A6	Evaluate existence and strength of density-dependent factors that may limit population growth.	• Miller (2012) evaluated as part of PVA. • Goodman (2010) evaluated as part of PVA. • Yackulic (2018) model in progress.	Ongoing
Population Dynamics / Noon et al. = Other Important Studies						
7	Import/--	--	A7	Model potential effects of hatchery augmentation on population dynamics.	• Miller (2012) evaluated as part of PVA. • Archdeacon and Remshardt (2012). • Archdeacon (2015) provides annual reports on augmentation. • Yackulic (2018) model in progress. • Hatch and Cowley (2020)?	Ongoing
8	Import/--	--	A8	Determine if collection and translocation of salvaged RGSM during summery drying contribute to population dynamics.	• Archdeacon (2017) gave a presentation on Fish Rescue.	Ongoing
Reproductive Biology of Rio Grande Silvery Minnow / Noon et al. = Priority 1						
9	1/--	--	B1, E2	Develop and deploy "vertically-integrating" Moore egg collectors; determine vertical and horizontal distribution of RGSM eggs as a function of flow and location	• Porter (2018) designed a multi-level vertical egg collector.	Work initiated; more needed

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
10	1/--	--	B2, D2	Assess effect of environmental cues (flow, velocity, temp, flow change) on spawning onset and activity.	• Cowley et al. (2009) evaluated effect of salinity on specific gravity of eggs. • Krabbenhoft et al. (2014) evaluated phenology. • Valdez (2010, 2019, 2020a) evaluated temperature degree-days for hatching.	Ongoing
Age and Growth / Noon et al. = Priority 2						
11	2/--	--	C	Clarify annular marks on otoliths and firmly establish longevity of RGSM.	• Horwitz et al. (2018) used scales and otoliths for juveniles and adults. • Zipper et al. (2020a; 2020b) verified otolith age for larvae.	Unresolved
Physical Habitat Relations of RGSMs / Noon et al. = Other Important Studies						
12	Import/--	--	D1	Estimate spatial extent of habitat and hydraulic quality used by RGSM for key life-stages (spawning, larval, juvenile, adult).	• Tetra Tech (2014) evaluated habitat for occupied, feeding/rearing, spawning/ egg/larval habitat. • Walsworth and Budy (2020). • Colorado State University (2020)? • Yackulic (2020). • Hatch and Cowley (2020)?	Evaluation ongoing by several groups
13	Import/--	--	D3	Determine roles and relative contributions to fish production by age in channel and floodplain habitats.	• Tetra Tech (2014). • Walsworth and Budy (2020). • Colorado State University (2020)? • Yackulic (2020). • Hatch and Cowley (2020)?	Evaluation ongoing through modeling
14	Import/--	--	D4	Evaluate management potential for fish production (recruitment and survival of age 0 fish) in each reach if annual peak flow and available habitat is permanently limited below historic levels.	• Tetra Tech (2014). • Walsworth and Budy (2020). • Colorado State University (2020)? • Yackulic (2020).	Evaluation ongoing through modeling

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
Sampling Methodologies / Noon et al. Priority 1						
15	1/--	--	E1	Establish age composition of RGSM population, including application of distribution separation methods.	• Valdez (2018b) evaluated age composition using distribution separation methods (presented to PMWG 10/2/2018). • Winter (2018) provided a Bayesian analysis of von Bertalanffy growth function (presented to PMWG 12/12/2018).	Ongoing
16	1/--	--	E1	Evaluate size and age of fish captured by gear type with gear selectivity.	• Widmer et al. (2012) PP to Science Workgroup, 8/21/2012. • Gonzales et al. (2012) evaluated fyke-net catches. • Valdez et al. (2020b) evaluated gear selectivity (presented to PMWG 10/2/2018).	Ongoing
17	2/2	--	E3	Calculate revised CPUE values using most abundant high CPUE mesohabitats for assessment of trend in abundance at October sampling date.	• Valdez (2018c) computed CPUE at mesohabitat-specific levels (presented to PMWG 10/2/2018).	--
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 1						
18	--/1	1, 2, 3	--	Separate catch and effort data from small-mesh and fine-mesh seines and compute CPUE for each gear type and by age (larvae, age-0, age 1, age 2+).	• Dudley et al. (2020) have computed larval and standard seine CPUE annually since 2018.	Ongoing
19	--/1, 2	4, 5	--	Evaluate effect of zero catches on CPUE (zero as dry site, no fish captured).	• Dudley et al. (2020) have evaluated effect of zero catches on CPUE annually since 2018.	Ongoing
20	--/1, 2	6	--	Evaluate effect of sample design on zero CPUE.	Effect of sample design on zero CPUE has not been evaluated.	Not Initiated

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
21	--/3, 1	7, 8	--	Evaluate detection and catchability (*p*-hat) of RGSM in seines, including effect of environmental factors (turbidity, temp., substrate, depth, velocity, discharge) during sampling on CPUE.	• Archdeacon and Davenport (2013) evaluated detection and population estimation.	More work needed
23	--/1	11, 14, 17	--	Evaluate mixture model for computing RGSM CPUE, and other models, including Bayesian hierarchical models; consider using key drivers of mesohabitat variability (e.g., velocity, substrate, depth) to replace the mesohabitat factor in mixture models.	The mixture model has not been evaluated in this manner.	Not Initiated
24	--/1, 0	12, 13	--	Increase sample sites by 20-50 sites per reach, and evaluate effect on CPUE; add random sites to replace dry sites.	• Dudley et al. (2020) added sample sites starting in 2018. • Archdeacon et al. (2015) Compared fish communities at random and non-random sites.	Needs additional evaluation
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 1.5/2						
26	--/1.5	18	--	Use classification and regression trees, boosted regression trees, or random forests to examine relationships between hydrologic variables and CPUE for identifying thresholds above or below which CPUE exhibits changes.	This has not been implemented.	Not Initiated
25	--/2	16	--	Examine historical availability of mesohabitats relative to discharge. If linked, annual or monthly discharge may be surrogate for mesohabitat availability.	This has not been examined.	Not Initiated

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 3						
27	--/3	19	--	Implement studies using different sampling designs (multi-year, multi-site, before-after-control-impact [BACI]) to better understand population response to changes in river discharge, habitat rehabilitation projects, and mesohabitats.	This has not been implemented.	Not Initiated
28	--/3	21	--	Conduct stock-recruitment studies to determine how abundance of fall recruits relates to abundance of spring spawners.	• Miller (2012) • Walsworth and Budy (2020). • Yackulic (2020). • Hatch and Cowley (2020)?	Ongoing
30	--/3	24	--	Expand the analyses in Dudley et al. (2015) to assess flow regime and habitat fragmentation effects on RGSM occurrence and abundance and suggest preliminary flow regimes for rehabilitating the wild RGSM population.	• This has not been implemented.	
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 0						
22	--/0	9	--	Evaluate recovery standards by gear, sample design, techniques, data analysis, and life stage.	Is evaluating recovery standards the charge of the PMWG?	Not Initiated
29	--/0	23	--	Consider genetic fingerprinting and epigenetic studies, including bar-coding and gene-expression, of presumed wild and hatchery fish to help determine hatchery contributions to spring spawners and long-term risks to wild population.	Is this an issue for the Genetics Group?	Not Initiated

Memo

To: Population Monitoring Workgroup

From: Rich Valdez, PMWG Co-Chair

Subject: Next Steps in Modeling Process—Ideas from Dr. Yackulic

Date: March 18, 2020

The following was transmitted to me via e-mail from Dr. Charles Yackulic on March 18, 2020, partly in response to "Follow-up Questions on Integrated Model for Rio Grande Silvery Minnow":

In terms of next steps, this is what I think might make sense:

Step 1) Consider some revision to model inputs. In particular,

a) adding habitat data by developing relationship between velocity and mesohabitat (I've already been working with Mick on this).

b) trying to figure out the early years and whether there are data issues (I've looked at this already and data is certainly sparser in those early years and there are a couple weird years - on the other hand I hate throwing out data - Also, if we just look at 2002 to present, 2004 still looks like a bit of an outlier in terms of high age-0 abundance for the number of age - 1+ we think are in the system). One thought I had after looking over the questions you sent me was that I should look at the size data and consider adding in an additional age classes (I know folks wanted this early on, but I was trying to limit complexity when we were considering additional spatial complexity and now that we have limited spatial complexity it means we can consider additional age classes).

c) consider adding additional age classes (see b and based on comments you sent).

d) consider modifying habitat data by the drying data - I know how we would do this, but want to talk to a few folks familiar with the system to see if this makes sense - we could do this as a group.

e) try analyzing augmentation data with a spatial analysis just to make sure we don't get different answers (issue here is that as long as monitoring sites are randomly distributed with respect to augmentation release sites we ought to be okay, but sounds like they have not always been distributed this way)

f) could try to integrate salvage data.

Although this seems like a lot and will take a while to work through, they all seem like things I can move through and check off without a whole lot of help from the group. In contrast, step 2 is going to require quite a bit of input.

Step 2) Develop future scenarios. (This can be done in parallel with step 1) I think key here is to consider some fairly different hypotheses about how to manage flow and other management actions - what are the specific ideas out there about how timing, magnitude and duration should be prioritized? This requires some facilitated brainstorming with the group. With what we have done on the modelling side, the simulations will be super easy - the hard part is defining the scenarios. Do we want to include some in the box and some out of the box scenarios (i.e., within the current interpretation of the Law of the river) or only within the box scenarios? I think this part requires some phone calls with the group (perhaps a smaller group to decide on the process and the larger group to get ideas on the biology).

Follow-up Questions on Integrated Model for Rio Grande Silvery Minnow
From Population Monitoring Workgroup
PRELIMINARY—March 15, 2020

1. The timing of spawning and runoff may not be consistent every year. In many years, spawning starts prior to or with early runoff. In other years, spawning takes place during increased flows of spring runoff. The timing, magnitude, and duration of floodplain inundation is an important aspect of the reproductive success of the species, and something that we want to better understand and test with the model.
2. What relationship of RGSM size to egg number was used in the model?
3. What conversion was used to derive abundance (N) from catch-per-unit-effort (CPUE)—the relationship from the 4-year ASIR study?
4. How does the model use the range of survival in simulations?
5. Can the model hold all variables stable and test only for different numbers of augmented fish—or salvaged fish—in a sensitivity analysis?
6. Displacement of stocked fish appears minimal. Will the USU/BOR movement study inform this issue, and how can we distinguish movement of hatchery fish from that of wild fish?
7. How is carrying capacity (Rf) a function of flow/inundation? Do these affect the alpha and beta parameters of the Beverton-Holt model—or do the recruits and spawners of each year set the BH parameters and thus Rf?
8. What is the relationship and timestep of flow and habitat (RU/RI and PO) that drive the model?
9. The mean annual survival estimates of age-1 fish derived by Goodman (2009) of 0.058, and Valdez (2010, 2018) of 0.04 and 0.027 are within the range of the annual adult survival rates as part of the model (slide 21). However, the rates for age-2 fish by Miller (0.05) and Valdez (2018) of 0.113 are higher than shown. Is the possible higher survival rate of age-2+ fish important for determining survival of older fish and their significance to the population, especially given that their fecundity is higher?
10. Is the survival of stocked fish an annual survival rate? If so, it is about 10 times higher than that of wild adults shown in slide 21—is this true?
11. It is unclear how the model handles river drying. Drying is a complex phenomenon and should be considered in both spatial and temporal scales?
12. Were any annual changes in RGSM abundance observed that suggesting an unexpected or unrealistic change in CPUE, indicating that the CPUE may not be a reliable index, especially at very low levels of abundance?

Follow-up Questions on Integrated Model for Rio Grande Silvery Minnow
From Population Monitoring Workgroup
PRELIMINARY—March 15, 2020

1. The timing of spawning and runoff may not be consistent every year. In many years, spawning starts prior to or with early runoff. In other years, spawning takes place during increased flows of spring runoff. The timing, magnitude, and duration of floodplain inundation is an important aspect of the reproductive success of the species, and something that we want to better understand and test with the model.

    a. *Agreed, what we need to do is to figure out how to facilitate a conversation where we make different hypotheses about timing, magnitude and duration clearer such that we can operationalize them as covariates – this process should be independent of looking at data and more of just a structured brainstorming session.*

2. What relationship of RGSM size to egg number was used in the model?

    a. *None. The model tries to estimate the number of yoy in June as a function of the number of age 1+ present in April – it differentiates between fish stocked the winter before and those present in the system for longer (i.e., either wild reared or stocked more than a year before). One idea I had after looking through Colleen's work is that we might look at the size distribution from April across years to see how much it varies and whether the structure of the model needs to be modified (I'm basing this on the observation that standard length has a nice relationship with fecundity regardless of age).*

3. What conversion was used to derive abundance (N) from catch-per-unit-effort (CPUE)—the relationship from the 4-year ASIR study?

    a. *The conversion is based on the availability of pool and run/riffle habitat, the catch rates in these two habitats and an estimated capture probability for monitoring seining. The capture probability is estimated by comparing monitoring data to the ASIR data during the 4 year study. The availability of habitat is based on the various habitat sources (USGS study, habitat availability form asir studies, etc.) The relative catch rates are informed by the ASIR monitoring data in a given period. The other factor is that because there is an underlying population model, some information is being shared from other sampling in the same year.*

4. How does the model use the range of survival in simulations?

    a. *The model is not yet formulated for simulation, but that is a logical next step. The model estimates a range of survival from the data (including its variation over time) that can easily be used to parameterize a simulation model…if we had an*

agreement of what we wanted to simulate we could modify existing code very easily – the harder part is deciding what makes sense to simulate.

5. Can the model hold all variables stable and test only for different numbers of augmented fish—or salvaged fish—in a sensitivity analysis?

    a. *Yes, we could do that.*

6. Displacement of stocked fish appears minimal. Will the USU/BOR movement study inform this issue, and how can we distinguish movement of hatchery fish from that of wild fish?

    a. *The USU/BOR study will inform this to a certain extent (although I would like to see them adopt an analytical framework that allows them to distinguish initial stocking movement from movements after stocking). There are two way to get at movement of wild fish: 1) assume that stocked fish act like wild fish after some time period (i.e., focus on movements from USU/BOR study starting say 1 or 2 months after stocking, 2) actually capture some wild fish and pittag them and put them back in the river.*

7. How is carrying capacity (Rf) a function of flow/inundation? Do these affect the alpha and beta parameters of the Beverton-Holt model—or do the recruits and spawners of each year set the BH parameters and thus Rf?

    a. *The equations used are as follows:*

$$\#\text{ recruits} = \frac{a(N_{1+} + \beta N_S)}{1 + a(N_{1+} + \beta N_S)/R_f}$$

$$R_f = e^{c + d * flow + \varepsilon}$$

Rf acts like a carrying capacity and is calculated by the second equation where c is an intercept, d estimate the impacts of the flow covariate and ε allows for deviations from the parametric relationship. This Rf is then combined with other parameters and abundance to predict recruitment via the top equation, where a is an estimated parameter representing the maximum number of yoy per adult (i.e., when flow conditions are optimal such that Rf becomes big and the N's are low), N_{1+} *is the number of age 1+ fish,* N_S *is the number of fish stocked the winter before that survived through April, and* β *is the relative impact of stocked fish (i.e., if* $\beta = 1$ *stocked fish contribute the same as wild fish, if* β *near zero, stocked fish have minimal contribution and wild fish do all the reproducing.)*

I know equations aren't intuitive to everyone so I could try to code up an excel spreadsheet for people to play with if we thought that would help…

8. What is the relationship and timestep of flow and habitat (RU/RI and PO) that drive the model?

Habitat areas are calculated based on the average discharge from the days within a month when catch data was collected – these habitat areas are then multiplied by the

catch within the habitats and divided by the capture probability to get at the overall expected abundance for that month.

9. The mean annual survival estimates of age-1 fish derived by Goodman (2009) of 0.058, and Valdez (2010, 2018) of 0.04 and 0.027 are within the range of the annual adult survival rates as part of the model (slide 21). However, the rates for age-2 fish by Miller (0.05) and Valdez (2018) of 0.113 are higher than shown. Is the possible higher survival rate of age-2+ fish important for determining survival of older fish and their significance to the population, especially given that their fecundity is higher?

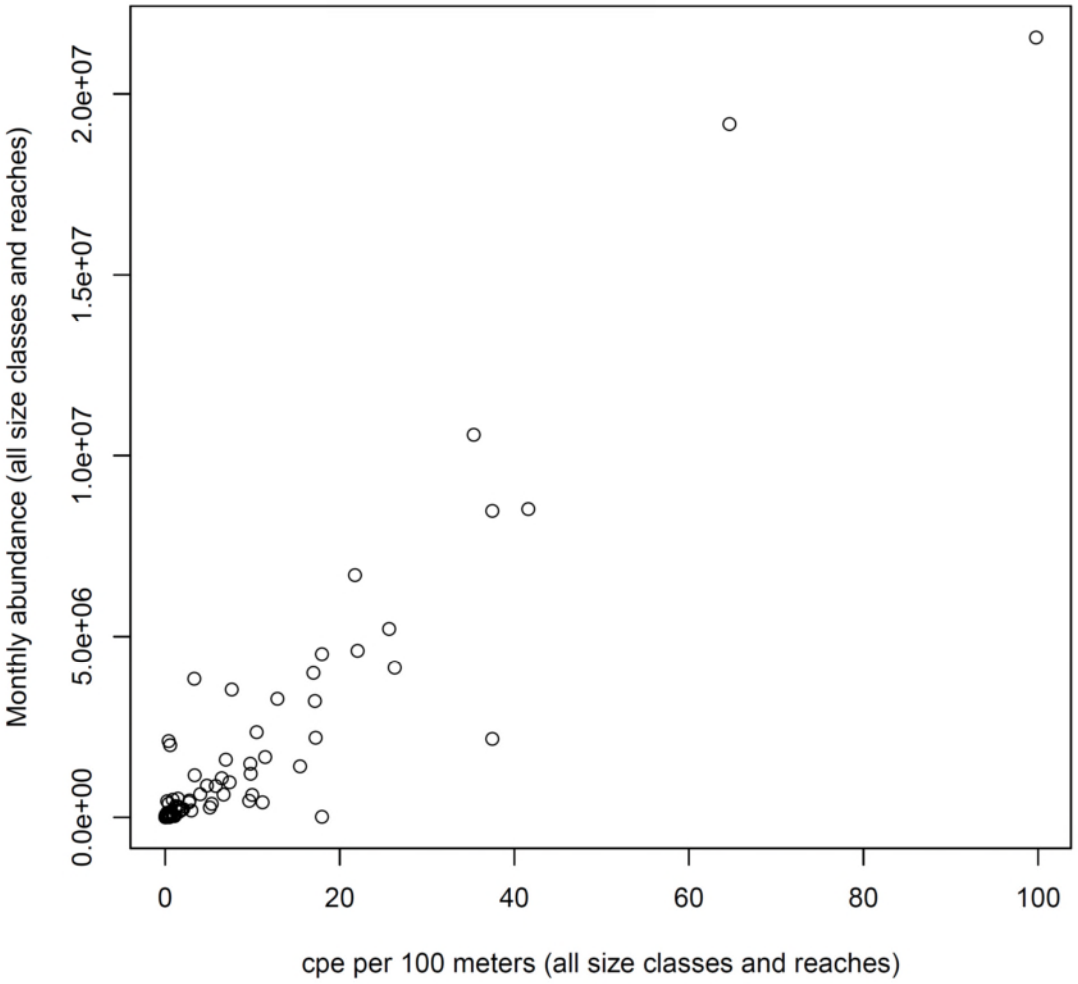
    a. *Yes, this could be and perhaps the model needs to be modified to allow for this. If enough folks in the group feel this is important, I can modify the model to allow for this.*

10. Is the survival of stocked fish an annual survival rate? If so, it is about 10 times higher than that of wild adults shown in slide 21—is this true? *No, that survival rate is just for the initial release – in other words, as soon as fish are put in the system this rate applies and then they adopt the vital rates of wild adults – so for example, the annual rate of stocked fish is something like 0.15*0.04 = 0.006 where 0.15 is the instantaneous survival and 0.04 is the annual survival over the rest of the year.*

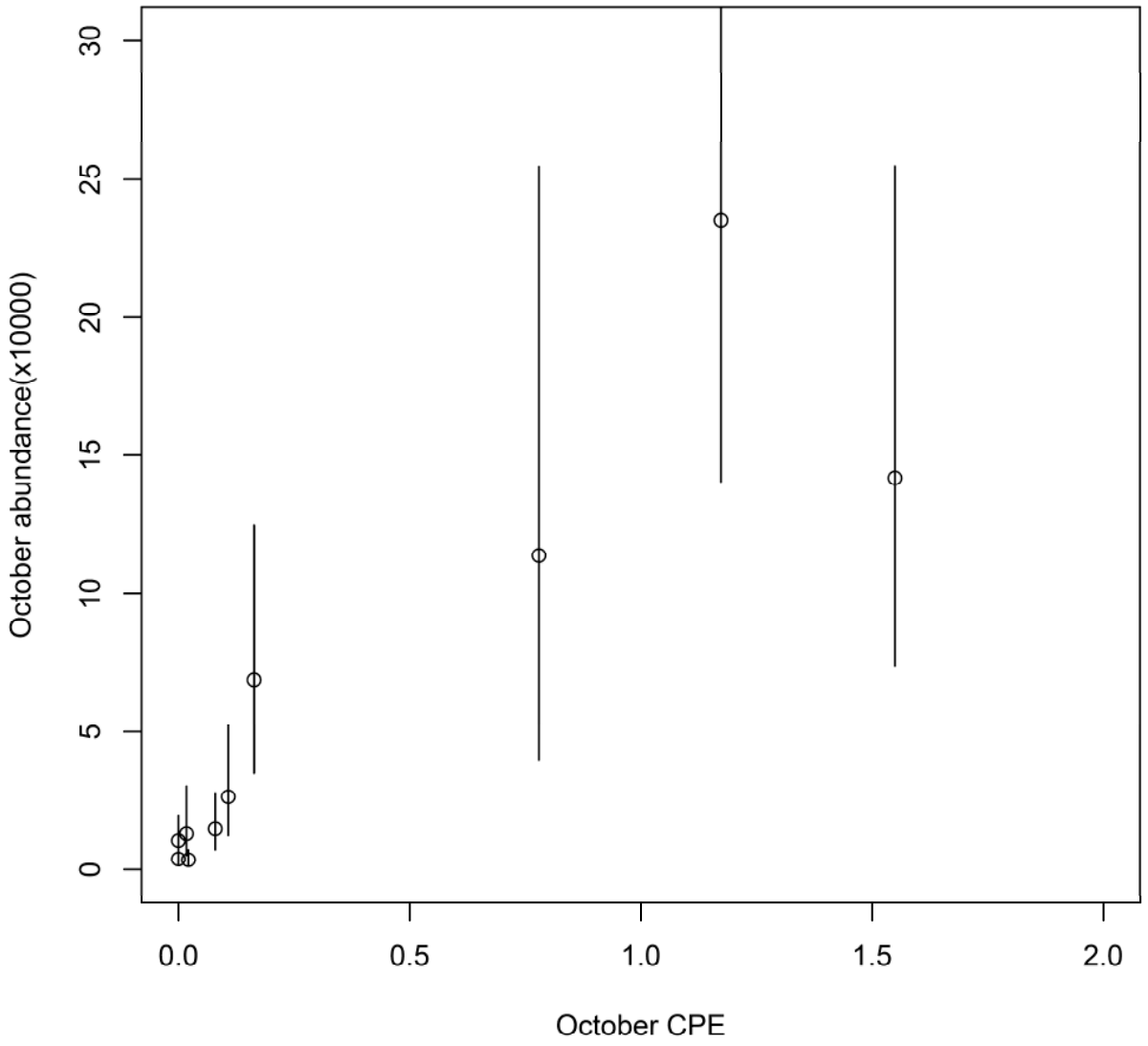
11. It is unclear how the model handles river drying. Drying is a complex phenomenon and should be considered in both spatial and temporal scales? *I tried incorporating drying into the more spatially resolute version of the model, by making fish either die or leave, but had trouble with it because of the lack of tagged wild fish. At present, the relatively coarse model could include drying as a covariate on survival (I haven't actually added it in, but I could). The other way the model could include drying is by modifying the expected habitat within a reach based on the drying data – I plan on doing this in the near future. The key here is that if a third of a reach is dried then that means there are 1/3 less fish for a given cpue then if it were not dried.*

12. Were any annual changes in RGSM abundance observed that suggested an unexpected or unrealistic change in CPUE, indicating that the CPUE may not be a reliable index, especially at very low levels of abundance?

    a. *That is a good question. The R^2 over the whole range was 0.88 when you aggregate cpe and N over all size classes and reaches within a given month of sampling. This is shown in first plot below that does not include uncertainty in abundance.*



b. The second plot (below) focuses only on October estimates and at the low end of cpe's. I tried to calculate cpe's the way I think you all do, but not sure it is exactly right (for example, do they use larval seines or only the big ones?) Note that I have added 95% CI's for abundance.


October abundance(x10000)
0
5
10
15
20
25
30
0.0
0.5
1.0
1.5
2.0
October CPE

c.

Middle Rio Grande Endangered Species Collaborative Program
Population Monitoring Work Group (PMWG)
2020 Work Plan

The Population Monitoring Work Group (PMWG) as tasked with providing technical review, focused assessment, and recommendations related to monitoring of fish populations in the Middle Rio Grande (MRG), as impacted by water management and river dynamics.

The PMWG plans to complete the following tasks in 2020:

Task	Subtask	Target Completion Date
1. Integrate and prioritize recommendations from the science panels	Track progress in addressing science panel recommendations	Provide summary progress on priority activities by November 20, 2020. EC update at Dec 2020 mtg
2. Analyze or review data used to support the integrated RGSM model	Prepare, analyze, or review up to four reports on; RGSM fecundity, age, survival, recruitment, or other analyses identified	Review and publish two reports through MRGESCP format and process by November 20, 2020 with provision to EC Dec 2020
3. Review a draft report of the Integrated RGSM Model methods and any preliminary results	Provide PMWG member reviews of a report documenting methods and data used. Provide reviews of preliminary results of Integrated RGSM Model	Review draft report by August 31, 2020, with comments by September 28, 2020. Comments on preliminary Integrated RGSM Model by Nov 20.

April 28, 2020

Documents:

Topics for Discussion

Meeting Minutes

Read-Aheads and Presentations

Draft 2 Consolidated Recommendations of Two Expert Science Panels on Monitoring of the Rio Grande Silvery Minnow [draft]

Draft Executive Summary: Age-Specific Survival of Rio Grande Silvery Minnow [draft]

Draft Executive Summary: Consolidation of Mesohabitats for Monitoring Rio Grande Silvery Minnow [draft]

Revised Middle Rio Grande Endangered Species Collaborative Program Population Monitoring Work Group 2020 Work Plan [revised]

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
April 28, 2020
1:00 PM – 4:00 PM

Zoom Information:
https://west-inc.zoom.us/j/8983593120
Call-In: +1-669-900-6833; Meeting ID: 898-359-3120

Meeting Agenda

1:00 – 1:15	**Welcome, Introductions, Agenda Review, Meeting Notes** ➢ **Decision:** Approval of April 28, 2020 agenda ➢ **Decision:** Approval of March 25, 2020 minutes Read aheads: ☐ April 28, 2020 meeting agenda ☐ March 25, 2020 meeting minutes	*PMWG Co-chairs*
1:15 – 1:45	**2020 Work Plan** Read aheads: ☐ Revised PMWG 2020 Work Plan	*Rich Valdez*
1:45 – 2:15	**Review Executive Summaries** Read aheads: ☐ Consolidated Recommendations Report ☐ Age-Specific Survival of Rio Grande Silvery Minnow ☐ Consolidation of Mesohabitats for Monitoring RGSM	*Kevin McDonnell* *Catherine Murphy* *Rich Valdez*
2:15 – 2:25	**Break**	
2:25– 2:40	**Summary of Technical Modelers Webinar**	*Kevin McDonnell*
2:40 – 3:45	**Discuss Scenarios for Integrated Model** • Follow-up Questions on Model Framework • Develop Model Scenarios Read aheads: ☐ Example Scenarios	*Rich Valdez* *Charles Yackulic* *Joel Lusk*
3:45 – 4:00	**Wrap-Up** • Announcements • Action Items • Next Meeting	*Rich Valdez*
4:00	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
April 28, 2020
1:00 PM – 4:00 PM

Location: Zoom meeting

Meeting Minutes

Decisions:

- ✓ Approval of April 28, 2020 PMWG meeting agenda.
- ✓ Approval of March 25, 2020 PMWG meeting minutes with the following revision:
  - In the action items list, replace "Utah State University" with "Colorado State University".
- ✓ Approval of revised 2020 PMWG work plan, with possible amendments of Element 2 dates based on Charles Yackulic's input.

Action Items:

WHO	WHAT	BY WHEN
Rich Valdez & PST	Discuss potential dates for the next PMWG meeting with Charles Yackulic and send out a doodle poll	May 4, 2020
Rich Valdez	Discuss deadlines for Element 2 of the 2020 Work Plan with Charles Yackulic and revise as needed	May 6, 2020
Catherine Murphy	Distribute to the PMWG full comments on the executive summaries as a writing guide	May 8, 2020
Rich Valdez	Write up the population structure questions from the discussion to use as modeling scenarios	May 8, 2020
Mike Marcus	Write up the habitat/flow trade-off questions from the discussion to use as modeling scenarios	May 8, 2020
PMWG members	Send Rich Valdez and Debbie Lee any further ideas for modeling scenarios	May 8, 2020
Joel Lusk	Send the scenarios presented to the technical modeling group to the PMWG	May 8, 2020

PST	Discuss inclusion of a PMWG progress report on the next Executive Committee (EC) agenda with the EC co-chairs	May 15, 2020
PMWG members	Review and provide comments on the Consolidation Document and the two example executive summaries	May 15, 2020
Catherine Murphy & Kevin McDonnell	Take the "Age-specific survival of Rio Grande Silvery Minnow" executive summary through the review process	May 15, 2020
Catherine Murphy & Kevin McDonnell & Mike Marcus	Revise the "Consolidation of Mesohabitats for Monitoring RGSM" executive summary	May 15, 2020

- **Next meeting**: TBD

Welcome, Introductions, Agenda Review, and Meeting Notes

Rich Valdez, SWCA and the PMWG chair, opened the meeting and led introductions. He reviewed the meeting agenda. He then reviewed action items from the March 25, 2020 meeting, and asked for comments on the meeting minutes. The following updates were given:

- Charles Yackulic, U.S. Geological Survey; Joel Lusk, U.S. Bureau of Reclamation (Reclamation); and Shay Howlin, Program Support Team (PST), discussed the 1996 FLO data, and agreed that that data should be entered into electronic format. Once the transect data is entered, it will be posted on the Program Portal.
- The Zotero library has been formed. If anyone needs help uploading files or editing metadata, email Debbie Lee, PST, for assistance.

Rich shared with the group that Joel L. has stepped down as PMWG co-chair due to his workload, and expressed his appreciation for Joel's work as co-chair. Joel will still be participating in the PMWG and, along with Eric Gonzales, representing Reclamation.

- ✓ **Decision**: Approval of April 28, 2020 PMWG meeting agenda
- ✓ **Decision**: Approval of March 25, 2020 PMWG meeting minutes with the following revision:
  - In the action items list, replace "Utah State University" with "Colorado State University".

2020 Work Plan

Rich V. reminded the group that at the last meeting, participants discussed the 2020 PMWG Work Plan and requested revisions. He presented the revisions to the PMWG. The group agreed to the following further revisions to the 2020 PMWG Work Plan:

- Include footnotes to reference the relevant science panel reports and the integrated stock assessment model
- Add a new subtask under Task 1: Work with the PST to integrate recommendations into the adaptive management process
- Include new subtask under Task 2:
  - Develop model parameters

    - Conduct sensitivity analyses
- Rename "tasks" to "elements"

During the discussion, Rich V. made the point that the integration and coordination with the model being developed by Utah State University (USU) to reanalyze the hydrobiological objective is outside the scope of the PMWG. He noted that the work group's purpose was to assist Charles Yackulic in the development of the integrated stock assessment model, and while the group will take into account other models, it will not enter into a formal evaluation or comparison between that model and any others. Kevin McDonnell and Catherine Murphy, PST, added that in the future, the goal is to build a decision tool that incorporates learnings from all the models.

- ➢ **Action Item**: Rich V. will discuss deadlines for Element 2 of the 2020 Work Plan with Charles Yackulic and revise as needed
- ✓ **Decision**: Approval of revised 2020 PMWG work plan, with possible amendments of Element 2 dates based on Charles Yackulic's input.

Review Executive Summaries

Rich V. reviewed the revised consolidation document. He noted that there were no volunteers to take on contributing authorship or reviewer for any of the 22 topic areas, and encouraged group members to volunteer once they have seen examples presented. He then noted that there were two example executive summaries prepared: he had prepared one on age-specific survival of Rio Grande silvery minnow (RGSM) and Mike Marcus had prepared one on consolidation of Mesohabitats for monitoring RGSM using the template discussed at the last meeting.

Catherine M. then thanked Rich V. and Mike M. for providing the examples as a way to spur discussion. She shared her initial reactions to the example executive summaries:

- Moving the Management Implications section to the top of the document will highlight that for readers. If this is proves redundant with the Program Goal section, those two sections can be combined.
- The Program Goal Relevance section is meant to be a short pitch for why this topic is important to the Program.
- The Literature Summary should summarize the findings of each citation, focusing on conclusions. There does not need to be a lot of data cited and long quotations. Instead, summarize what the reader should be learning.

Kevin M. added that these executive summaries should be fairly quick to develop and short in length. He reminded the group that the PST was available to help the writers, and there was a review built into the executive summary development process, and it is laid out in the template. Rich V. noted that it was important that the summaries provide information that can be consumed and digested quickly by people with a range of technical backgrounds and expertise.

Mike M. informed the group that the draft "Consolidation of Mesohabitats for Monitoring RGSM" executive summary has significant overlap with another topic, spatial extent and historical availability of habitat and hydraulic quality used by RGSM, and could see a need to separate the two topics out. Catherine M. and Kevin M. offered to help Mike M. revise the mesohabitat executive summary, while preserving the information that should be included in the spatial extent and historical availability of habitat and hydraulic quality executive summary.

- ➢ **Action Item**: Review and provide comments on the Consolidation Document and the two example executive summaries

- **Action Item**: Catherine M. will distribute to the PMWG her full comments on the executive summaries as a writing guide
- **Action Item**: Catherin M. and Kevin M. will take the "Age-specific survival of Rio Grande Silvery Minnow" executive summary through the review process
- **Action Item**: Catherine M., Kevin M., and Mike M. will revise the "Consolidation of Mesohabitats for Monitoring RGSM" executive summary

Summary of Technical Modelers Workshop
Rich V. invited Kevin M. to provide a brief summary of the technical modelers workshops. Kevin M. informed the group that Charles Y., the modelers from USU, Tim Walsworth and Phaedra Budy, Rich. V., Joel L., Eric G., and himself met to discuss the two models being developed, where they overlapped, and how the two efforts can inform each other. The next step for both modeling efforts is the identification of management actions. Rich V. also began to describe a conceptual framework for designing a hydrograph and its application to identifying future management actions.

- **Action Item**: Joel L. will share the scenarios he had presented to the technical modeling group with the PMWG

Discuss Scenarios for Integrated Model
The PMWG discussed how to develop scenarios to run through the integrated model under development by Charles Y. The group developed ideas that fell into two broader categories: population structure, and the trade-off between habitat and flow, listed below:

Population Structure
1. Effect of RGSM augmentation on population (2.5 million from 2001 to 2019)
2. Effect of RGSM salvage on population
3. Effect of impediment/passage at three diversion dams on population

Habitat and Flow Trade-off
1. Spring runoff hydrograph to inundate floodplains as RGSM nurseries
2. Summer base flow to minimize drying
3. Balance spring and summer hydrographs (tradeoff spring runoff and river drying)
4. Acres of floodplain habitat needed to affect October CPUE

- **Action Item**: Rich V. will write up the population structure questions from the discussion to use as modeling scenarios
- **Action Item**: Mike M. will write up the habitat/flow trade-off questions from the discussion to use as modeling scenarios
- **Action Item**: PMWG members will send Rich V. and Debbie L. any further ideas for modeling scenarios

Wrap Up
The following items were suggested as agenda topics for the next meeting:
- Mike M. presenting on the information he compiled in the mesohabitat executive summary
- Thomas Archdeacon presenting on the results of the gonad somatic index results, and information about the larger RGSM reproductive study
- Continue the conversation on developing scenarios

- **Action Item**: Rich V. and the PST will confer with Charles Y. on his availability for the next PMWG meeting and distribute a doodle poll

Meeting Participants
Thomas Archdeacon, U.S. Fish and Wildlife Service
Lynette Giesen, U.S. Army Corps of Engineers
Eric Gonzales, U.S. Bureau of Reclamation
Grace Haggerty, N.M. Interstate Stream Commission
Shay Howlin, U.S. Bureau of Reclamation
Debbie Lee, Program Support Team
Joel Lusk, U.S. Bureau of Reclamation
Mike Marcus, Assessment Payers Association of the Middle Rio Grande Conservancy District
Anne Marken, Middle Rio Grande Conservancy District
Melissa Mata, U.S. Fish and Wildlife Service
Kevin McDonnell, Program Support Team
Kate Mendoza, Albuquerque-Bernalillo County Water Utility Authority
Rich Valdez, SWCA
Stephen Zipper, SWCA

Note taker: Debbie Lee

Consolidated Recommendations of Two Expert Science Panels on Monitoring of the Rio Grande Silvery Minnow

Richard A. Valdez and Mike Marcus
Population Monitoring Workgroup
Draft 2, April 16, 2020

Overview

The Population Monitoring Workgroup (PMWG) is charged by the Executive Committee (EC) of the MRGESCP with evaluating the monitoring program for the Rio Grande silvery minnow (RGSM) in the Middle Rio Grande. In July 2012, the EC approved the first of three tasks—that the PMWG convene a science panel and conduct a workshop to evaluate the monitoring program. The following is a summary of actions taken by the PMWG pursuant to Task 1 (workshop) and the transition to Task 2 (review monitoring plan and evaluate demographic parameters):

- July 13, 2012: EC approves charge for Task 1 (CPUE Workshop; PMWG 2012).
- May 2014: PMWG sends survey to EC on fish population monitoring needs (DBSA 2015).
- Dec 8-10, 2015: PMWG holds Independent Science Panel Workshop on Population Monitoring, Isleta Casino and Resort, Albuquerque, NM (Hubert et al. 2016).
- Apr 13, 2016: Final Report of Science Panel to PMWG on RGSM Population Monitoring (Hubert et al. 2016).
- July 12, 2016: PMWG forwards request to EC to initiate Task 2 (Review Population Monitoring Plan), and initiates evaluation and prioritization of Hubert recommendations.
- Mar 23, 2017: PMWG requests that Bureau of Reclamation incorporate eight Hubert recommendations into Population Monitoring Contract.
- Jun 2017: Final Report on RGSM Scientific Uncertainties for Adaptive Management (Noon et al. 2017).
- Nov 29, 2017: PMWG initiates consolidated review and prioritization of panel recommendations from Hubert (22, Table A-1) and Noon (19, Table A-2).
- Jun 15, 2018: Members of PMWG begin analyses of specific panel recommendations (e.g., Valdez 2018).
- Nov 11, 2018: Contracted biometrician initiates Integrated RGSM Population Model to assist evaluation of panel recommendations (Yackulic 2018).
- Feb 18, 2020: Consolidated review of Hubert and Noon panel recommendations completed and organized by category, according to subject matter and priority (Table A-3).
- Feb 26, 2020: PMWG agrees to write short summaries of scientific topics identified from prioritized consolidated recommendations (Table 1).

Consolidation Process

Following the December 2015 monitoring workshop, the PMWG began to review the science panel's draft report, and provided questions and comments to the panel with requests for clarification and possible expansion of the report. After receiving the final report (Hubert et al. 2016), the PMWG received EC approval in July 2016 to proceed with the Task 2 assessment of the panel recommendations. The following steps were taken to consolidate the science panel recommendations:

1. Each recommendation was copied verbatim from the science panel report and listed in Table A-1 for the Hubert panel and A-2 for the Noon panel; recommendation number and report page number were added to facilitate locating each in the respective report.
2. The prioritizations for each recommendation within each science panel report were added as the last two columns of Tables A-1 and A-2. Prioritizations include those assigned by the PMWG and by the Noon panel; the Hubert panel did not assign priorities.
3. The recommendations were consolidated into a single table (Table A-3) and categorized by priority.
4. Science topics were extracted from the consolidated recommendations and listed in Table 1.

The PMWG's Task 2 review produced a four-tiered prioritization system for recommendations ranging from 0, for recommendations considered outside the scope of the PMWG charge, to 1 through 3 for recommendations within the scope of the charge. The priority system was also applied to the recommendations of a second science panel on RGSM scientific uncertainty (Noon et al., 2017):

- Priority 1: Highest priority for recommendations viewed specifically as items that could be quickly assessed using existing data or other readily available information (i.e., low-hanging fruit).
- Priority 2: Recommendations considered of high importance but requiring relatively simple modification of the sampling program and analysis of the results for comparison with data collected without modifications: these recommendations were provided to the Bureau of Reclamation Contract Officer to modify the population monitoring program (PMP).
- Priority 3: Lowest priority for recommendations considered important, but requiring extensive modification of the PMP or possibly new field research.

Summary Writeups

A short write-up will be provided by members of the PMWG for each of the science topics identified in Table 1. Each Executive Summary will be formatted according to the template developed by the PMWG (PMWG 2020).

Table 1. List of recommended science topics from the Hubert and Noon science panels.

Science Topic	Recommendation Number[1]		Responsible Person
	Hubert	Noon	
1. Relationship of CPUE and true population size of RGSM	--	A1	
2. Age-specific survival of RGSM	--	A2, A3	
3. Size and age-specific fecundity of RGSM	22	A4, B3	
4. Relationship of demographic rates and abiotic and biotic factors	10, 24	A5	
5. Evaluate existence and strength of density dependence to limit population	21	A6	
6. Effect of augmentation on RGSM Population	--	A7	
7. Contribution of salvaged RGSM to population dynamics	--	A8	
8. Develop and deploy "vertically-integrating" Moore egg collectors	--	B1, E2	
9. Effect of environmental cues on spawning onset and activity	--	B2, D2	
10. Age composition of RGSM population	--	C, E1	
11. Selectivity of gears used to sample RGSM	--	E1	
12. Spatial extent and historical availability of habitat and hydraulic quality used by RGSM	16	D1	
13. Roles and relative contributions to fish production by age in channel and floodplain habitats	--	D3	
14. Evaluate management potential for fish production by reach	--	D4	
15. Consolidation of mesohabitats for monitoring RGSM	--	E3	
16. Compute CPUE from larval and standard seines by age	1, 2, 3	--	
17. Evaluate effect of zero catches on CPUE and sample design	4, 5, 6	--	
18. Effect of environmental factors on seine capture probability	7, 8	--	
19. Mixture model and alternatives for computing RGSM CPUE	10, 11, 14, 17	--	
20. Use classification and regression trees, boosted regression trees, or random forests to examine relationships between hydrologic variables and CPUE	18	--	
21.Effect of increased sample size on RGSM monitoring	12, 13	--	
22. Implement studies using different sampling designs	19	--	

[1]see Tables A-1 and A-2 for Recommendation Numbers

Literature Cited

Daniel B. Stephens and Associates, Inc. (DBSA) 2015. Survey of the Executive Committee on fish population monitoring needs. Summary Report, Middle Rio Grande Endangered Species Collaborative Program. Albuquerque, NM.

Hubert, W.A., M.C. Fabrizio, and R. Hughes. 2016. Summary of findings by the External Expert Panelists: Rio Grande silvery minnow population monitoring workshop Isleta Casino and Resort, 8-10 December 2015. U.S. Bureau of Reclamation, Albuquerque, NM.

Noon, B., D. Hankin, T. Dunne, and G. Grossman. 2017. Independent Science Panel Findings Report: Rio Grande silvery minnow key scientific uncertainties and study recommendations. Prepared for the U.S. Army Corps of Engineers, Albuquerque District on Behalf of the Middle Rio Grande Endangered Species Collaborative Program. Prepared by GeoSystems Analysis, Inc. Albuquerque, NM. June 2017. Contract No. W912PP-15-C-0008.

Population Monitoring Workgroup (PMWG). 2012. Approval of the 1st task for review of the collaborative program fish monitoring program for the Rio Grande silvery minnow. A Proposal for a CPUE Metrics and Methodologies Workshop, Submitted to The Executive Committee of the Middle Rio Grande Endangered Species Collaborative Program July 13, 2012, Albuquerque, NM.

Population Monitoring Workgroup (PMWG). 2020. Assimilation and synthesis of information and data related to the Rio Grande silvery minnow. By Catherine Murphy and Kevin McDonnell for PMWG, Western EcoSystems Technology, Inc (WEST), Albuquerque, NM.

Valdez, R.A. 2018. Age composition of Rio Grande silvery minnow: Application of distribution separation methods to estimate age composition. A data analysis done for and in collaboration with the Data Analysis Team of the Population Monitoring Workgroup, Albuquerque, NM.

Yackulic, C.B. 2018. Developing an integrated population model for Rio Grande silvery minnow in the Middle Rio Grande. U.S. Geological Survey, Southwest Biological Science Center, Flagstaff, AZ.

Appendix A: Tables of Science Panel Recommendations

Table A-1. Recommendations and observations from the Hubert et al. (2016) Population Monitoring Science Panel. The Hubert Science Panel did not assign priorities to these recommendations and observations, but priorities were assigned by the Population Monitoring Work Group (PMWG) to the recommendations. Priority: 1 = high, 2 = moderate, 3 = low, 0 = no consideration by PMWG.

Number[1]	Page	Recommendation	Panel Priority	PMWG Priority
1	28	Separate the catch and effort data from the small-mesh seine and the fine-mesh seine into two data sets and compute separate CPUE indices for each gear type, as well as for individual age classes captured in each gear type.	--	1
2	28	The CPUE from the small-mesh seine is primarily an index of the relative abundance of a single cohort of RGSM (i.e., the most recent cohort) that is recruited into the gear late in the summer and captured into the summer of the following year. The precision of the index can be improved by exclusion of older cohorts. A separate CPUE index can be computed for older cohorts. Consider the use of length-at-age data and frequency histograms to identify cohorts.	--	1
3	28	Only larval fish should be included in the computation of CPUE indices from the fine-mesh seine because of this gear's selectivity for this life stage.	--	1
4	28	An aspect of the CPUE data that warrants attention is the treatment of zero catches in data analyses. Inclusion of dry sample sites as zero CPUE values when analyzing CPUE data for RGSM in the MRG should be avoided. Field data records and the database in which the RGSM CPUE data are stored allow dry sampling sites to be distinguished from sites that were sampled and no RGSM were caught. The problem arises during statistical analyses because the naughty naughts (observations of zeros at dry sampling sites) are treated in the same manner as the zero catches at fished sites where no RGSM are caught.	--	1
5	28	Survey designs should strive to minimize false zeros resulting from: (1) an inappropriate sampling design (e.g., sampling in mesohabitats avoided by RGSM) and (2) ineffective survey methods (e.g., insufficient sampling effort to detect an organism when it is present).	--	1 and 2

Number[1]	Page	Recommendation	Panel Priority	PMWG Priority
6	29	The proportions of various mesohabitat types sampled are likely to bias CPUE indices because the catchability coefficient probably differs among mesohabitat types and RGSM are likely to be selective for specific mesohabitat types. We recommend that better understanding of the influence of mesohabitat type on CPUE be developed and used to account for variability in CPUE indices. Further, we recommend that estimation of mean site-specific CPUE be improved by addressing the variable number of mesohabitats that are sampled at any given site and the amount of sampling in each mesohabitat type. We recommend estimation of mean site-specific CPUE from individual seine hauls (which are distinguishable in the database as of 2006); mean CPUE at each site is then computed from the individual CPUEs at each of the 18-20 mesohabitat units sampled per site.	--	1 and 2
7	29	Environmental factors (e.g., turbidity, water temperature, substrate size, depth, current velocity, and discharge) during sampling are likely to bias CPUE indices because of their influence on catchability. We recommend that better understanding of the influence of measurable environmental factors on the catchability of each seine type be developed and used to account for variability in CPUE indices.	--	3
8	29	Factors influencing detection and catchability of RGSM in seines need to be determined and incorporated into the sampling design to permit more robust estimation of CPUE.	--	1
9	29	Measures of CPUE for RGSM from the MRG are currently identified as recovery standards for the species. We recommend modification of recovery standards to be explicit regarding the gear, sampling design, sampling techniques, data analysis, and life stage, as well as protocols used to compute the CPUE index.	--	0
10	29	We recommend depiction of the relationship of hydrological covariates and estimates of the mean annual CPUE for RGSM derived from the mixture model. Those relationships should use the October data from 1993 to 2014. Further, we recommend that such analyses be repeated for catch data collected in 2006 to the present, but using the individual seine-haul approach to estimate CPUE.	--	1
11	29	We recommend that the assumptions of the mixture models be fully defined and that the results of analyses be interpreted with consideration of the assumptions and the effects of the potential violation of assumptions.	--	1

Number[1]	Page	Recommendation	Panel Priority	PMWG Priority
12	29	A greater number of sampling sites would improve the accuracy and precision of status assessments and improve estimates of RGSM CPUE and spatial distribution, especially at the reach scale. A greater number of sampling sites in each of the three reaches would facilitate status and trend estimates at the reach scale. To make statistically rigorous reach-scale CPUE estimates, 20-50 sites per reach are recommended. A design with substantially more sites and longer site lengths should be more effective at detecting RGSM when they are at low densities or demonstrating patchy distributions.	--	1
13	29	When river flows decline so that dry sampling sites occur among the 20 fixed sites sampled by the Monitoring Program, the ability to make inference regarding CPUE of RGSM over the MRG is impaired. The current 20-fixed-site sampling is not adequate when dry sampling sites occur. An ancillary randomized sampling design is recommended at such times to be able to make inferences about RGSM abundance and distribution throughout the entire MRG. Such a random sampling design would entail sampling at many more sites over the length of the MRG. An ancillary design of this type would enhance the feasibility of assessing the abundance and distribution of RGSM in the MRG during years of low flows and when the species is likely to occur in low abundance.	--	0
14	30	Consider using key drivers of mesohabitat variability, such as current velocity, substrate size, and water depth at specific locations where seines are deployed, to replace the mesohabitat factor in the mixture models.	--	2
16	30	Examine the historical availability of mesohabitats in the MRG relative to discharge. If these two measures can be linked, then annual or monthly discharge may provide a good surrogate of mesohabitat availability.	--	2
17	30	Evaluate alternatives to the parametric mixture model, in particular, Bayesian hierarchical models, for estimating annual CPUEs.	--	2
18	30	Use classification and regression trees, boosted regression trees, or random forests to examine relationships between hydrologic variables and CPUE for identifying thresholds above or below which CPUE exhibits changes.	--	1.5

Number[1]	Page	Recommendation	Panel Priority	PMWG Priority
19	30	Implement directed studies using different sampling designs, such as multi-year, multi-site, before-after-control-impact (BACI) designs to enhance understanding of the response of the population to changes in river discharge, habitat rehabilitation projects, and availability of mesohabitats.	--	3
21	30	Conduct stock-recruitment studies to determine how the abundance of fall recruits relates to the abundance of spring spawners. Investigate the effects of spring and summer discharges on the stock recruitment relationship to enhance understanding of the dynamics of RGSM. Implement a spring sampling protocol at spawning sites to estimate the number of spring spawners, and compare with October results for several years; such studies may provide useful data on RGSM population dynamics and limiting factors.	--	3
22	30	Complete a study of age-specific fecundity and survival rates based on pre-breeding (fall) population estimates, spring spawners, and hatchery supplementation. Results from this study could be used to estimate population recovery and extirpation potentials as a function of altered flow regimes and stocking.	--	3
23	30	Consider genetic fingerprinting and epigenetic studies, including bar-coding and gene-expression, of presumed wild and hatchery fish to help determine hatchery contributions to the spring spawners and the long-term risks to the wild population.	--	0
24	30	Expand the analyses in Dudley et al. (2015) to assess flow regime and habitat fragmentation effects on RGSM occurrence and abundance and suggest preliminary flow regimes for rehabilitating the wild RGSM population.	--	3

[1]numbers 15 and 20 are missing in the original report by Hubert et al. (2016), apparently as an inadvertent error in numbering

Table A-2. Recommendations from the Noon et al. (2017) Adaptive Management Science Panel. The Noon Science Panel assigned priorities to these recommendations, and some priorities were assigned by the Population Monitoring Work Group (PMWG). Priority: 1 = high, 2 = moderate, 3 = low, 0 = no consideration by PMWG, Important = Recommendation is important, but not priority was assigned.

Number	Page	Recommendation	Panel Priority	PMWG Priority
A1	17	Clarify the relationship between the annual catch-per-unit-effort and true population size by estimating catchability.	1	1
A2	18	Determine the key, age-specific, life history sensitivities of the RGSM (that is, use Eigen- analysis methods to determine which vital rates [survival and/or reproduction] most affect rates of population change.	1	3
A3	18	Estimate age-specific survival rates	1	3
A4	19	Estimate age-specific fecundities of wild fish.	1	3
A5	19	Using statistical modeling, estimate the relationships between RGSM demographic rates and A.) hydrological factors (flow magnitude and duration, summer drying of the channel); and B.) abiotic environmental factors (temperature, turbidity, salinity); and C.) biotic factors (predation, completion, prey availability).	1	3
A6	20	Evaluate the existence and strength of any density-dependent factors that may be limiting population growth.	2	--
A7	20	Model the potential effects of hatchery augmentation on population dynamics and the significance of hatchery fish to achieving recovery objectives.	Important	--
A8	20	Determine if the collection and translocation of salvage fish during summery drying periods contributes significantly to population dynamics.	Important	--
B1	21	Development and deployment of "vertically-integrating" Moore egg collectors	1	--
B2	21	Improved assessments of relations between possible environmental cues that trigger spawning activity.	1	--
B3	21	Establish size-specific fecundities of natural-spawning RGSM.	2	--
C	22	Clarify the detail of annular mark formation on otoliths and firmly establish the longevity of RGSM	2	--

Number	Page	Recommendation	Panel Priority	PMWG Priority
D1	22	Estimate the spatial extent and hydraulic quality used by RGSM for key life-stages (spawning, larval rearing, juvenile and adult survival). Estimate how these habitats are distributed in the river channel and floodplain in each MRG reach under a range of discharges and seasonal flow regimes.	Important	--
D2	23	Establish the proximate trigger(s) for spawning by evaluating the effects of flow velocity, temperature, rate of increase in flow velocity, or some combination of these factors.	Important	--
D3	23	Determine the roles and relative contributions to fish production (age 0 recruitment and survival of all age-classes) of channel and floodplain habitat in a reach of channel and floodplain typical of the MRG.	Important	--
D4	24	What is the management potential for fish production (recruitment and survival of age 0 fish) in each reach of the MRG if the annual peak flow, and thus the nature and range of available habitats, is permanently limited below historic levels of availability?	Important	--
E1	24	Establish the age composition of the RGSM population, including A.) application of distribution separation methods to estimate age composition, and B.) gear selection study.	1	--
E2	25	Determine how the vertical and horizontal distribution of RGSM eggs in the MRG mainstream channel varies as a function of flow and location?	1	--
E3	25	Calculate revised CPUE values as mesohabitat-specific levels and do not combine across mesohabitat types. The meso-habitat specific CPUE calculated for the most abundant high density mesohabitat type should be used for assessment of trend in abundance of the RGSM population at the October sampling date.	2	2

Table A-3. Consolidated and categorized recommendations from the Hubert et al. (2016) and Noon et al. (2017) Science Panels.

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
Population Dynamics / Noon et al. = Priority 1						
1	1/1	--	A1	Clarify relationship between annual CPUE index and true population size.	• Dudley et al. (2011a, 2011b, 2011c, 2012) implemented population estimation. • Goodman (2012) evaluated Population Estimation Program. • Valdez (2018a) evaluated relationship between CPUE and true population size (presented to PMWG 6/20/2018).	Remains unresolved
2	1/3	--	A2	Determine which age-specific vital rates (survival, reproduction, etc.) most affect population change.	• Goodman (2010) did deterministic dynamics of environmental correlates. • Miller (2012) performed sensitivity analysis as part of PVA. • Yackulic (2018) model in progress (presented to PMWG 12/12/2018).	Ongoing
3	1/3	--	A3	Estimate age-specific survival rates.	• Goodman (2009) estimated survival from quarterly comparisons of CPUE. • Miller (2012) reconciled survival rates from PVA. • Valdez (2018b) estimated survival of wild RGSM (presented to PMWG 12/12/2018).	Ongoing
4	1/3	22	A4, B3	Estimate size and age-specific fecundities of wild fish.	• Platania and Altenbach (1996) did clutch and batch production and fecundity estimates in a lab. • Caldwell et al. (2019) evaluated reproductive potential of captive RGSM. • Archdeacon?	Information needed on wild RGSM

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
5	1/3	10	A5	Model relationships between demographic rates and hydrological factors (flow magnitude, duration, drying), abiotic factors (temp, turbidity, salinity), and biotic factors (predation, completion, prey).	• Miller (2012) related demographic rates to hydrological factors as part of PVA. • Archdeacon (2016) evaluated reduced spring flow. • Yackulic (2018) model in progress. • Walsworth and Budy (2020) model in progress. • Hatch and Cowley (2020)?	Ongoing
Population Dynamics / Noon et al. = Priority 2						
6	2/--	--	A6	Evaluate existence and strength of density-dependent factors that may limit population growth.	• Miller (2012) evaluated as part of PVA. • Goodman (2010) evaluated as part of PVA. • Yackulic (2018) model in progress.	Ongoing
Population Dynamics / Noon et al. = Other Important Studies						
7	Import/--	--	A7	Model potential effects of hatchery augmentation on population dynamics.	• Miller (2012) evaluated as part of PVA. • Archdeacon and Remshardt (2012). • Archdeacon (2015) provides annual reports on augmentation. • Yackulic (2018) model in progress. • Hatch and Cowley (2020)?	Ongoing
8	Import/--	--	A8	Determine if collection and translocation of salvaged RGSM during summery drying contribute to population dynamics.	• Archdeacon (2017) gave a presentation on Fish Rescue.	Ongoing
Reproductive Biology of Rio Grande Silvery Minnow / Noon et al. = Priority 1						
9	1/--	--	B1, E2	Develop and deploy "vertically-integrating" Moore egg collectors; determine vertical and horizontal distribution of RGSM eggs as a function of flow and location	• Porter (2018) designed a multi-level vertical egg collector.	Work initiated; more needed

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
10	1/--	--	B2, D2	Assess effect of environmental cues (flow, velocity, temp, flow change) on spawning onset and activity.	• Cowley et al. (2009) evaluated effect of salinity on specific gravity of eggs. • Krabbenhoft et al. (2014) evaluated phenology. • Valdez (2010, 2019, 2020a) evaluated temperature degree-days for hatching.	Ongoing
Age and Growth / Noon et al. = Priority 2						
11	2/--	--	C	Clarify annular marks on otoliths and firmly establish longevity of RGSM.	• Horwitz et al. (2018) used scales and otoliths for juveniles and adults. • Zipper et al. (2020a; 2020b) verified otolith age for larvae.	Unresolved
Physical Habitat Relations of RGSMs / Noon et al. = Other Important Studies						
12	Import/--	--	D1	Estimate spatial extent of habitat and hydraulic quality used by RGSM for key life-stages (spawning, larval, juvenile, adult).	• Tetra Tech (2014) evaluated habitat for occupied, feeding/rearing, spawning/ egg/larval habitat. • Walsworth and Budy (2020). • Colorado State University (2020)? • Yackulic (2020). • Hatch and Cowley (2020)?	Evaluation ongoing by several groups
13	Import/--	--	D3	Determine roles and relative contributions to fish production by age in channel and floodplain habitats.	• Tetra Tech (2014). • Walsworth and Budy (2020). • Colorado State University (2020)? • Yackulic (2020). • Hatch and Cowley (2020)?	Evaluation ongoing through modeling
14	Import/--	--	D4	Evaluate management potential for fish production (recruitment and survival of age 0 fish) in each reach if annual peak flow and available habitat is permanently limited below historic levels.	• Tetra Tech (2014). • Walsworth and Budy (2020). • Colorado State University (2020)? • Yackulic (2020).	Evaluation ongoing through modeling

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
Sampling Methodologies / Noon et al. Priority 1						
15	1/--	--	E1	Establish age composition of RGSM population, including application of distribution separation methods.	• Valdez (2018b) evaluated age composition using distribution separation methods (presented to PMWG 10/2/2018). • Winter (2018) provided a Bayesian analysis of von Bertalanffy growth function (presented to PMWG 12/12/2018).	Ongoing
16	1/--	--	E1	Evaluate size and age of fish captured by gear type with gear selectivity.	• Widmer et al. (2012) PP to Science Workgroup, 8/21/2012. • Gonzales et al. (2012) evaluated fyke-net catches. • Valdez et al. (2020b) evaluated gear selectivity (presented to PMWG 10/2/2018).	Ongoing
17	2/2	--	E3	Calculate revised CPUE values using most abundant high CPUE mesohabitats for assessment of trend in abundance at October sampling date.	• Valdez (2018c) computed CPUE at mesohabitat-specific levels (presented to PMWG 10/2/2018).	--
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 1						
18	--/1	1, 2, 3	--	Separate catch and effort data from small-mesh and fine-mesh seines and compute CPUE for each gear type and by age (larvae, age-0, age 1, age 2+).	• Dudley et al. (2020) have computed larval and standard seine CPUE annually since 2018.	Ongoing
19	--/1, 2	4, 5	--	Evaluate effect of zero catches on CPUE (zero as dry site, no fish captured).	• Dudley et al. (2020) have evaluated effect of zero catches on CPUE annually since 2018.	Ongoing
20	--/1, 2	6	--	Evaluate effect of sample design on zero CPUE.	Effect of sample design on zero CPUE has not been evaluated.	Not Initiated

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
21	--/3, 1	7, 8	--	Evaluate detection and catchability (*p*-hat) of RGSM in seines, including effect of environmental factors (turbidity, temp., substrate, depth, velocity, discharge) during sampling on CPUE.	• Archdeacon and Davenport (2013) evaluated detection and population estimation.	More work needed
23	--/1	11, 14, 17	--	Evaluate mixture model for computing RGSM CPUE, and other models, including Bayesian hierarchical models; consider using key drivers of mesohabitat variability (e.g., velocity, substrate, depth) to replace the mesohabitat factor in mixture models.	The mixture model has not been evaluated in this manner.	Not Initiated
24	--/1, 0	12, 13	--	Increase sample sites by 20-50 sites per reach, and evaluate effect on CPUE; add random sites to replace dry sites.	• Dudley et al. (2020) added sample sites starting in 2018. • Archdeacon et al. (2015) Compared fish communities at random and non-random sites.	Needs additional evaluation
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 1.5/2						
26	--/1.5	18	--	Use classification and regression trees, boosted regression trees, or random forests to examine relationships between hydrologic variables and CPUE for identifying thresholds above or below which CPUE exhibits changes.	This has not been implemented.	Not Initiated
25	--/2	16	--	Examine historical availability of mesohabitats relative to discharge. If linked, annual or monthly discharge may be surrogate for mesohabitat availability.	This has not been examined.	Not Initiated

Number	Priority SP/PMWG	Hubert	Noon	Consolidated Recommendation	Progress (see Literature Cited)	Status
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 3						
27	--/3	19	--	Implement studies using different sampling designs (multi-year, multi-site, before-after-control-impact [BACI]) to better understand population response to changes in river discharge, habitat rehabilitation projects, and mesohabitats.	This has not been implemented.	Not Initiated
28	--/3	21	--	Conduct stock-recruitment studies to determine how abundance of fall recruits relates to abundance of spring spawners.	• Miller (2012) • Walsworth and Budy (2020). • Yackulic (2020). • Hatch and Cowley (2020)?	Ongoing
30	--/3	24	--	Expand the analyses in Dudley et al. (2015) to assess flow regime and habitat fragmentation effects on RGSM occurrence and abundance and suggest preliminary flow regimes for rehabilitating the wild RGSM population.	• This has not been implemented.	
Sampling Methodologies / Hubert et al. Recommendations Sorted by PMWG Rankings = Priority 0						
22	--/0	9	--	Evaluate recovery standards by gear, sample design, techniques, data analysis, and life stage.	Is evaluating recovery standards the charge of the PMWG?	Not Initiated
29	--/0	23	--	Consider genetic fingerprinting and epigenetic studies, including bar-coding and gene-expression, of presumed wild and hatchery fish to help determine hatchery contributions to spring spawners and long-term risks to wild population.	Is this an issue for the Genetics Group?	Not Initiated

Executive Summary

Topic Area Title:

Age-specific survival of Rio Grande Silvery Minnow (RGSM)
Noon et al. (2017) recommendations A2 and A3.

Program Goal Relevance:

Provides an important demographic parameter to understand the numbers of fish surviving from one year to the next under different flow and environmental conditions.

Brief Summary of Available Literature:

Estimates of survival for RGSM were derived by Remshardt (2007) and Valdez (2010), and used by Miller (2012) to compute and infer age-specific survival in a RAMAS PVA (Table 1). Survival of RGSM by cohort was estimated by Goodman (2010) and used to resolve age-specific survival in a FORTRAN PVA. Yackulic (2020) preliminarily derived estimates of annual adult survival from an integrated population model. Estimated survival of RGSM has also been developed by Mike Hatch and David Cowley of New Mexico State University as part of an ongoing stock assessment model and PVA, but these estimates are not available at this time.

Remshardt (2007) estimated monthly survival of 0.662 for hatchery-reared fish released into the MRG in November 2004 and monitored through spring 2005. The fish were age-4 and were marked with VIE tags. Survival was estimated from the decline of marked fish in approximately monthly samples.

Valdez (2010) used the ASIR Population Monitoring dataset to compute mean monthly CPUE of all ages across reaches for years 1993–1997 and 1999-2010. He regressed these CPUEs over time in a "catch-curve" analysis that yielded an estimate monthly survival of 0.763 for wild fish, which was expanded to an annual survival rate of 0.039 (0.76312 = 0.039) for individuals 12 to 24 months of age. Valdez (2018) expanded the analysis to include mean monthly CPUE data for 1993-2017 (not 1998 and 2009) and derived monthly survival estimates for age-0 (mean = 0.736, range = 0.267-0.970), age-1 (mean = 0.740, range = 0.472-0.968), and age-2 (mean = 0.834, range = 0.583-0.976), which transform to mean annual survival of 0.03, 0.03, and 0.11, respectively. Annual adult survival (age 1+) was estimated at about 0.04.

Miller (2012) used the Remshardt (2007) and Valdez (2010) estimates of survival in his PVA model and reasoned that these monthly estimates represented some form of upper and lower bounds for the true value of this parameter. Miller (2012) noted that Remshardt (2007) did not see significant differences in survival among marked and unmarked fish in his 2005

augmentation study, and assumed that augmented fish (i.e., hatchery fish) were immediately subject to the same monthly rates of survival as the wild fish. Miller (2012) also assumed constant survivorship throughout the year, with the exception of an assumed lower survivorship of approximately 0.15 during the first month of life; he estimated survival of age-0 fish as (0.66211 = 0.007) x 0.15 = 0.0016 for fish up to 12 months of age. Miller (2012) then assumed a constant survival rate for age-1 (12-24 months of age) as 0.66212 = 0.007. Miller (2012) also assumed a constant annual survival for age-2 and age-3 individuals equal to 0.05, which was a value consistent with preliminary statistical analyses of survival (0.058) conducted by Goodman (2010) as part of PVA Workgroup activity.

Goodman (2009a) also used the 1993–1997 and 1999-2010 ASIR Population Monitoring dataset and estimated survival of RGSM by regressing inter-quarterly (Qn+1 vs Qn) CPUEs for all ages and reaches. Goodman (2010) determined a survival rate of 0.0580 for the 2007 cohort by plotting CPUE on a log scale and using the slope of the regression. Goodman (2009a) concluded that for years with a strong reproductive pulse, the survival rate to the pre-breeding census (early spring) ranges from about 0.03 to about 0.3; for years with reproductive failure, survival rate varies more widely, but the estimates may be less reliable for those years. On this basis, the Goodman concluded that PVA modeling should reasonably represent the cohort survival until the pre-breeding census as a random variable, with a mean around 0.1 and a mode around 0.05, and a longer right tail.

Table 1. Summary of Survival Estimates:

	Larvae	Age-0		Age-1		Age-2		Hatchery Age-?	
Citation	**Monthly**	**Monthly**	**Annual**	**Monthly**	**Annual**	**Monthly**	**Annual**	**Monthly**	**Annual**
Remshardt (2007)	--	--	--	--	--	--	--	0.662	0.01
Goodman (2009)	--	--	0.058	--	--	--	--	--	--
Hatch (2009)	--			0.09[b]				--	--
Valdez (2010)	--	0.763	0.04	--	--	--	--	--	--
Miller (2012)	0.15[a]	0.662	0.0016	0.662	0.007	--	0.05[a]	--	--
Valdez (2018)	0.502[c] (2016)	0.736	0.03	0.74	0.03	0.834	0.11	--	--
	0.472[c] (2017)	--	--	--	--	--	--	--	--
	0.301[d] (2017)	--	--	--	--	--	--	--	--
Yackulic (2020)	--	0.20 (0.15-0.25)[e]	--		0.04 (0.02-0.06)f			--	--

[a] estimated from model derivation.
b estimated from salvaged fish of all ages.
c estimated from floodplains.
d estimated from mainstem.
e approximate range derived from integrated model for June to October.
f approximate range of annual adult survival derived from integrated model.

Yackulic (2020), as part of the development of an integrated model for RGSM, derived estimates of annual adult survival (age-1+) each for the Angostura, Isleta, and San Acacia reaches. Altogether, estimates range from about 0.02 to 0.06 with a central distribution of about 0.04. Estimates of age-0 survival from June to October ranged from about 0.15 to 0.25 with a central distribution of about 0.20.

Mike Hatch (Personal communication, PVA Workgroup Meeting, 2009) provided an annual survival estimate of 0.09 for RGSM from salvaged fish, but no report was provided to detail the age of fish or method for deriving this estimate.

List the Uncertainties:

1. Is age-specific survival (larvae, ages 0, 1, 2+) different?
2. Is survival of older fish (age 2+) sufficiently high to enable "carry-over" from survival of older and presumably large and more fecund fish?

List the Hypotheses Identified from Literature:

1. Low spring-time survival of larval RGSM does not significantly increase population size, as measured by the October CPUE index.
2. Numbers of large and more fecund RGSM are not sufficiently large to significantly increase reproductive success.

Management Implication(s) of Hypotheses (if any):

1. Providing habitat and suitable conditions for survival of larvae can help to set cohort strength and the number of fish in the population.
2. Providing habitat and suitable conditions for survival of age-2+ fish could provide "carry-over" in the population so that large more fecund fish remain in years when reproduction and recruitment are otherwise low.

Potential Approaches to Test Hypotheses:

1. Estimate survival of larval RGSM from exponential function of density, or derived from modeling exercises.
2. Sample more intensively in spring to better determine the numbers of large RGSM present in the population in a given year.

DRAFT

Literature Cited:

Goodman, D. 2009. Rio Grande silvery minnow PVA: relating quarterly monitoring summaries to the synthesis. Draft Report, Montana State University, Bozeman, MT.

Goodman, D. 2010. Parameter estimation strategy for the PVA: I. Deterministic dynamics and environmental covariates. Draft Report, Montana State University, Bozeman, MT.

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Noon, B., D. Hankin, T. Dunne, and G. Grossman. 2017. Independent Science Panel Findings Report: Rio Grande silvery minnow key scientific uncertainties and study recommendations. Prepared for the U.S. Army Corps of Engineers, Albuquerque District on Behalf of the Middle Rio Grande Endangered Species Collaborative Program. Prepared by GeoSystems Analysis, Inc. Albuquerque, NM. June 2017. Contract No. W912PP-15-C-0008.

Remshardt, W.J. 2007. Experimental augmentation and monitoring of Rio Grande silvery minnow in the Middle Rio Grande, New Mexico. Annual Report 2005. Final report to the Middle Rio Grande Endangered Species Collaborative Program and the U.S. Bureau of Reclamation, Albuquerque, New Mexico. 101 pp.

Valdez, R.A. 2010. Age, growth, and survival of Rio Grande silvery minnow. Power Point presentation to the Population Viability Analysis Workgroup. SWCA, Inc., Albuquerque, NM.

Valdez, R.A. 2018. Survival of Wild Rio Grande Silvery Minnow in the Middle Rio Grande. A Data Analysis Done for and in Collaboration with the Population Monitoring Workgroup. SWCA and New Mexico Interstate Stream Commission, Albuquerque, NM.

Yackulic, C.B. 2020. Rio Grande Silvery Minnow integrated population model. Power Point presentation to Population Monitoring Workgroup, February 26, 2020. U.S. Geological Survey, Flagstaff, AZ.

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Executive Summary: Consolidation of Mesohabitats for Monitoring RGSM

Source Recommendation

Noon et al. (2017) E3: "Calculate revised CPUE values as mesohabitat-specific levels and do not combine across mesohabitat types. The mesohabitat specific CPUE calculated for the most abundant high density mesohabitat type should be used for assessment of trend in abundance of the RGSM population at the October sampling date."

Program Goal Relevance

Revising the distribution and intensity of sampling across mesohabitat types at the sampling sites, along with other potential modifications, during the Population Monitoring Program (PMP) may improve the relationships associating computed catch per unit effort (CPUE) index values to the abundance and status of RGSM in the MRG. Such a revision also may enhance the cost-effectiveness of the PMP.

Literature Summary

Assessing the potential importance for and differences among in-channel habitat characteristics influencing RGSM presence during sampling includes consideration of the continual physical habitat variables of flow and depth. The PMP, perhaps logically, has focused on qualitative mesohabitat types as flow-depth "surrogates," such as implemented by the ongoing PMP, see below. To best enable the Population Monitoring Workgroup (PMWG) to evaluate this recommendation, the following includes summaries and sometimes direct quotes from a sample of reports linking RGSM occurrence to habitat flows, depths, and mesohabitat types.

Dudley and Platania (1996) provided the earliest extensive qualitative assessment RGSM habitat usage. Focusing on winter habitat, they reported that the majority (72.3%) of RGSM were caught in areas containing instream debris and consistently occurred over small substrata, at moderate depths, and in low velocity water. Subsequently, **Dudley and Platania (1997)** collected RGSM and other fish species during monthly sampling from July 1994 to June 1996 at two MRG sites, one each near Rio Rancho and Socorro. Habitat availability was determined at both sites monthly during the end of that monitoring period, from October 1995 to June 1996. They reported that RGSM exhibited differences in habitats use by size-class, with velocity being the strongest predictor of habitat use by size-class closely followed by depth; however, the correlation between these two physical variables clouded clear definition of the relative importance of each. They reported a bimodal distribution for depth use by RGSM, with individuals most commonly collected at depths <20 cm (0.7 ft) and 31-40 cm (1.1-1.3 ft), with few collected at depths >50 cm (1.6 ft). RGSM were abundant (86.5%) in areas having little or no water velocity (<10 cm/s; 0.3 ft/s), but only occasionally (11.0%) in areas of moderate velocity (11-30 cm/s; 0.4-1.0 ft/s) and rarely (0.8%) in habitats with water velocities >40 cm/s (1.3 ft/s). Most RGSM (91.3%) were collected over silt substrata. RGSM tended to be most abundant in low-velocity mesohabitats (debris piles, backwaters, and pools) and rarest in high velocity habitats (runs and riffles). Greater proportions of RGSM occurred in higher velocity mesohabitats (main and side channel runs) in summer than winter, with the population shifting from pool and backwater habitats in summer to habitats with instream debris piles in winter.

Summarizing available information, the **USFWS (2010, p. 11)** RGSM recovery plan states that the species "… only uses a small portion of the available aquatic habitat (**Platania 1993a, 1993b, [Dudley and Platania] 1997**).… [The species] is most often found in areas of low or moderate water velocity (e.g., eddies formed by debris piles, pools, backwaters, and embayments) and is rarely found in habitats with high water velocities, such as main channel runs, which are often deep and swift (**Dudley and Platania 1997, Watts et al. 2002, Remshardt 2007**). … [RGSM] augmentation monitoring throughout the middle Rio Grande (**Remshardt 2007, 2008**) reflected similar findings to other studies. No distinctions in habitat associations were observed between marked (hatchery) and unmarked (wild) [RGSM] … collections were positively associated with habitats that included low velocity and/or features that provide habitat diversity such as shorelines, debris, eddies, and submerged vegetation."

Implementation of mesohabitat sampling during the RGSM PMP has varied somewhat over time. The most recent approach is described in the 2019 PMP draft completion report (**Dudley et al. 2020, p.7**): "Fish were collected by rapidly drawing a two-person 3.1 m x 1.8 m small-mesh seine (ca. 4.8 mm [0.2 in]) through 18 discrete mesohabitats (< 1.5 m long [5 ft]). Runs were sampled four times at each site, as were shoreline pools (when available); backwaters, pools, and riffles were sampled two times (when available); any remaining samples (to obtain a total of 18 to 20) were taken in shoreline runs. A 1.2 m x 1.2 m [2 ft x 2 ft] fine-mesh seine (ca. 1.6 mm [0.6 in]) was used to selectively sample shallow low-velocity mesohabitats for larval fish (two samples/site) from April to October. Mesohabitats with similar conditions, which did not exceed reasonable depths or velocities for efficient seining, were sampled regardless of flow conditions." This report also includes the following (**Dudley et al. 2020, p.51**): "A qualitative examination of the mesohabitats occupied by [RGSM] was conducted to obtain general information on the habitat-use patterns of this species. While the physical locations of mesohabitats shift around considerably over time, established sampling protocols for this study ensured that similar mesohabitats (i.e., depths and velocities) were sampled across years. We sampled a wide variety of mesohabitats to ensure balanced monitoring of the ichthyofaunal community and all life phases of Rio Grande Silvery Minnow. Population trends in the five different mesohabitats (BW, PO, RU, SHPO, SHRU [backwaters, pools, runs, shoreline pools, shoreline runs]) were quite similar over the study period (2002–2019), despite notable differences in the estimated densities of [RGSM] among mesohabitats. Densities were typically highest in lower velocity mesohabitats and lowest in higher velocity mesohabitats. General mesohabitat-use patterns observed during this study were similar to those documented during past studies (e.g., **Dudley and Platania 1997**)."

Bovee et al. (2008, p. 1) used two-dimensional hydraulic simulations to model hydraulic conditions for a range of discharges at three study sites in the MRG upstream from San Acacia Dam. Suitable habitat characteristics were defined for RGSM by consensus of a panel of experts and were "defined as areas having suitable hydraulic conditions alone and as areas having suitable hydraulics in association with large woody debris. Suitable hydraulic habitat for adults was reported as maximum at discharges between 40 and 80 cubic feet per second [cfs], which then declined rapidly at discharges larger than 150 [cfs]. When large woody debris was included in the definition of suitable habitat, discharges between 40 and 200 [cfs] provided maximum suitable habitat for adults. Juvenile

hydraulic habitat was maximized at discharges between 20 and 80 [cfs], and hydraulic habitat associated with large woody debris was largest at flows between 40 and 150 [cfs]."

Technical staff from the U.S. Geological Survey, collaborating with USACE and USFWS personnel, evaluated the physical habitat characteristics and fish assemblage composition of available mesohabitats over a range of streamflows at 15 MRG sites during winter 2011–12 and summer 2012 (**Braun et al. 2015**). They reported that in the winter of 2011–12 RGSM were weakly associated with sand substrates, relatively moderate velocities, and relatively shallow depths; during summer 2012 they were associated with run mesohabitats, relatively high velocities, sand substrates, and relatively moderate depths. Of the four minnow species assessed, RGSM were collected from the narrowest range of depths (0.30–2.1 ft) during summer 2012 and the narrowest range of velocities in both winter 2011–12 (0.0–3.18 ft/s) and summer 2012 (0.02–1.51 ft/s). They also measured the physical characteristics of mesohabitats. Time constraints limited the number of mapped mesohabitat measured, but number of each mesohabitat type assessed was in proportion their abundance, with 20 mesohabitats assessed at each site. Measured depths and velocities varied greatly by mesohabitat type, site, and sampling period for both assessment periods. Applying area-weighting factors to the depths and velocities for sites assessed in both winter 2011–12 and summer 2012 typically had shallower mean depths and slower mean velocities during summer 2012, when discharges tended to be lower. Visual inspection of the box and whisker plots presented in their Figure 10 for measured depths and velocities for each of the eight type of mesohabitat assessed during each season at each sampling site assessed reveals considerable overlapping distributions for both physical parameters across all mesohabitat types within each site by season. [The data produced by this study, with perhaps other collected field data, are currently undergoing additional assessment by the USACE to evaluate approaches to (1) integrate its mesohabitat mapping with LiDAR, HEC-RAS, orthophotography, and other data sources to produce a geospatial model of in-channel habit; (2) investigate geospatial and temporal analyses for describing and presenting in-channel habitat information; and (3) develop techniques for integrating riparian floodplain and riverine habitat into single mapspace for the MRG (M. Porter, personal communication, email 4/9/2020).]

To assess how the distribution and availability of quality habitat for RGSM changed with flows at five MRG sites, **Tetra Tech (2014)** used, in part, geographic information system (GIS) methods to post-process outputs from an earlier project that collected in-channel data and conducted hydrodynamic simulation modeling (**Bohannan-Huston et al. 2004**). That earlier project included measurement of surface-water elevations and topographic surveys at eight sites along the Rio Chama and the MRG, completed during two visits per site. Each visit included 39 to179 geo-referenced, paired, in-channel flow and depth measurements using a survey-grade Global Positioning System (GPS) and total station theodolite. Those field data were then used by the earlier study to develop for each site a 1-foot contour topographic map of the riverbed and part of the adjacent floodplain. This topographic information was then used, in part, as input for RMA2 model to output of finite element mesh for each site composed of fine-scale triangular and quadrilateral elements with corner and mid-point nodes. As no comparable information is available for the MRG, Tetra Tech's obtained these early field data and modeled outputs. This

information was then post-processed to develop site-specific habitat quality assessments, displayed using GIS, for RGSM at five of the earlier assessed sites in the MRG. The three habitat quality criteria used included

1. *Most commonly occupied habitat* (surface water areas averaging ≤ 1.5 feet (45 cm) depth and ≤ 1.5 ft/sec (0.45 m/sec) flow velocity, **USFWS, 2003, 2010**);
2. *Highest quality habitat for juvenile and adult feeding and larval rearing* (surface water areas averaging ≤ 1.5 feet (45 cm) depth and≤ 0.5 ft/sec (0.15 m/sec) velocity; **SEPM, 1984; Bovee, et al. 2008; USFWS, 2003, 2010**; and
3. *Highest quality habitat for spawning and for egg and larvae retention* (surface water and inundated floodplain areas averaging ≤ 1.5 feet (45 cm) depth and near 0 ft/sec. i.e., ≤ 0.05 ft/sec [1.5 cm/sec]) velocity; **Fisher et al., 1979; USFWS 2003, 2010**).

Highest quality modelled RGSM in-channel habitat conditions at the five MRG sites showed general patterns of declining quality with increasing flows, but each showed marked differences depending their in-channel geomorphic characterizations (**Tetra Tech 2014)**. The Bernalillo site had near maximum in-channel quality area for most commonly occupied habitat at about 350 cfs, which then declined sharply through modelled flows of 514 and 1,054 cfs until the modelled flow of 2,108 cfs when an ephemeral side channel re-connected yielding maximum habitat quality across all three criteria; the modeled flow of about 3,500 cfs then produced generally marked declines for all three assessed criteria. Modeled flows at the Central site showed highest in-channel habitat quality across all three criteria modeled flows of 197 and 462 cfs, with and marked declines in available in-channel habitat quality for all three quality criteria at modelled flows of 1,054 and 3,488 cfs. Areas of highest habitat qualities at the Bernardo site across all three criteria occurred for modeled flows of 334 and 605 cfs, with marked declines across all three criteria for modeled flows of 1,025, 2,218 and 3,500 cfs. The Bosque del Apache site had relatively abundant high-quality habitat across all four model flows from 256 to 3,097 cfs. Maximum in-channel quality habitat at the San Marcial site occurred for all three criteria at the modeled flow of 225 cfs; modeled flows of 625 to 2,753 cfs yielded declining projections of in-channel habitat quality for all three criteria. (The Tetra Tech report included RGSM habitat quality assessments using FLO-2D model output for inundated floodplains. Flows of approximately 5,000 cfs were estimated as required to inundate the floodplain along the Angostura to Isleta Reach; 3,500 cfs for the Isleta to San Acacia Reach; and 2,000 cfs for the reach from San Acacia to the San Marcial RR Bridge. As floodplain inundation is not relevant for consideration of in-channel mesohabitat assessments, these results are not summarized here.)

Coordinated and funded by the USBR (**Posner 2020**), Colorado State University, the University of New Mexico and American Southwest Ichthyological Researchers are currently conducting a multi-objective project linking morphodynamic and biological habitat conditions along the MRG. Eleven reach and linkage reports are planned. Of these, reports are currently available for the Isleta Diversion Dam to Rio Puerco reach (**Yang et al. 2019**), Rio Puerco to San Acacia Diversion Dam (**LaForge et al. 2019**), and San Acacia Diversion Dam to Escondida Bridge (**Doidge and Julien 2019**). Most of each report contains detailed assessments on

how physical conditions of the MRG have changed since 1918 using historical information and aggradation/degradation lines (agg/deg lines) survey data. MRG sub-reaches included in these reports were distinguished and identified using channel slope changes using the agg/deg line data. The agg/deg line surveys are completed every ten years using photogrammetry earlier and LIDAR surveys more recently. The agg/deg lines are spaced approximately 500-feet apart and are primarily used to estimate sedimentation and morphological changes in the river channel and floodplain along the MRG. The Isleta report appendix also describes the approach used to assess RGSM habitat condition through the subreaches using GIS to integrate 1-D HEC-RAS analysis of agg/deg line measurements and USGS gage information with RGSM PMP results and habitat quality criteria. The HEC-RAS modeling integrates the channel width information from the agg/deg line surveys with corresponding USGS gage flows during the survey to fit a channel-depth trapezoid for each survey line extending from line to line [i.e., "an underwater prism" **(Doidge and Julien 2019, page 48)**]. These results were integrated with time and location corresponding RGSM PAP data and/or criteria values to map RGSM reach occupancy (use) and/or habitat quality using GIS. Criteria for RGSM habitat quality used in both the Isleta and Rio Puerco reach reports were a slight modification of the functional life-history criteria developed by **Tetra Tech (2014)**. The San Acacia reach reports used RGSM habitat quality based on lifestage (age) criteria presented by **Mortensen et al. (2019)**. That report included three habitat quality criteria based water flow velocity and depth for three RGSM lifestages:

1. *Larvae* (<5 cm/s [<0.2 ft/s] and <15 cm depth [<0.5 ft]);
2. *Juveniles* (<30 cm/s [<1.0 ft/s] and 1-50 cm [0.03-1.6 ft]); and
3. *Adults* (<40 cm/s [<1.3 ft] and 5-60 cm [0.2-2.0 ft]).

For the Isleta reach, **Yang et al. (2019)** reported maximum spawning, rearing, and feeding habitat to occur at the modelled flow of approximately 3,500 cfs, i.e., when the floodplain inundated [a flow volume equivalent to that reported by Tetra Tech (2014)], whereas maximum good habitat [called "most commonly occupied" in the Tetra Tech (2014) report] occurred for the modelled flow of 600 cfs [similar to that reported by Tetra Tech (2014) for the Bernardo site]. **Doidge and Julien (2019)** noted that they considered the modeling done at low flows (<1,000 cfs) to be inaccurate. They also used RAS-Mapper for the 2012 LIDAR data, while comparisons across years were done using 1-D HEC-RAS techniques only. Reasonable correspondence between the two methods was shown. Considering results for the 2012 only, their modeling shows maximum RGSM habitat through the entire San Acacia reach for larva occurs at approximated 2,500 cfs, 4,500 for juveniles, and 5,500 cfs for adults **(Doidge and Julien 2019, page 57, Figure 51)**. [Note that **Tetra Tech (2014)** reported that floodplain inundation occurred at approximately 2,000 cfs for the reach from San Acacia to the San Marcial RR Bridge.] (Note also that USBR is also funding a project to Utah State University reportedly including considerations of mesohabitat relationships to RGSM, but information from that project is unavailable for this summary.)

For the PMWG, **Marcus (2019)** characterized and summarized the PMP data collect for RGSM using "regular gear" from February 1993 to October 2017. He primarily used histogram bins to

group categories of collected data. Summing total RGSM collected by mesohabitat type for the period March 2002 to 2017 and the decade 2008-2017 showed that total numbers of RGSM collected varied by more than four orders of magnitude across the sampled mesohabitat types. He suggested that limiting the numbers of mesohabitat types sampled to those in the top three classifications having the greatest numbers of RGSM collected (mid-channel shoreline runs and pools plus backwaters, with the possible additions of the next four types with abundant RGSM recorded) might be done without meaningful loss of information, but cautioned that more advanced analyses of these results are needed to refine this conclusion. Other data summaries indicated that hauls with >50 RGSM collected occurred most frequently in mid-channel shoreline pools followed by backwater mesohabitats, with markedly and progressively lower collection numbers occurring for the other mesohabitat types. In turn, the greatest abundance of RGSM in hauls with >50 RGSM occurred in side-channel pools followed by backwater mesohabitats. In contrast, the two mesohabitats having the greatest frequency of hauls lacking RGSM were mid-channel runs and mid-channel shoreline runs.

Valdez (2013) described the attributes of the CPUE data produced by the PMP and evaluated the use of these data under several objectives, including (1) characterize the spatial and temporal distribution of the CPUE samples, including the statistical properties of the CPUE data particularly as related to precision and accuracy; (2) identify uses and limitations of the CPUE data; and (3) recommend aspects of a monitoring program for the RGSM based on these findings. He reported that the high level of heterogeneity in the collection data indicated a mismatch between the spatial distribution of sampling units (i.e., seine hauls) and the contagious distribution of RGSM. Here he noted that RGSM are usually found as large concentrations (i.e., schools) in preferred habitats that are disconnected and uncommon. He also stated that the placement of seine hauls proportional to mesohabitat areas misses many of the small and uncommon habitats occupied by the fish, producing a disproportionately large number of zero catches. CPUE for RGSM was considerably higher in certain mesohabitat types. He concluded that there is not sufficient information at this time to develop a reliable, precise, and unbiased monitoring program for the RGSM. Nevertheless, his assessment indicated that the spacing and location of sampling units (i.e., seine hauls) should be congruous with the spatial distribution of the RGSM, which is strongly allied to specific mesohabitat types, especially during the period of least abundance variability (i.e., September through November). While the current monitoring design uses a stratified fixed-site design that samples mesohabitat types in proportion to their area at the same locations during each sampling event, he suggested that the PMP design would be improved upon using a stratified random-site design or a systematic random design.

Recommendation E3 from **Noon et al. (2017)** suggested evaluating individual mesohabitat types and not combining types for computing mean annual CPUE. Intending to specifically address this recommendation and working with the PMWG, **Valdez (2018)** prepared another report to specifically assess catch-per-unit-effort estimates from the PMP by individual mesohabitat types. Using the PMP data, CPUEs were calculated for each of the most abundant mesohabitat types with highest fish density to determine whether the trend in abundance of RGSM could be assessed using only one or a few of these mesohabitat types. Only one mesohabitat type (MCPO) yielded a distribution and magnitude of CPUEs not significantly different from that computed

using all mesohabitats types, but the sample size included only 283 seine hauls. To determine how the number of samples might be increased using subsets of the 22 mesohabitat types sampled during 2002-2016, he found that CPUE estimates computed using RGSM collections from only the main channel pools and backwaters produced mean annual October CPUEs not significantly different (Kolmogorov-Smirnov [K-S] test; $p > 0.05$) from CPUEs computed using all mesohabitat types, but the numbers of samples (seine hauls) in both of these mesohabitats were still markedly less that an order of magnitude fewer than the total from across all mesohabitats included in the PMP during the same period. Additional analyses showed that combining the six mesohabitat types with highest CPUEs (five pool types plus backwaters) could be used to produce larger sample sizes. For example, combining mesohabitat samples for the annual October CPUEs produced for the combined five pool types ($n = 1,496$), and for the combined five pools types plus backwaters ($n = 1,972$). Both of these produced CPUEs not significantly different (K-S test; $p > 0.05$) from those computed CPUEs using all mesohabitat types ($n = 5,563$). This demonstrated that either of these combinations can produce the same pattern of CPUEs with 73% and 65% fewer samples, respectively. But, he noted that unequal samples of backwaters over time or space could inflate and bias CPUEs. Of importance, the reduced numbers of samples using only the available pools plus backwaters reduced the precision (i.e., coefficient of variation) of CPUE by about 27% and 19%, respectively for the two estimators of pools only and of pools plus backwaters. However, simulating an equal number of 400 samples per year showed an improved precision of 29% and 34%, respectively, over the simulated CPUEs drawn from all mesohabitats. Additional discussion was presented to address issues related to potential limited occurrence for the six mesohabitat types by sampling site and over years, also an approach was suggested to potentially reduce the numbers seine hauls needed for RGSM at differing densities.

List the Uncertainties:

1. Is the ongoing use of multiple diverse mesohabitat-based sampling for the PAP the most appropriate basis for assessing RGSM population trends in along the MRG? Most habitat use assessments used as a basis for defined habitat suitability for RGSM focus on the physical habitat characteristic of flow and depth. In contract the PAP sampling, beginning at least with Dudley and Platania (1997), has used mesohabitat types as a surrogate for depth and velocity. Yet, physical conditions measured for mesohabitats presented by Braun et al. (2015) clearly show considerable overlap in flow and depth measurements among all of the mesohabitat types they assessed. From this, questions may be raised on whether multiple diverse mesohabitat-based sampling as currently employed by the PAP are appropriate or, indeed, are reasonable surrogates for habitat flows and depths apparently favored by RGSM. If the current PAP based on multiple diverse mesohabitat-based sampling do not reasonably, consistently, or agreeably characterize depth and flow (i.e., habitat suitability) most favored by RGSM, what is an appropriate alternative?
2. Is it appropriate, as apparently is the current practice if the PMP, to weight sampling of mesohabitats more toward those that have been frequently flow and depth characteristics

reported to provide conditions less suitable for, less favoring RGSM presence, which produce biased low CPUE index values for RGSM occurrences?

3. What is the appropriate habitat scale to assess most suitable habitat quality for RGSM? RGSM individuals and schools likely are ever changing visitors to habitats of varying qualities. The reviewed assessments occurred over a range of scales. Favorable feeding habitats used by adults and juveniles are likely exist mostly at the microhabitat scale where suitable food resources can accumulation for this benthic feeding fish species. Quieter flow habitats include shoreline and backwater areas and, particularly during higher flows, troughs between bed ripples and dunes. Most favorable spawning and early rearing habitat for larvae likely are provided by larger habitat floodplain areas, whereas good or most commonly occupied habitat for larger RGSM could involve even larger in-channel and floodplain areas. The Tetra Tech (2014) report assessed quality in-channel RGSM habitat using modeled depths and flows developed using one-foot topographic bed-data contours, areas close a microhabitat scale. Larger mesohabitat-scale sampling is used during the PAP and other RGSM sampling studies (e.g., Braun et al. 2015). And, the ongoing USBR studies define quality RGSM habitat areas using 500-m long sub-reaches and modeled smooth-bed underwater prisms, which may be considered a macrohabitat scale. The smaller scale assessments suggest that the best in-channel habitat for RGSM occur typically over an incremental scale in 100s cfs until the floodplains connect, whereas the largest scale modeling assessments concluded that model flows of <1,000 cfs to be inaccurate and that the best RGSM habitat quality occurs at modelled flows of >2,500, in effect, after floodplains connect (Doidge and Julien 2019).
4. What more assessment is needed for recommendation E3 posed by Noon et al. (2017)? Marcus (2019) and Valdez (2013, 2018) have summarized and assessed the PAP RGSM collection data associated with mesohabitats sampled. Valdez (2018) specifically assessed these data in the manner specified under the E2 recommendation from Noon et al. (2017) and has made recommendation on next steps.
5. Will next step recommendations present in Valdez (2018) be followed? The combination of mesohabitat types (PO/BA/ED; RU/RI/FL) recommended by Valdez (2018) are being implemented by Yackulic (2020) in a RGSM Integrated Model.
6. Can the PAP be modified in a manor to produce potentially more reliable CPUE index values for RGSM population trends, which may also be more cost effective for the MRGESCP?

List the Hypotheses Identified from Literature:

1. Based on the PMP as currently implemented (e.g., Dudley et al. 2020): All mesohabitat types currently sampled and in the proportioned sampled during the PMP are necessary and appropriate for the calculation of CPUE index values to characterize the status of RGSM population in the MRG.
2. The PMP can be modified to emphasize a subset of the currently defined mesohabitat types to compute CPUE index values to track RGSM trends, while continuing to provide a meaningful relationship and continuity to the long history of data from the RGSM PMP.

Management Implication(s) of Hypotheses (if any):

The MRGESCP and its collaborating member will potentially obtain improved data quality on RGSM trends in the MRG and potentially at less cost.

Potential Approaches to Test Hypotheses:

Follow recommendations provided in Valdez (2013, 2018) and then assess results relative to historical RGSM PAP collections.

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C**ontributors:** Mike Marcus

Reviewers:

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Middle Rio Grande Endangered Species Collaborative Program
Population Monitoring Work Group (PMWG)
2020 Work Plan

The Population Monitoring Workgroup (PMWG) is charged by the Executive Committee (EC) of the MRGESCP with evaluating the monitoring program and demographics for the Rio Grande Silvery Minnow (RGSM) in the Middle Rio Grande, in accordance with three tasks: (1) conduct a workshop on CPUE methodology, (2) review the fish population monitoring plan, and (3) update the monitoring plan. Task 1 was completed in 2016, and Task 2 is currently being executed by the PMWG.

The PMWG plans to conduct and complete the following tasks in 2020:

Task	Subtask	Target Completion Date
1. Integrate and prioritize 22 recommendations from two science panels	1a. Consolidate recommendations 1b. Complete Executive Summaries on six to eight recommendations to aid in the ranking and implementation processes	1a. February 18, 2020 1b. December 20, 2020
2. Develop and review integrated RGSM model	2a. Complete base model 2b. Review model, conduct sensitivity analyses, and run scenarios 2c. Complete draft working model	2a. February 26, 2020 2b. September 15, 2020 2c. December 20, 2020
3. Develop draft report of Integrated RGSM model and preliminary results	3a. Complete Preliminary Draft Report on Integrated RGSM Model	3a. December 20, 2020
4. Reports to EC	4a. Draft Progress Report to EC 4b. Present preliminary findings to EC 4c. End of Year Report to EC	4a. May 1, 2020 4b. May EC Meeting 4c. Last 2020 EC Meeting

June 2, 2020

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

- *Draft Modeling Scenarios for the Middle Rio Grande [draft]*
- *Revised Middle Rio Grande Endangered Species Collaborative Program Population Monitoring Work Group 2020 Work Plan [revised]*
- *Draft Executive Summary: Age Composition of Rio Grande Silvery Minnow [draft]*
- *Draft Executive Summary: Age-Specific Survival of Rio Grande Silvery Minnow [draft]*
- *Draft Executive Summary: Consolidation of Mesohabitats for Monitoring Rio Grande Silvery Minnow [draft]*
- *Draft Executive Summary: Effect of Environmental Cues on Spawning Onset and Activity of Rio Grande Silvery Minnow [draft]*
- *Table 1. List of Potential Water Management Scenarios for Utah State University Modeling*
- *Executive Summary: Consolidation of Mesohabitats for Monitoring Rio Grande Silvery Minnow Trends [presentation]*

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
June 2, 2020
9:00 AM – 12:00 N

Zoom Information:
https://west-inc.zoom.us/j/8983593120
Call-In: +1-669-900-6833; Meeting ID: 898-359-3120

Meeting Agenda

9:00 – 9:15	**Welcome, Intros, Agenda, Meeting Notes, 2020 Work Plan** ➢ **Decision:** Approval of June 2, 2020 agenda ➢ **Decision:** Approval of April 28, 2020 minutes Read aheads: ☐ June 2, 2020 meeting agenda ☐ April 28, 2020 meeting minutes ☐ PMWG 2020 Work Plan (to EC)	*PMWG Chair*
9:15 – 9:30	**Executive Summaries Review by PMWG (due 7/1/2020)** Read aheads: ☐ Age-Specific Survival of RGSM ☐ Consolidation of Mesohabitats for Monitoring RGSM ☐ Age Composition of RGSM ☐ Spawning Onset and Activity of RGSM	*Rich Valdez* *Kevin McDonnell* *Catherine Murphy*
9:30 – 10:15	**Consolidation of Mesohabitats for Monitoring RGSM**	*Mike Marcus*
10:15– 10:25	**Break**	
10:25– 10:40	**1996 FLO Data**	*Shay Howlin*
10:40 – 11:30	**Modeling Scenarios** • Develop Model Scenarios Read aheads: ☐ Modeling Scenarios	*Rich Valdez* *Charles Yackulic*
11:30 – 12:00	**Wrap-Up** • Announcements (Hatch Paper, Coordinated Modeling) • Action Items • Next Meeting	*Rich Valdez* *Mick Porter*
12:00	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
Meeting Summary

June 2, 2020, 9:00 AM – 12:00 PM
Location: Zoom Meeting

Decisions:

- ✓ Approval of June 2, 2020 PMWG meeting agenda
- ✓ Approval of April 28, 2020 PMWG meeting minutes

Action Items:

WHO	WHAT	BY WHEN
Program Support Team (PST)	Send a doodle poll for June 2020 to schedule next meeting	June 4, 2020
PST	Distribute Hatch et al. (2020) paper	June 4 ,2020
Catherine Murphy	Create a tracking spreadsheet for the executive summary review process	June 4, 2020
PST	Distribute the writing guide for executive summaries	June 4, 2020
Shay Howlin	Ask Joel Lusk to review the FLO 1996 metadata description	June 7, 2020
PST	Upload the FLO 1996 data to Zotero	June 12, 2020
Rich Valdez	Distribute the one-page PMWG summary for the Executive Committee update	June 12, 2020
Program Support Team	Organize the Zotero library with separate folders for each executive summary topic	June 12, 2020
PMWG members	Provide comments on the draft executive summaries to the PST: • Age-specific Survival of Rio Grande Silvery Minnow (RGSM) • Consolidation of Mesohabitats for Monitoring RGSM • Age Composition of RGSM • Spawning Onset and Activity of RGSM	July 15, 2020
Mike Marcus & Catherine M.	Revise the Consolidation of Mesohabitats for Monitoring RGSM executive summary to incorporate the discussion points from the meeting	July 1, 2020
Rich V., Charles Yackulic, and PST	Develop an approach to look at modeling scenarios in the PMWG	By the next meeting

Meeting Summary

Welcome, Introduction, Meeting Notes, 2020 Work Plan

- Rich Valdez, SWCA Environmental Consultants, PMWG chair, opened the meeting, led introductions, and reviewed the meeting agenda. He then reviewed the action items from the April 28, 2020 PMWG meeting. The revised 2020 PMWG Work Plan has been approved by the PMWG and will be presented to the Executive Committee (EC) for approval at the June meeting.

✓ **Decision**: Approval of the PMWG June 2, 2020 meeting agenda
✓ **Decision**: Approval of the April 28, 2020 PMWG meeting minutes

➢ **Action Item**: Catherine M., PST, will distribute the executive summary writing guide to the PMWG
➢ **Action Item**: Rich V. will distribute a draft PMWG summary update to the PMWG

Executive Summaries Review by PMWG

- Four draft executive summaries were provided to the PMWG as read-aheads:
    - Age-specific Survival of RGSM
    - Consolidation of Mesohabitats for Monitoring RGSM
    - Age Composition of RGSM
    - Spawning Onset and Activity of RGSM
- PMWG members are invited to contribute to or review the executive summaries. There have been some comments on them. The comment period on the four draft summaries will be extended to July 15.
- The review process will be incredibly important in developing the summaries. The initial draft is a starting point, and it's expected that there will be counterpoints and additions from other interested individuals. To ensure that the review process stays organized, the group could use a tracking system.
    - Would that system include a track date on the document?
        - Track dates are a part of the document already. To further track the document, the PST will set up a table in the AM Database that will store who is providing comments and when. This will help comments get incorporated in an organized way. It's still early in the process, but it's expected that there will be a substantial number of comments as the process continues. The group should be encouraged to comment knowing that there will be documentation that all comments are being addressed.
    - The PMWG should be sure to get the full range of information with each summary. They should cover different ideas, thoughts, and hypotheses to best represent the group. The tracking tool can be displayed at each meeting to show progress on the summaries.
- When originally talking about the executive summaries, the group discussed the documents going to the EC. However, these documents are too time-consuming for EC review. The EC should get a summary document, preferably one page. Cutting down the document leaves out important detail for PMWG, so attention should be paid to the intended audience and content appropriate for each.
    - There are two audiences for the document: technical experts and the EC. The first step should be to create a version with all the information. Then, the PMWG can write condensed abstracts or fact sheets for the EC.

    - The full document should be structured to focus on the key takeaways up front.
    - The executive summaries exercise should both inform the EC and contribute to the adaptive management (AM) process. From the executive summaries, one should be able to identify research questions or topics that need to be included in the Program's science plan.
- In order to help with the review process, the references for each of the executive summaries can be placed in the PMWG Zotero library.
- In the AM plan, will each uncertainty be listed and have an executive summary?
    - That hasn't been decided yet. If we get the process streamlined here, it can be used in other groups that are working to decide which uncertainties to move forward.
- When looking at the different executive summaries and reference lists, it's clear that some have had a lot of time spent on them and some have not. We could use a more neutral look, like simple stating the objectives of a study and its methods and results. A standardized approach helps to avoid incorporation of bias. This might resolve some conflict.
    - This comment should be included as part of a review, so it gets documented. It's a good idea to standardize the executive summaries.
    - This is a pilot effort. These comments help fix the process and streamline it.
    - When citing a paper in an executive summary, it's important to cite the results and not the discussion.

- **Action Item**: Catherine M. will create a tracking spreadsheet for the executive summary review process
- **Action Item**: The PST will organize the Zotero library with separate folders for each executive summary topic
- **Action Item**: PMWG members will provide comments on the draft executive summaries to the PST by July 15, 2020

Consolidation of Mesohabitats for Monitoring RGSM

- Mike M., Assessment Payers Association of the Middle Rio Grande Conservancy District, presented on the Consolidation of Mesohabitats for Monitoring RGSM executive summary (see presentation). These are the main points discussed following the presentation:
    - In looking at habitat studies, you could get two different results for habitat preference based on abundance that year. It's hard to draw preference on mesohabitat when you don't catch fish.
    - Mike M. discussed evaluating habitat studies, usefulness of seine hauls, schooling fish, representativeness of sampling, and goals of monitoring.
    - In the U.S. Army Corps of Engineers (USACE) project, the mapping and distribution of mesohabitat types analyzed isn't included in the report. If data are available, we may be able to look at them.

➢ **Action Item:** Mike M. will work with Catherine M. to revise the Consolidation of Mesohabitats for Monitoring RGSM executive summary to incorporate the discussion points from the meeting

1996 FLO Data

- Shay Howlin, PST, presented an update on the 1996 FLO data. FLO is the acronym of the consulting company that collected the data. The data have been entered and subjected to quality assurance/quality control. The data will be packaged as an Excel file and uploaded

to the Program Portal once the metadata are reviewed for accuracy. Shay H. will ask Joel Lusk, Reclamation, to review and can also send to any interested PMWG members.
    - The 1996 FLO data will be updated to the Program Portal.

- **Action Item**: Shay H. will ask Joel L. to review the FLO 1996 metadata description
- **Action Item**: The PST will upload the FLO 1996 data to the Program Portal

Modeling Scenarios

- Charles Yackulic, U.S. Geological Survey, has developed an integrated model and the PMWG is looking into modeling scenarios. Rich V. and Charles Y. put together a preliminary write-up of potential modeling scenarios, including a list of 7 items and are using the model as a forecast tool. The following are the main points of the discussion on modeling scenarios:
    - The 7 items are potentially relevant to management actions.
    - The list is reasonable but some items cannot be modeled outputs based on the data. So, we'll have to consider the scenarios and how much they matter.
        - Sensitivity analysis using salvage, for example: What will it look like if we assume all salvaged fish die, and all salvaged fish have the same survival rate? We need to take the worst and best cases and determine how much they affect model behavior. The critical uncertainties are the ones that significantly change model performance and/or outcomes.
    - There is sufficient information to separate augmented fish in the model.
    - To determine acres of floodplain habitat, a technical Ad Hoc group may need to be formed that models floodplain habitat availability over time. We may need to think about a way to estimate how discharge turns into floodplain habitat and how management actions tie in. This item requires work before putting it into the model.
    - What information is needed to translate these ideas into parameters that the model can use?
        - For numbers 1 and 7, Aubrey Harris, USACE, has been doing habitat modeling work for USACE and Reclamation. In a couple months, there should be pretty good data.
    - The integrated model is the skeleton to test hypotheses, but we still need people who know the fish and its biology to help come up with alternative competing hypotheses. That's where PMWG can be really useful.
    - Consider what we know about the species and ways to optimize the spring runoff hydrograph. A scenario analysis, using hypothesized conditions rather than empirical observations, may provide useful upper and lower bounds for some estimates. Following the scenario analysis, management approaches for working with less water can be explored.
    - How do you imagine running these within the model? What metrics do we expect to look at to compare between these scenarios?
        - The list of 7 items is almost a list of different management actions. For some of them, we're trying to quantify impact, including uncertainty. Down the line we'll consider the impacts of one action versus another and how to prioritize them.
    - How are we going to quantify what an impact is?
        - For short term, look at abundance. If we get to the point of comparing different strategies, it makes sense to look at probability of extirpation or extinction.

Exercise Looking at Spring Hydrograph

- The PMWG looked at the spring hydrograph. The following are the main points of the discussion:
    - What are two or three different hydrographs that may optimize RGSM habitat?
        - As a group the PMWG could also outline a couple different hypotheses that are obviously contrasting.
            - There hasn't been an attempt to design studies to determine hypotheses. There hasn't been enough flexibility to do so.
    - The group could do a sensitivity analysis and see what falls out as most important. This might direct what scenarios to look at.
        - Restrictions on water operations to modify the hydrograph may nullify a sensitivity analysis. Documenting these restrictions and their effect on the hydrograph is, therefore, a very useful preliminary step.
    - Something I'm not seeing is a different way to think about scenarios 1, 2, and 3. Will it be possible in some years to flip from one scenario prioritizing spawning to another year prioritizing adult survival? How many years can you go in one way or another before a total crash?
        - This is a state-dependent management decision and something we want to explore.
    - Joel L. gave us some hydrographs that U.S. Fish and Wildlife Service used to work on for the BO. Are those examples of hydrologic shifting useful for this exercise?
        - Those were good to figure out how to optimize, but it's just one approach and we have to figure out how to manage across 7 different hydrographs.
    - Is it possible to use a single hydrograph and manipulate the 7 elements independently and in combination?
        - 7 hydrographs might be overkill. Maybe the PMWG needs to decide it doesn't matter what you do in wet years and only focus on dry or medium years. Then consider how you would shape the hydrograph if you had full control or partial control.
    - Make sure the hydrographs are very distinct from each other so we can isolate why one hydrograph behaves differently from another in the model.
    - PMWG can come up with some blocky hydrographs (considering variations on magnitude, timing and duration of rise) just to get some concepts together. Everyone can come up with 1-3 hydrographs to see how common they are.
    - Some of the things coming out of this group's discussion are directly relatable to development of the Program's AM strategy and plan. The PST is very interested in using outputs of this group's model and tying it to pieces of the AM plan. All members are asked to think about how each of these questions relates to things like the conceptual ecological model.

- **Action Item**: Charles Y. and Rich V. will develop an approach to look at modeling scenarios in the PMWG

Wrap-Up

- Announcements:
    - There is a new Hatch paper and it will be presented at the next meeting.
        - The paper will be sent as follow-up and uploaded to Zotero.

- **Action Item**: The PST will distribute the Hatch et al. (2020) paper
- **Action Item**: The PST will send a doodle poll for June 2020 to schedule next meeting

Participants:

Anne Marken	Middle Rio Grande Conservancy District
Catherine Murphy	Program Support Team
Charles Yackulic	U.S. Geological Survey
Debbie Lee	Program Support Team
Eric Gonzales	U.S. Bureau of Reclamation
Grace Haggerty	New Mexico Interstate Stream Commission
Kevin McDonnell	Program Support Team
Lynette Giesen	U.S. Army Corps of Engineers
Melissa Mata	U.S. Fish and Wildlife Service
Mick Porter	U.S. Army Corps of Engineers
Mike Marcus	Assessment Payers Association of the Middle Rio Grande Conservancy District
Mo Hobbs	Albuquerque Bernalillo County Water Utility Authority
Rich Valdez	SWCA Environmental Consultants
Shay Howlin	Program Support Team
Thomas Archdeacon	U.S. Fish and Wildlife Service
Trevor Birt	New Mexico Interstate Stream Commission

Modeling Scenarios for the Middle Rio Grande

Population Monitoring Workgroup

May 21, 2020

Draft 1.1--Preliminary

Introduction

Three mathematical models are being developed to better understand the relationship of the endangered Rio Grande silvery minnow (RGSM) to environmental correlates, including river hydrology (Yackulic 2019; Walsworth and Budy 2020; Hatch et al. 2020). Scientific uncertainty and questions about ongoing management actions help to drive the design and utility of these models for addressing key hypotheses. A practical method of model interrogation is the development of experiments or management-oriented scenarios that produce expected species responses to a suite of options reflective of decisions faced by managers (e.g., Melis 2011). This document describes modeling scenarios designed to evaluate RGSM responses to associated environmental correlates of the Middle Rio Grande (MRG), including river discharge.

Rationale for Scenarios

The 2016 Biological Opinion for Water Operations of the MRG (USFWS 2016) contains the Hydrobiological Objectives (HBOs) as a practical framework for developing modeling scenarios. The HBOs are based on the fundamental relationship between river discharge and October CPUE, and offer two strategies for RGSM conservation:

- The production strategy fosters the production of young RGSM during spring, and
- The survival strategy provides guidelines to manage for RGSM survival when spring and summer flows are low.

These strategies describe the needs of the fish for two life history phases (spawning/larvae and juvenile/adults) during two hydrological periods (high spring flow and low summer base flow). These phases and periods are fundamental drivers of the RGSM population in the MRG, and the modeling scenarios developed herein reflect the need to understand mechanism within each period, as well as tradeoffs associated with water distribution across both periods.

Scenarios Under Development

The following modeling scenarios are under development as further described below:

1. Spring runoff hydrograph to inundate floodplains as RGSM nurseries
2. Summer base flow to minimize drying
3. Balance spring and summer hydrographs (tradeoff spring runoff and river drying)
4. Effect of RGSM augmentation on population (2.5 million from 2001 to 2019)
5. Effect of RGSM salvage on population
6. Effect of impediment/passage at three diversion dams on population
7. Acres of floodplain habitat needed to affect October CPUE

Scenario #1: Spring Runoff Hydrograph

- **Over-Riding Hypothesis:** The shape of the spring hydrograph determines reproductive success of RGSM.

- **Key Variables:** The following considerations are identified for each of the five key variables of spring runoff (Fig. 1):

  a. Timing
     1. Spring runoff may start as early as mid to late April, and as late as mid-May.
     2. Inundated floodplains provide habitat for newly-hatched RGSM larvae.
     3. Floodplains are available to more larvae if inundation begins between initial spawning (~700 ACDDs) and onset of majority of spawning (~1,000 ACDDs).

  b. Magnitude
     1. Floodplain inundations begins ~1,500 cfs at San Acacia reach; ~2,000 cfs at Isleta reach; ~2,500 cfs at Angostura reach.
     2. Relatively steady magnitude provides stable habitat for maturing larvae, and minimizes displacement and stranding.

  c. Duration
     1. Floodplain habitat needed for larvae to develop fins and fin rays in 14-22 days.
     2. Duration should include as much of the larval hatch as possible (Fig. A-1).

  d. Upramp
     1. Daily increase in flow not as critical as downramp.

  e. Downramp
     1. Rapid downramp can displace or strand larvae.

- **Conceptual Scenarios**: Conceptual modeling scenarios were developed with an Excel spreadsheet tool using the five hydrographic variables as inputs. Of 27 possible scenarios for three key variables, nine are identified in Table 1 and are illustrated in Figs. A-2-A-4.

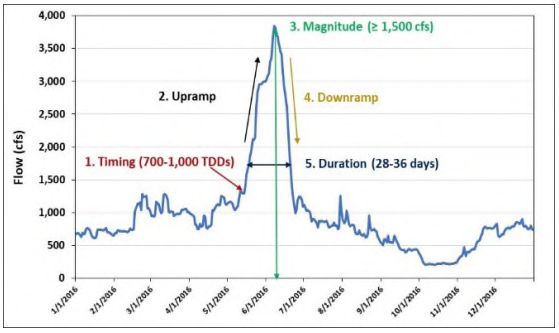


Figure 1. Five variables of spring runoff, with 2016 hydrograph for illustration.

Table 1. Scenarios for each of three runoff variables (see Figs. A-2-A-4 for illustrations).

Timing	Magnitude	Duration
1. Early (start April 15)	4. Low (<1,500 cfs)	7. Short (<15 days)
2. Mid (start May 1)	5. Moderate (1,500-3,000 cfs)	8. Medium (15-45 days)
3. Late (start May 15)	6. High (>3,000)	9. Long (>45 days)

Scenario #2: Summer Base Flow

- **Over-Riding Hypothesis:** Mortality from summer drying drives annual October CPUE.

- **Key Variables:** The following considerations are identified for each of the variables of summer base flow:

    a. Timing of Drying
        1. Early drying can strand post-larval RGSM with reduced swimming capability.
        2. Early drying can portend long drying duration.
    b. Duration of Drying
        1. Shorter duration drying allows quicker reinvasion.
        2. Longer duration reduces habitat availability.
        3. Longer duration affects food base longer and delays reset of food base (diatoms, algae, macroinverts).
    c. Length (river miles) of Drying
        1. Longer section(s) of drying results in more mortality and reduces habitat availability.
        2. Longer section(s) of drying affects more of food base.
    d. Rate of Drying
        1. Slower rate of drying may allow fish to move with water.
        2. Faster rate of drying traps fish in pools and pockets.

Scenario #3: Balance Spring and Summer Hydrographs

- **Over-Riding Hypothesis:** Possibly water volume used for spring runoff can be managed to minimize summer drying.

- **Key Variables:** The following considerations are identified for each of the variables of spring and summer hydrographs:

    a. Volume of water available
        1. Sufficient water volume is necessary to balance spring and summer hydrographs.
        2. Insufficient volume (low water year) limits management options.
        3. Moderate to high water volume can increase management options, depending on other management considerations (see #3 below).
    b. Series of low water years
        1. Second or third sequential low water year increases urgency to manage flows.
        2. Other management considerations may limit options in series of low water years.
    c. Other management considerations
        1. Status of Articles of Rio Grande Compact.
        2. Volume of water in reservoir storage.
        3. Others?

Scenario #4: Effect of RGSM Augmentation on Population

- **Over-Riding Hypothesis:** Augmentation of hatchery-reared RGSM helps to sustain the RGSM population in low water years or in years following poor production/recruitment.

- **Key Variables:** The following considerations are identified for each of the variables of augmentation:

    a. Number of RGSM stocked
        1. Number stocked can affect population size of RGSM.
        2. Greater number stocked can lead to more fish surviving.
        3. Large number stocked may affect genetics of RGSM population.
    b. Size and age of RGSM stocked
        1. Size and age of stocked RGSM can influence survival.
        2. Size and age of stocked RGSM can affect reproductive potential from size/age-specific fecundity.
    c. Number (CPUE index) in pre-existing brood stock by October
        1. Number of RGSM in pre-existing broodstock can influence effect of augmented fish on the population; augmented fish will have a larger influence on the population with a small pre-existing broodstock.
        2. Number of pre-existing broodstock of given size/age can vary effect of augmented RGSM on reproductive potential.

Scenario #5: Effect of RGSM Salvage on Population

- **Over-Riding Hypothesis:** Salvage of RGSM from isolated pools during drying and translocation to wetted areas helps to improve survival.

Scenario #6: Effect of Impediment/Passage at Three Diversion Dams on Population

- **Over-Riding Hypothesis:** Diversion dams at Angostura, Isleta, and San Acacia impede movement of RGSM among reaches and reduces population viability.

Scenario #7: Acres of Floodplain Habitat Needed to Affect October CPUE

- **Over-Riding Hypothesis:** Greater availability of floodplain habitat in spring enhances reproductive success and survival of larval RGSM that can result in higher October CPUE.

References

Hatch M.D., F. Abadi, W.J. Boeing, S. Lois, M.D. Porter, and D.E. Cowley. 2020. Sustainability management of short-lived freshwater fish in human-altered ecosystems should focus on adult survival. PLoS ONE 15(5): e0232872. https://doi.org/10.1371/journal.pone.0232872

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Yackulic, C.B. 2020. Rio Grande Silvery Minnow integrated population model. Power Point presentation to Population Monitoring Workgroup, February 26, 2020. U.S. Geological Survey, Flagstaff, AZ.

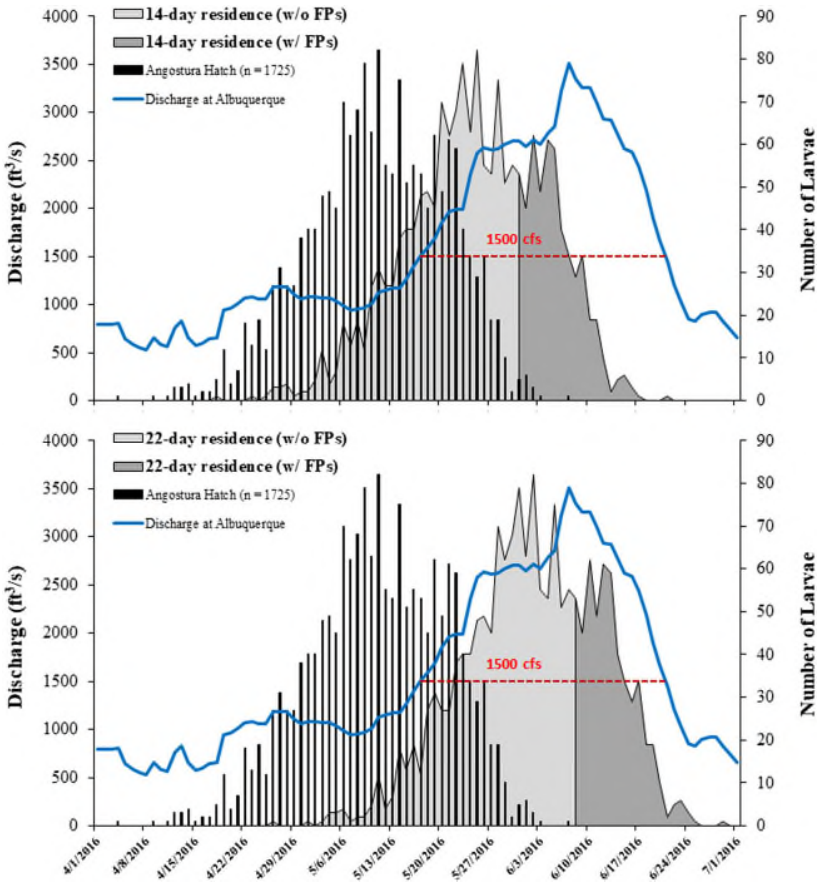


Figure A-1. Estimated hatch dates of Rio Grande silvery minnow and the projected end of floodplain residence by larvae for 14 and 22 days, divided as larvae hatched with and without floodplains (FPs). Discharge is for the Rio Grande at Albuquerque (U.S. Geological Survey #08330000). Horizontal dashed line shows discharge of 1,500 ft3/s where inundation of the six study sites began. Figure 10 from Valdez et al. (2019).

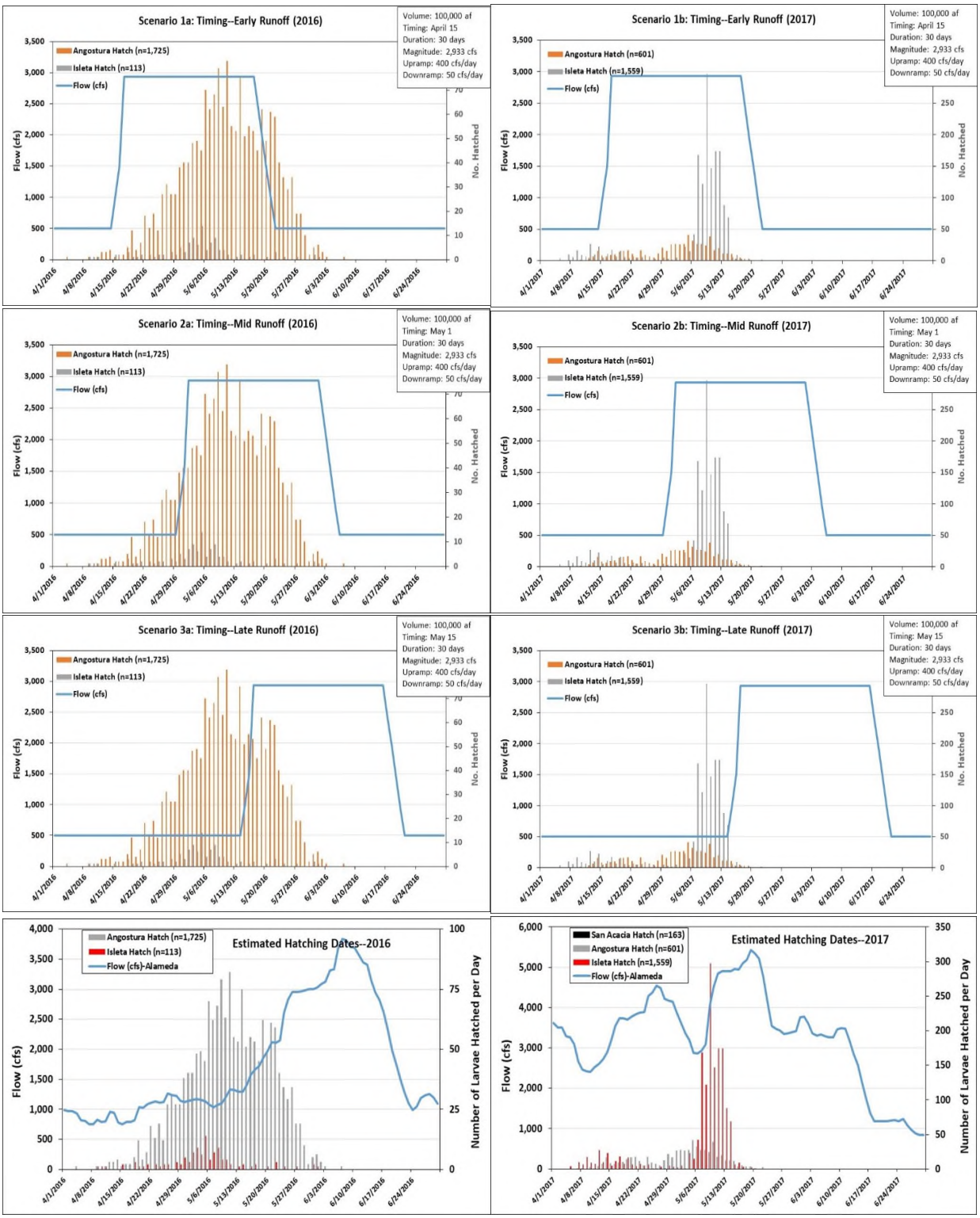


Figure A-2. Conceptual scenarios for **timing** of spring runoff as early (a. April 15), medium (b. May 1), and late (c. May 15), with estimated hatch dates of RGSM for 2016 (left column) and 2017 (right column). Actual hydrographs for April 1 to June 30 are shown for 2016 and 2017 on the bottom row.

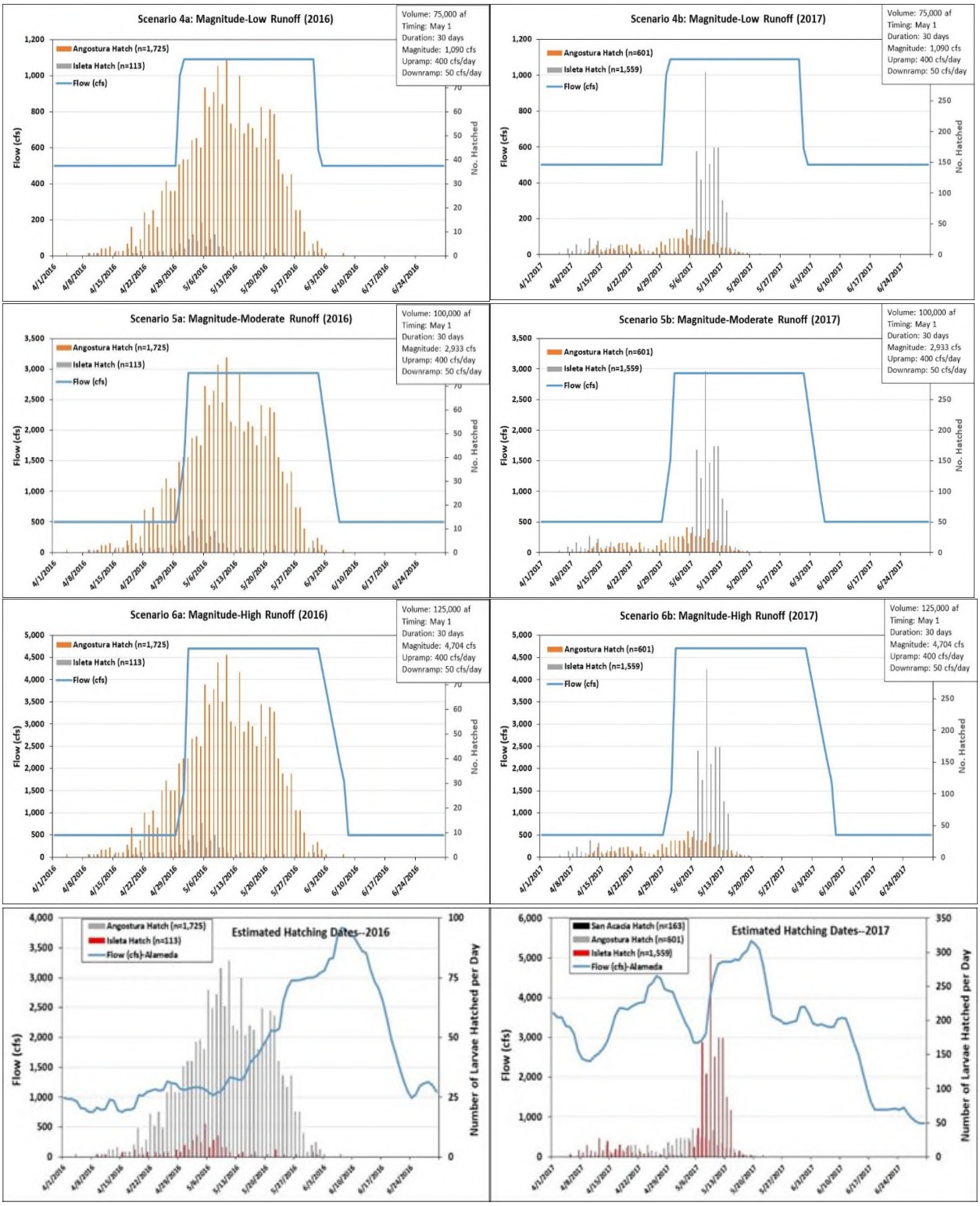


Figure A-3. Conceptual scenarios for **magnitude** of spring runoff as low (a. <1,500 cfs), moderate (b. 1,500-3,000 cfs), and high (c. >3,000 cfs), with estimated hatch dates of RGSM for 2016 (left column) and 2017 (right column). Actual hydrographs for April 1 to June 30 are shown for 2016 and 2017 on the bottom row.

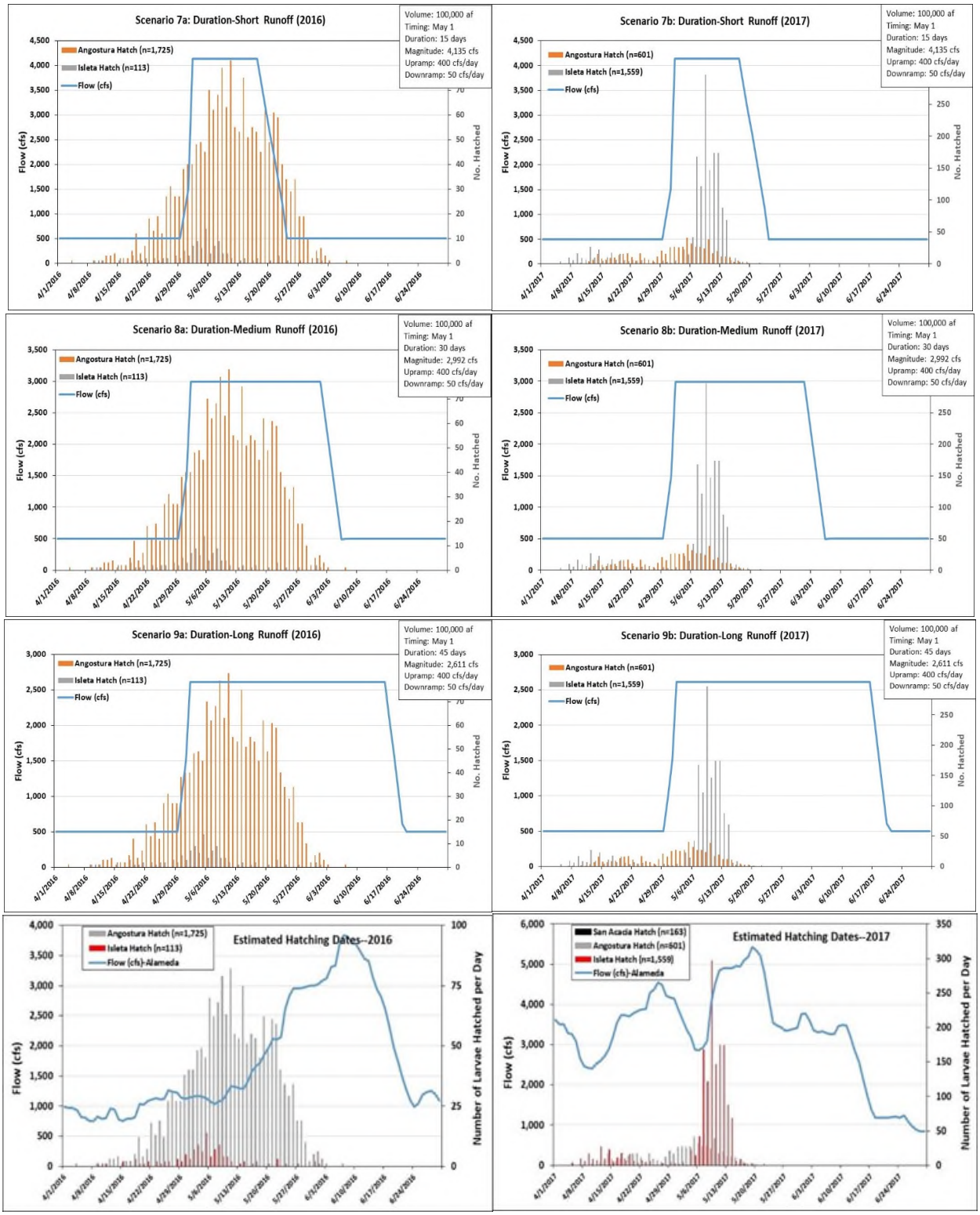


Figure A-4. Conceptual scenarios for **duration** of spring runoff as short (a. <15 days), medium (b. 15-45 days), and long (c. >45 days), with estimated hatch dates of RGSM for 2016 (left column) and 2017 (right column). Actual hydrographs for April 1 to June 30 are shown for 2016 and 2017 on the bottom row.

Middle Rio Grande Endangered Species Collaborative Program
Population Monitoring Work Group (PMWG)
2020 Work Plan

The Population Monitoring Workgroup (PMWG) is charged by the Executive Committee (EC) of the MRGESCP with evaluating the monitoring program and demographics for the Rio Grande Silvery Minnow (RGSM) in the Middle Rio Grande, in accordance with three tasks: (1) conduct a workshop on CPUE methodology, (2) review the fish population monitoring plan and demographics, and (3) update the monitoring plan. Task 1 was completed in 2016, and Task 2 is currently being executed by the PMWG.

The PMWG plans to conduct and complete the following elements under Task 2 in 2020:

Elements	Sub-Element	Target Completion Date
1. Integrate and prioritize consolidated recommendations from two science panels[1]	1a. Consolidate recommendations	1a. February 18, 2020
	1b. Complete Executive Summaries on six to eight recommendations to aid in the ranking and implementation processes	1b. September 15, 2020
	1c. Work with WEST to integrate recommendations into AM process	1c. Ongoing
2. Develop and review integrated RGSM model[2]	2a. Complete base model	2a. February 26, 2020
	2b. Review model parameters	2b. July 15, 2020
	2c. Conduct sensitivity analyses, and run scenarios	2c. September 15, 2020
	2d. Complete draft working model	2d. December 20, 2020
3. Develop draft report of Integrated RGSM model and preliminary results	3a. Complete Preliminary Draft Report on Integrated RGSM Model	3a. December 20, 2020
4. Reports to EC	4a. Draft Progress Report to EC	4a. June 2020
	4b. Present preliminary findings to EC	4b. June EC Meeting
	4c. End of Year Report to EC	4c. Last 2020 EC Meeting

[1] Hubert Science Panel Report was completed in 2016; Noon Science Panel Report was completed in 2017.
[2] Dr. Charles Yackulic of the USGS has been retained through the NMISC to develop an integrated model.

Executive Summary

Topic Area Title: Age Composition of Rio Grande Silvery Minnow

Panel Recommendations (Noon et al. 2017):

- C: Clarify the detail of annular mark formation on otoliths and firmly establish the longevity of RGSM.
- E1: Establish the age composition of the RGSM population, including A.) application of distribution separation methods to estimate age composition, and B.) gear selection study.

Program Goal Relevance:

Provides an understanding of age composition for the current RGSM population, the effectiveness of sampling to characterize age structure, and possible changes in age composition over time that may be limiting population self-sustainability.

Brief Summary of Available Literature:

The age composition of the Rio Grande silvery minnow (RGSM) remains unresolved because: (a) various sample gears and locations reveal larger (and possibly older) fish than reported in standard monitoring, (b) modal separation and modal progression analyses indicate small numbers of older fish in the contemporary population not reported through monitoring, (c) numbers of older fish may be too small in some years for capture, (d) older, viable fish in captivity show the species is capable of living much longer than seen in the wild, and (e) examination of historical specimens shows older fish than reported from the contemporary population, indicating age truncation.

The RGSM in the Middle Rio Grande (MRG) is thought to comprise of principally three ages: age 0 (young-of-year less than one calendar year of age), age 1 (12-24 months old), and age 2 (24-36 months old). This determination was initially based on nominal assignment of age from visual inspection of fish length (e.g., Propst 1999; Dudley and Platania 2020). Histograms of wild RGSM lengths generally show one or two distinct modes and a blending or smearing of subsequent modes, reflecting slowed growth at maturity and overlapping lengths of older, same-age fish (Valdez 2018).

Cowley et al. (2006) determined length-at-age from scale growth rings of 13 preserved RGSM specimens collected in 1847 from San Ildefonso, NM, about 85 miles upstream Albuquerque. Scale annuli showed age classes 1 to 5 were present, indicating that individuals historically may have lived longer than fish of the contemporary population. The presence of multiple individuals of several ages suggests that annual survival rates of young fish were high historically,

accounting for the presence of older fish. This analysis also showed that the species is iteroparous (i.e., undergoes multiple reproductive events in its lifetime), rather than being short-lived and semelparous (i.e., a single reproductive cycle before death). This means that RGSM spawn and survive multiple years, rather than all spawning at one time and dying.

The first study to age RGSM from growth increments of scales and otoliths (Horwitz et al. 2018) determined from 158 specimens in 2009 and 2010 that the majority were ages 0, 1, and 2, with only three individuals age 3. Horwitz et al. (2018) disputed the ages determined by Cowley et al. (2006) for the preserved specimens of 1874, submitting that reexamination of scales showed the fish were age 0 to age 2.

Miller (2012) used four age classes in a population viability analysis (PVA) model for the RGSM, while acknowledging that the study of Horwitz et al. (2011) demonstrated the presence of three age classes in the population. Miller (2012) stated that model runs showed that "While the number of individuals in the oldest age class is quite small, we cannot statistically exclude the possibility of some individuals surviving to four years of age." Goodman (2010) also developed a PVA for RGSM and allowed the modeled population to self-extinguish at age 4 or 5.

As part of the data assimilation for the Miller (2012) PVA, Valdez and Medley (2010) conducted modal progression analysis using monthly standard-length data of 29,580 RGSM from the standardized population monitoring program. This analysis revealed that the population sampled during 1993-1997 and 1999 consisted of individuals up to 5 years of age with a predicted maximum length ($L\infty$) of 84 mm SL, which was slightly smaller than the largest fish observed in the samples at 87 mm SL. Proportions of fish from all samples with lengths equal to or less than predicted length-at-age were 77%, 21%, 2%, 0.17%, and 0.05%, respectively, whereas specimens examined by Cowley et al. (2006) were 8%, 23%, 31%, 31%, and 8% for ages 1-5, respectively.

Lengths at annulus formation 1-5 from modal progression were 41, 62, 73, 78, and 81 mm SL Valdez and Medley (2010), respectively, and were comparable to and not significantly different ($p < 0.05$) from lengths of 46, 61, 70, 76, and 81 mm SL, respectively, estimated from scale annuli from 13 preserved fish collected in 1874 (Cowley et al. 2006). This comparison indicates that growth of individuals in the contemporary population does not appear to differ from growth of individuals from historical collections. Lengths at age-1 (nominal 1st birthday) from modal progression analysis (41 mm SL) and from scale annuli (46 mm SL) were similar to lengths of 45-49 mm SL cited by Platania and Dudley (2003) for fish spawning at the end of their first year of life. Estimated length at ages 2-5 from this modal progression were slightly higher than those determined by Cowley et al. (2006), possibly because the historical collections were from San Ildefonso, an upstream reach of river with a shorter growing season than reaches of the MRG.

Valdez (2018) then used monthly length-frequency distributions and modal separation analyses to determine presumed age composition from standard lengths of 61,850 RGSM measured as part of the standardized population monitoring program for 1993-2016. He also used growth models and modal progression analysis to estimate length-at-age for the same samples. Length-frequency analysis using 2-mm bins of monthly data employed the Bhattacharya and NORMSEP methods (Sparre and Venema 1998) to distinguish lengths as most probable modes. This analysis determined that there were predominantly 1 to 3 length groups, with small proportions of a 4th length group and rarely a 5th group. These length groups presumably corresponded to ages, but actual age could not be determined from this analysis. A modal progression analysis using Shepard's Method of ELEFAN (Sparre and Venema 1998) also showed evidence of 4 and 5 length groups, but it was difficult to track length modes for more than 2-3 years. The data were then used to evaluate growth, using a first order von Bertalanffy growth function (VBGF) and a seasonalized von Bertalanffy growth function (SVBGF). These analyses showed that the RGSM sampled were comprised predominantly of 1 to 3 length groups, with small numbers of larger (and presumably older) fish that may or may not be present in some years. RGSM illustrate a seasonal growth rate (fast in spring-fall, slow in winter), with the best AICc score for the SVBGF. These samples represent post-larval fish that recruit into the gear type in June or July, at 1.5-2 months of age.

Hatch et al. (2020) used model simulations to evaluate two hypothetical "average fish" and five example fish species of age 1 or age 2 maturity, including RGSM. From a population equilibrium baseline representing a natural, unaltered environment, systematic reductions in adult survival were imposed to quantify how age truncation affected the causes of variation in population growth rate. Hatch et al. (2020) estimated the relative contributions to population growth rate arising from simulated temporal variation in age-specific vital rates and population structure. At equilibrium and irrespective of example species, population structure (first adult age class) and survival probability of the first two adult age classes were the most important determinants of population growth. As adult survival decreased, the first reproductive age class became increasingly important to variation in population growth. These results support the findings of Miller (2012) that the contemporary RGSM population was driven largely by the reproduction of age-1 fish. The conclusion of age truncation reached by Hatch et al. (2020) also lends credence to Cowley et al. (2006) that the historical population reflected older fish because of higher survival by younger fish. These findings indicate that older fish (age 3+) could be present in contemporary population, but in such low numbers as to be largely undetected in some years. This also supports the conclusion by Platania and Dudley (2003) and Miller (2012) that the majority of RGSM spawners are fish at the end of their first year of life (age-1), despite higher fecundity (number of eggs per females) in older fish.

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Longevity of the RGSM is best determined from captive fish. Captive fish live longer than wild fish (Horwitz et al. 2011, 2018) and are still reproductively capable at 4+ years of age (City of Albuquerque BioPark 2018). Maximum documented longevity in the wild is about 30 months for wild fish inferred from length-frequency, but up to 36 months for hatchery-released fish. It is not uncommon for RGSM in captivity to live beyond 2 years and up to 6 years, especially at lower water temperatures. The U.S. Geological Survey's (USGS) Columbia Environmental Research Center in Yankton South Dakota had several silvery minnows in captivity with a maximum age of 11 years that range in size from 46 to 73 (± 8.1) mm SL (Buhl, pers. comm., cited in USFWS 2010).

Maximum longevity of wild RGSM was thought to be about 25-36 months, with most fish dying after their first reproductive cycle at 12-13 months, and few surviving past their second reproductive cycle at about 24-25 months (Platania and Dudley 2003). More recent analyses with model separation, modal progression, and growth models indicate that fish up to 4 or 5 years of age are likely present in the wild population. But because these older fish may not be represented every year, or because they may occupy habitat not commonly sampled, or outswim the gears in use, their presence may be missed and under-represented in the population.

Gear selection will be presented in a separate Executive Summary.

List the Uncertainties:

1. Does current fish monitoring account for all sizes (and presumably ages) of RGSM?
2. What proportion of the RGSM population is comprised of fish 3+ years of age?
3. How important are fish 3+ years of age in maintaining the population through years of low reproduction and recruitment?

List the Hypotheses Identified from Literature:

1. The contemporary RGSM population is age-truncated and reliant on age-1 reproduction.
2. Age-2 and age-3+ RGSM are important to carry over population reproduction in consecutive years of low flow.
3. Carry-over of reproductive potential was evidently present in the historical population, but may be limited in the contemporary population.

Management Implication(s) of Hypotheses (if any):

1. Enabling survival of older RGSM to age 3+ increases annual reproductive potential and minimizes population variability.

2. Survival of age-3+ fish could provide "carry-over" in the population so that large more fecund fish remain in years when reproduction and recruitment are otherwise limited by low river discharge.

Potential Approaches to Test Hypotheses:

1. Age fish sampled with a variety of gears and over time to determine if older fish in the population are being missed.
2. Determine through modeling the effect of various numbers of older fish on population production and viability.

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Contributors:

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Reviewers:

Executive Summary

Topic Area Title:

Age-specific survival of Rio Grande Silvery Minnow (RGSM)
Noon et al. (2017) recommendations A2 and A3.

Program Goal Relevance:

Provides an important demographic parameter to understand the numbers of fish surviving from one year to the next under different flow and environmental conditions.

Brief Summary of Available Literature:

Estimates of survival for RGSM were derived by Remshardt (2007) and Valdez (2010), and used by Miller (2012) to compute and infer age-specific survival in a RAMAS PVA (Table 1). Survival of RGSM by cohort was estimated by Goodman (2010) and used to resolve age-specific survival in a FORTRAN PVA. Yackulic (2020) preliminarily derived estimates of annual adult survival from an integrated population model. Estimated survival of RGSM has also been developed by Mike Hatch and David Cowley of New Mexico State University as part of an ongoing stock assessment model and PVA, but these estimates are not available at this time.

Remshardt (2007) estimated monthly survival of 0.662 for hatchery-reared fish released into the MRG in November 2004 and monitored through spring 2005. The fish were age-4 and were marked with VIE tags. Survival was estimated from the decline of marked fish in approximately monthly samples.

Valdez (2010) used the ASIR Population Monitoring dataset to compute mean monthly CPUE of all ages across reaches for years 1993–1997 and 1999-2010. He regressed these CPUEs over time in a "catch-curve" analysis that yielded an estimate monthly survival of 0.763 for wild fish, which was expanded to an annual survival rate of 0.039 (0.76312 = 0.039) for individuals 12 to 24 months of age. Valdez (2018) expanded the analysis to include mean monthly CPUE data for 1993-2017 (not 1998 and 2009) and derived monthly survival estimates for age-0 (mean = 0.736, range = 0.267-0.970), age-1 (mean = 0.740, range = 0.472-0.968), and age-2 (mean = 0.834, range = 0.583-0.976), which transform to mean annual survival of 0.03, 0.03, and 0.11, respectively. Annual adult survival (age 1+) was estimated at about 0.04.

Miller (2012) used the Remshardt (2007) and Valdez (2010) estimates of survival in his PVA model and reasoned that these monthly estimates represented some form of upper and lower bounds for the true value of this parameter. Miller (2012) noted that Remshardt (2007) did not see significant differences in survival among marked and unmarked fish in his 2005

augmentation study, and assumed that augmented fish (i.e., hatchery fish) were immediately subject to the same monthly rates of survival as the wild fish. Miller (2012) also assumed constant survivorship throughout the year, with the exception of an assumed lower survivorship of approximately 0.15 during the first month of life; he estimated survival of age-0 fish as (0.66211 = 0.007) x 0.15 = 0.0016 for fish up to 12 months of age. Miller (2012) then assumed a constant survival rate for age-1 (12-24 months of age) as 0.66212 = 0.007. Miller (2012) also assumed a constant annual survival for age-2 and age-3 individuals equal to 0.05, which was a value consistent with preliminary statistical analyses of survival (0.058) conducted by Goodman (2010) as part of PVA Workgroup activity.

Goodman (2009a) also used the 1993–1997 and 1999-2010 ASIR Population Monitoring dataset and estimated survival of RGSM by regressing inter-quarterly (Qn+1 vs Qn) CPUEs for all ages and reaches. Goodman (2010) determined a survival rate of 0.0580 for the 2007 cohort by plotting CPUE on a log scale and using the slope of the regression. Goodman (2009a) concluded that for years with a strong reproductive pulse, the survival rate to the pre-breeding census (early spring) ranges from about 0.03 to about 0.3; for years with reproductive failure, survival rate varies more widely, but the estimates may be less reliable for those years. On this basis, the Goodman concluded that PVA modeling should reasonably represent the cohort survival until the pre-breeding census as a random variable, with a mean around 0.1 and a mode around 0.05, and a longer right tail.

Table 1. Summary of Survival Estimates:

	Larvae	Age-0		Age-1		Age-2		Hatchery Age-?	
Citation	**Monthly**	**Monthly**	**Annual**	**Monthly**	**Annual**	**Monthly**	**Annual**	**Monthly**	**Annual**
Remshardt (2007)	--	--	--	--	--	--	--	0.662	0.01
Goodman (2009)	--	--	0.058	--	--	--	--	--	--
Hatch (2009)	--			0.09[b]				--	--
Valdez (2010)	--	0.763	0.04	--	--	--	--	--	--
Miller (2012)	0.15[a]	0.662	0.0016	0.662	0.007	--	0.05[a]	--	--
Valdez (2018)	0.502[c] (2016)	0.736	0.03	0.74	0.03	0.834	0.11	--	--
	0.472[c] (2017)	--	--	--	--	--	--	--	--
	0.301[d] (2017)	--	--	--	--	--	--	--	--
Yackulic (2020)	--	0.20 (0.15-0.25)[e]	--		0.04 (0.02-0.06)f			--	--

[a] estimated from model derivation.
b estimated from salvaged fish of all ages.
c estimated from floodplains.
d estimated from mainstem.
e approximate range derived from integrated model for June to October.
f approximate range of annual adult survival derived from integrated model.

Yackulic (2020), as part of the development of an integrated model for RGSM, derived estimates of annual adult survival (age-1+) each for the Angostura, Isleta, and San Acacia reaches. Altogether, estimates range from about 0.02 to 0.06 with a central distribution of about 0.04. Estimates of age-0 survival from June to October ranged from about 0.15 to 0.25 with a central distribution of about 0.20.

Mike Hatch (Personal communication, PVA Workgroup Meeting, 2009) provided an annual survival estimate of 0.09 for RGSM from salvaged fish, but no report was provided to detail the age of fish or method for deriving this estimate.

List the Uncertainties:

1. Is age-specific survival (larvae, ages 0, 1, 2+) different?
2. Is survival of older fish (age 2+) sufficiently high to enable "carry-over" from survival of older and presumably large and more fecund fish?

List the Hypotheses Identified from Literature:

1. Low spring-time survival of larval RGSM does not significantly increase population size, as measured by the October CPUE index.
2. Numbers of large and more fecund RGSM are not sufficiently large to significantly increase reproductive success.

Management Implication(s) of Hypotheses (if any):

1. Providing habitat and suitable conditions for survival of larvae can help to set cohort strength and the number of fish in the population.
2. Providing habitat and suitable conditions for survival of age-2+ fish could provide "carry-over" in the population so that large more fecund fish remain in years when reproduction and recruitment are otherwise low.

Potential Approaches to Test Hypotheses:

1. Estimate survival of larval RGSM from exponential function of density, or derived from modeling exercises.
2. Sample more intensively in spring to better determine the numbers of large RGSM present in the population in a given year.

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Literature Cited:

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Executive Summary: Consolidation of Mesohabitats for Monitoring RGSM

Source Recommendation

Noon et al. (2017) E3: "Calculate revised CPUE values as mesohabitat-specific levels and do not combine across mesohabitat types. The mesohabitat specific CPUE calculated for the most abundant high density mesohabitat type should be used for assessment of trend in abundance of the RGSM population at the October sampling date."

Program Goal Relevance

Revising the distribution and intensity of sampling across mesohabitat types at the sampling sites, along with other potential modifications, used during the Population Monitoring Program (PMP) may improve the relationship associating computed catch-per-unit-effort (CPUE) index estimates of RGSM population trends from the PMP to needed estimates of the RGSM abundance and status in the MRG. Such a revision also may enhance the cost-effectiveness of the PMP.

Literature Summary

Assessing the potential importance for and differences among in-channel habitat characteristics influencing RGSM presence during sampling began with the recognition that RGSM occurrence in samples occurred along the continuous physical-habitat variables of flow and depth. Subsequently, due largely to the impossibility of measuring flow and depths prior to sampling without causing fish to scatter, the PMP focused on sampling within qualitative mesohabitat categories as flow-depth "surrogates." The following summarizes a sampling of the literature and PMWG analyses intended to aid in evaluating this peer recommendation and provide next step recommendations toward potential modification of PMP sampling procedures. (Additional PMWG documents overview and summarize additional literature and analysis assessing relationships of flow, depth, and habitat quality to RGSM in the MRG.)

Platania (1993a, b) provided the earliest extensive assessments of fish population distributions and RGSM habitat usage along the MRG. Focusing on winter habitat, **Dudley and Platania (1996)** reported that the majority (72.3%) of RGSM were caught in mesohabitats containing instream debris and consistently occurred over small substrata, at moderate depths, and in low velocity water. Subsequently, **Dudley and Platania (1997)** collected RGSM and other fish species during monthly sampling from July 1994 to June 1996 at two MRG sites, one each near Rio Rancho and Socorro. Habitat availability was determined at both sites monthly October 1995 to June 1996. They reported that RGSM exhibited differences in habitats use by size-class, with velocity being the strongest predictor of habitat use by size-class closely followed by depth; however, the correlation between these two physical variables clouded clear definition of the relative importance of each. Most RGSM (91.3%) were collected over silt substrata. RGSM tended to be most abundant in low-velocity mesohabitats (debris piles, backwaters, and pools) and rarest in high velocity habitats (runs and riffles). Greater proportions of RGSM occurred in higher velocity mesohabitats (main and side channel runs) in summer than winter, with the population shifting from pool and backwater habitats in summer to habitats with instream debris piles in winter.

Summarizing available information, the **USFWS (2010)** RGSM Recovery Plan states that the species only uses a small portion of the available aquatic habitat, occurring most often mesohabitats having low or moderate water velocity (e.g., eddies formed by debris piles, pools, backwaters, and embayments) and is rarely found in habitats with high water velocities, such as main channel runs, which are often deep and swift (citing **Platania 1993a, 1993b, Dudley and Platania 1997; Watts et al. 2002; Remshardt 2007, 2008**). Both marked (hatchery) and unmarked (wild) RGSM collections are positively associated with habitats having low velocity, most commonly shorelines, debris, eddies, and submerged vegetation.

Implementation of mesohabitat sampling during the RGSM PMP has varied somewhat over time. Its purpose is to estimate "population trends over time using a density index (i.e., CPUE)" (**Dudley et al. 2020: 48**).The most recent approach is described in the 2019 PMP draft completion report (**Dudley et al. 2020**). This includes collection fish using a two-person 3.1 m x 1.8 m small-mesh seine (ca. 4.8 mm [0.2 in]) through 18 discrete mesohabitats (< 1.5 m long [5 ft]). Runs were sampled four times at each site, as were shoreline pools (when available); backwaters, pools, and riffles were sampled two times (when available); any remaining samples (to obtain a total of 18 to 20) were taken in shoreline runs. Also, a 1.2 m x 1.2 m [2 ft x 2 ft] fine-mesh seine (ca. 1.6 mm [0.6 in]) was used to selectively sample shallow low-velocity mesohabitats for larval fish (two samples/site) from April to October. Mesohabitats with similar conditions, which did not exceed reasonable depths or velocities for efficient seining, were sampled regardless of flow conditions.

Dudley et al. (2020) also described results from their qualitative examination of mesohabitats occupied by RGSM, noting that the physical locations of mesohabitats in the MRG shift around considerably over time. They reported that RGSM occupancy trends were quite similar throughout 2002–2019 for five different mesohabitats, backwaters, pools, runs, shoreline pools, shoreline runs, despite notable differences in the estimated densities of RGSM among mesohabitats. Densities were typically highest in lower velocity mesohabitats and lowest in higher velocity mesohabitats.

Technical staff from the U.S. Geological Survey, collaborating with USACE and USFWS personnel, evaluated the physical habitat characteristics and fish assemblage compositions of available mesohabitats over a range of streamflows at 15 MRG sites during winter 2011–12 and summer 2012 (**Braun et al. 2015**). They reported that in the winter of 2011–12, RGSM were weakly associated with sand substrates, relatively moderate velocities, and relatively shallow depths; during summer 2012 they were associated with run mesohabitats, relatively high velocities, sand substrates, and relatively moderate depths. Of the four minnow species assessed, RGSM were collected from the narrowest range of depths (0.30–2.1 ft) during summer 2012 and the narrowest range of velocities in both winter 2011–12 (0.0–3.18 ft/s) and summer 2012 (0.02–1.51 ft/s). As time allowed, they also measured the physical characteristics of mesohabitats with the number of each mesohabitat type assessed done in proportion their abundance, with 20 mesohabitats assessed at each site. Measured depths and velocities varied greatly by mesohabitat type, site, and sampling period for both assessment periods. Applying area-weighting factors to the depths and velocities for assessed sites, they reported that shallower mean depths and slower

mean velocities during summer 2012, when discharges tended to be lower, relative to same sites in winter 2011–12. Visual inspection of the box and whisker plots presented in their Figure 10 for measured depths and velocities for each of the eight type of mesohabitat assessed during each season at each assessed sampling site reveals considerable overlapping distributions for both physical parameters across all mesohabitat types within each site by season. [The data produced by this studyare currently undergoing additional assessment by the USACE to evaluate approaches to (1) integrate its mesohabitat mapping with LiDAR, HEC-RAS, orthophotography, and other data sources to produce a geospatial model of in-channel habit; (2) investigate geospatial and temporal analyses for describing and presenting in-channel habitat information; and (3) develop techniques for integrating riparian floodplain and riverine habitat into single mapspace for the MRG (M. Porter, personal communication, email 4/9/2020).]

For the PMWG, **Marcus (2019)** primarily used histogram bins to group categories of collected data to characterize and summarize PMP data collect using RGSM using "regular gear" from February 1993 to October 2017. Summing the total RGSM collected by mesohabitat type only for the period March 2002 to 2017 and for the decade 2008 to 2017 showed that total numbers of RGSM collected varied by more than four orders of magnitude across the sampled mesohabitat types. He suggested that limiting the numbers of mesohabitat types sampled to those in the top three classifications having the greatest numbers of RGSM collected (mid-channel shoreline runs and pools plus backwaters, with the possible additions of the next four types with abundant RGSM recorded) might be done without meaningful loss of information, but cautioned that more advanced analyses of these results are needed to refine this conclusion. This summary indicated that hauls with >50 RGSM collected occurred most frequently in mid-channel shoreline pools followed by backwater mesohabitats, with markedly and progressively lower collection numbers occurring for the other mesohabitat types. In contrast, the two mesohabitats having the greatest frequency of hauls lacking RGSM were mid-channel runs and mid-channel shoreline runs.

For the PMWG, **Valdez (2013)** assessed the attributes and uses of the CPUE estimates produced by the PMP under several objectives. He reported that the high level of heterogeneity in the collection data indicated a mismatch between the spatial distribution of sampling units (i.e., seine hauls) and the distribution of RGSM, nothing that RGSM usually occur as large concentrations (i.e., schools) in preferred habitats that are disconnected and uncommon. He stated that the placement of seine hauls proportional to mesohabitat areas misses many of the small, uncommon, but important habitats occupied by RGSM, producing a disproportionately large number of zero catches for sampled mesohabitats, with considerably higher CPUE estimates in certain mesohabitat types. He concluded that there was not sufficient information at that time to develop a reliable, precise, and unbiased monitoring program for the RGSM. Nevertheless, his assessment indicated that the spacing and location of sampling units (i.e., seine hauls) should be congruous with the spatial distribution of the RGSM, which is strongly allied to specific mesohabitat types, especially during September through November when there is least variability abundance. He suggested two alternative PMP designs that would improve monitoring results.

To repeat, Recommendation E3 from **Noon et al. (2017)** suggested evaluating individual mesohabitat types and not combining types for computing mean annual CPUE estimates. Working with the PMWG to specifically address this recommendation, **Valdez (2018)** assessed CPUE estimates calculated for each of the most abundant mesohabitat types with highest fish density to determine whether the trend in abundance of RGSM could be assessed using only one or a few of the mesohabitat types. Only one mesohabitat type, mid-channel pools, yielded a distribution and magnitude of CPUEs not significantly different from that computed using all mesohabitats types, but the sample size was limited, including only 283 seine hauls. By using subsets of the 22 mesohabitat types sampled during 2002-2016, he found sample sizes could be increased while maintaining computed CPUE estimates not significantly different from those currently reported by the PMP using RGSM collections from only the main channel pools and backwaters, but the total numbers of samples (seine hauls) from both of these mesohabitats were less that an order of magnitude fewer than the total in the PMP during the same period. Next, combining the six mesohabitat types with highest CPUEs (five pool types plus backwaters) would produce larger sample sizes, again producing CPUEs not significantly different from those reported by the PMP using all mesohabitat types. Thus, either of these combinations could produce the same CPUEs patterns with 73% and 65% fewer samples, respectively. He noted that unequal samples of backwaters over time or space could inflate CPUEs. Of note, the reduced numbers of samples using only the available pools plus backwaters reduced the precision (i.e., coefficient of variation) of CPUE by about 27% and 19%, respectively for the two estimators of pools only and of pools plus backwaters. However, simulating an equal number of 400 samples per year showed an improved precision of 29% and 34%, respectively, over the simulated CPUEs drawn from all mesohabitats. Additional discussion was presented to address issues related to potential limited occurrence for the six mesohabitat types by sampling site and over years, also an approach was suggested to potentially reduce the numbers seine hauls needed for RGSM at differing densities.

List the Uncertainties:

1. Is the ongoing use of multiple diverse mesohabitat-based sampling for the PMP the most appropriate basis for assessing RGSM population trends in along the MRG? The PMP sampling has used mesohabitat types as a surrogate for depth and velocity where RGSM most commonly are collected. Yet, physical conditions measured for mesohabitats presented by Braun et al. (2015) clearly show considerable overlap in flow and depth measurements among all of the mesohabitat types they assessed. From this, questions may be raised on whether multiple diverse mesohabitat-based sampling as currently employed by the PMP are appropriate or, indeed, are reasonable surrogates for habitat flows and depths apparently favored by RGSM. If the current PMP based on multiple diverse mesohabitat-based sampling do not reasonably, consistently, or agreeably characterize depth and flow (i.e., habitat suitability) most favored by RGSM, what is an appropriate alternative?

2. Is it appropriate, as apparently is the current practice of the PMP, to weight sampling of mesohabitats more toward those frequently characterized as having flow and depth characteristics less suitable for, less favoring RGSM presence, which then would produce biased low CPUE index values for RGSM occurrences?
3. What more assessment is needed for recommendation E3 posed by Noon et al. (2017)? Marcus (2019) and Valdez (2013, 2018) have summarized and assessed the PMP RGSM collection data associated with mesohabitats sampled. Valdez (2018) specifically assessed these data in the manner specified under the E2 recommendation from Noon et al. (2017) and has made recommendation on next steps.
4. Will next step recommendations present in Valdez (2018) be followed? The combination of mesohabitat types (PO/BA/ED; RU/RI/FL) recommended by Valdez (2018) are being implemented by Yackulic (2020) in a RGSM Integrated Model.
5. Can the PMP be modified in a manor to produce potentially more reliable CPUE index values for RGSM population trends, which may also be more cost effective for the MRGESCP?

List the Hypotheses Identified from Literature:

1. Based on the PMP as currently implemented (e.g., Dudley et al. 2020): All mesohabitat types currently sampled and in the proportioned sampled during the PMP are necessary and appropriate for the calculation of CPUE index values to characterize the trends of RGSM population in the MRG.
2. The PMP can be modified to emphasize a subset of the currently defined mesohabitat types to compute CPUE index values to track RGSM trends, while continuing to provide a meaningful relationship and continuity to the long history of data from the RGSM PMP.
3. There is no reasonable method to routinely assess the status (actual population abundance) of RGSM in the MRG.

Management Implication(s) of Hypotheses (if any):

The MRGESCP and its collaborating member will potentially obtain improved data quality on RGSM trends in the MRG and potentially at less cost.

Potential Approaches to Test Hypotheses:

Follow recommendations provided in Valdez (2013, 2018) and then assess results relative to historical RGSM PMP collections.

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Executive Summary

Topic Area Title: Effect of Environmental Cues on Spawning Onset and Activity of Rio Grande Silvery Minnow

Panel Recommendations (Noon et al. 2017):

- B2: Improved assessments of relations between possible environmental cues that trigger spawning activity.
- D2: Establish the proximate trigger(s) for spawning by evaluating the effects of flow velocity, temperature, rate of increase in flow velocity, or some combination of these factors.

Program Goal Relevance:

Understanding the cues that trigger RGSM spawning can lead to possible management actions that can maximize reproductive success and recruitment and eventually lead to population self-sustainability.

Brief Summary of Available Literature:

The Rio Grande silvery minnow (RGSM) is a schooling fish that spawns principally in spring during snow-melt runoff, with altricial larvae hatching in 2−4 days at ~4 mm long (Platania and Altenbach 1998; Dudley and Platania 2007). The species belongs to a reproductive guild of small, broadcast-spawning minnows that evolved in hydrologically variable rivers of western North America, characterized by high spring snow-melt runoff, low summer flow, and periodic high spikes from monsoonal rainstorm events (Krabbenhoft et al. 2014). These minnows maximize their reproductive success by releasing and fertilizing their eggs in the water column in response to rapidly increasing sediment-laden spring flow and water temperature (Cowley et al. 2009). The cues that trigger spawning by RGSM are not well understood, but identifying those cues can lead to possible management actions that maximize reproductive success and recruitment, and eventually to population self-sustainability.

The RGSM has been described as a “pelagic-spawning species” whose non-adhesive semi-buoyant eggs and newly-hatched larvae drift long distances downstream, with a subsequent return of young to upstream natal areas (Dudley and Platania 2007). These presumed upstream migrations remained undocumented, and more recently, the RGSM has otherwise been characterized as “demersal spawning” in low velocity main channel and floodplain habitats (Medley and Shirey 2013), like those of the historical Middle Rio Grande (MRG). Medley and Shirey (2013) examined the characteristics of RGSM eggs and proposed that the species is

primarily a demersal floodplain spawner with evolved eggs that are secondarily buoyant in high sediment environments rather than a main channel pelagic, broadcast spawning species with an evolved long-distance downstream drift phase. The evidence that the species is a floodplain spawner is further supported by studies in an outdoor aquaculture facility in which RGSM adults left the stream during hydrological manipulation and entered off-channel, low-velocity habitats where they spawned exclusively (Hutson et al. 2018). This strategy is consistent with the reproductive ecology of other *Hybognathus* species and broadcast-spawning minnows (e.g., Page and Burr 1991; Jenkins and Burkhead 1994; Department of Fisheries and Oceans 2016).

In the contemporary MRG, floodplains have become delinked from the main channel (Molles et al. 1998), and the reproductive phenology of spring broadcast spawners, including the RGSM and two extinct species (i.e., phantom shiner, *Notropis orca*; and Rio Grande bluntnose shiner, *Notropis simus simus*), has been disrupted by the reduced frequency and magnitude of spring floodplain inundation (Turner et al. 2010; Krabbenhoft et al. 2014). The onset of RGSM spawning in the contemporary MRG is not well understood but appears to be driven by a set of complex factors that include season and photoperiod, water temperature, and river discharge (USFWS, 2010). The synergistic effect of increased photoperiod and temperature in spring typically induces oocyte development in temperate fishes (de Vlaming 1975), and appears to lead to gonadal maturation of female RGSM in the wild, but the actual onset of spawning appears to be cued by a hydrological event. Platania and Dudley (2008) reported that spawning by RGSM appeared to be strongly associated with changes in flow and water temperature, where an appearance of eggs occurred shortly after a 200-300 cfs daily increase in river discharge. Moreover, Hutson et al. (2018) determined from an outdoor aquaculture facility that the most important spawning cue for RGSM appeared to be an increase in flow stage. The change in stage may be the increased discharge that leads to floodplain inundation or a flow spike prior to or absent of inundation.

As part of annual egg collection in the MRG, Dudley et al. (2019) used logistic regression modeling of RGSM egg presence-absence data to reveal strong associations with the percentage change in mean daily discharge just prior to egg collection. The probability of collecting eggs (i.e., occurrence), as opposed to egg passage rate, was highest when river flows increased substantially across days. The probability of collecting eggs during a 100% daily increase in flow was 0.80, whereas the probability was 0.97 during a 200% increase in flow. RGSM egg presence-absence data also revealed associations with water temperatures, though not as robust as the discharge relationships. The probability of collecting eggs ranged from 0.51 (temperature = 14°C) to 0.26 (temperature = 26°C). The probability of collecting eggs showed a steady decrease as a function of elevated water temperatures. These findings seem to support the

hypothesis that photoperiod and temperature lead to gonadal development, but the act of spawning is cued by increase in river discharge.

The hypothesis that increased river discharge cues the fish to spawn was used during the low water year of 2018 (Lusk and Lang 2018; SWCA 2018) when four temporary increases in discharge were implemented at the Angostura and Isleta diversion dams. Eggs were collected with MECs for transfer to hatcheries and subsequent augmentation of the population. Each 24-hour flow increase (i.e., "jiggle") was created by holding water behind a dam and releasing it as a spike to cue RGSM to spawn. Local rainstorm-related increases in flow (i.e., "riggle") also took place. Releases took place at the Isleta Dam on May 8 (increased discharge from 95 to 200 cfs, jiggle) and May 22 (50 to 700 cfs, jiggle + riggle), and at the Angostura Dam on May 15 (500 to 650 cfs, jiggle) and May 29 (400 to 550 cfs, jiggle). In addition, riggles occurred in the Angostura Reach May 21 (500 to 1,200 cfs) and June 3-4 (450 to 900 cfs). The largest numbers of RGSM eggs were collected within 1-2 days after each spike flow, and very few or no eggs were collected before a jiggle or a riggle. The jiggles produced between 201 and 41,750 eggs one day after the release. The largest number of eggs (96,802) were collected two days after the Isleta jiggle + riggle of May 22, which followed the second largest flow change of about 650 cfs. The second largest number of eggs were collected one day (41,750) and two days (16,000) after the Isleta jiggle of June 4. All of the jiggles and riggles produced eggs except for the May 8 Isleta jiggle.

Egg collection studies show the presence or absence of eggs within the 2-4 day incubation period of RGSM. In an attempt to better determine spawning and hatching times, larval RGSM were collected from floodplains of the MRG and the hatching dates of these fish were determined from a temperature growth model (Valdez et al. 2019, In Review) and from daily growth increments of otoliths (Zipper unpublished manuscript; Zipper et al. unpublished manuscript). The normal distribution of estimated hatching dates over a period of about a month indicates that female readiness and spawning are not simultaneous across the population and that different females are at different stages of gonadal maturation and possibly cued by different sequential hydrological events (Valdez et al. 2019). Individual RGSM in laboratory trials have been observed in multiple spawning events of 3–18, with 15–30 min intervals between events (Platania & Altenbach, 1996), but this does not account for the spatial distribution in spawning and hatching dates observed for 2016 (Valdez et al. 2019) and for 2017 (Valdez In review).

The earliest persistent spawning for RGSM in 2017 was April 5 in the Angostura and Isleta reaches; whereas earliest persistent spawning in 2016 was April 16 and April 17, respectively (Valdez et al. 2019). River temperatures at the Alameda Bridge at first spawning for 2016 and 2017 were 12.5°C and 10.6°C, respectively; however, the cumulative temperature degree-days (ACDD above 5ºC) were similar at 692 and 694, respectively. This indicates that river

temperature at the time of spawning may vary, but the total thermal regime experienced by the fish continues to accumulate. For the two years of study, ACDD for RGSM for first persistent spawning was about 700, and the bulk of spawning started at about 1,000.

A predictor of spawning time for RGSM is needed to explore hydrological opportunities that will enhance spawning, egg incubation, and larval nursery habitat. As a first approximation of a temperature index, Valdez et al. (2019) computed annual cumulative mean daily river temperature (ACDD) at the Alameda Bridge of 717 and 692 for the start of spawning in the Angostura and Isleta reaches, respectively. No other estimates of ACDDs are available for RGSM spawning, which are among the earliest of spawning cyprinids in the MRG (Krabbenhoft et al. 2014). Comparable estimates of growing season degree-days (synonymous with ACDDs) for the start of spawning by the congeneric brassy minnow (*Hybognathus hankinsoni*) was 671 (April 25) and 741 (April 30) for the fathead minnow (*Pimephales promelas*; Falke et al. 2010). Computed ACDD was 758 (June 1) for the red shiner (Cyprinella lutrensis) and 727 (May 30) for the fathead minnow in the Yampa River, Colorado, based on 1981 spawning dates by Muth and Nesler (1993). These studies show that while dates for onset of spawning vary, ACDDs tend to be about 700 for small-bodied western cyprinids.

The ACDDs derived for RGSM probably reflect photoperiod and temperature accumulation, as well as a hydrological spawning cue; daily increases in discharge of 200–300 cfs occurred in early and middle April, correspondent with the onset of spawning. A more resolute predictor will allow managers to know when the fish are ready to spawn so as to synchronize discharge with spawning and larval hatch, as hydrological conditions allow. A measure of annual cumulative water temperature may be a reliable predictor of spawning onset and peak, but this index will need to be more thoroughly investigated in a laboratory setting with additional data collection in the wild.

List the Uncertainties:

1. Is ACDD a reliable index for onset and peak of RGSM spawning?
2. Are there management options that can be implemented if annual spawning dates can be predicted?

List the Hypotheses Identified from Literature:

1. Female RGSM gonadal maturation is complete with spawning readiness at about 700 ACDDs.
2. Onset of RGSM spawning is cued by increases in river discharge of 200-300 cfs.

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3. Female readiness and spawning are not simultaneous across the population and different females are at different stages of gonadal maturation and possibly cued by different sequential hydrological events.

Management Implication(s) of Hypotheses (if any):

1. Management options (flow management and habitat restoration) may be available to enhance spawning, egg incubation, and larval survival if timing of spawning readiness is known in advance.
2. Floodplain habitat can be enhanced to correspond with available annual water volume and river discharge.

Potential Approaches to Test Hypotheses:

1. Conduct laboratory studies to determine ACDD for RGSM.
2. Continue to evaluate relationship of discharge to onset of spawning.
3. Determine is spawning onset differs by reach of the MRG.

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Table 1. List of potential water management scenarios for Utah State University to consider for their RGSM CPUE prediction model. Note: Bureau of Reclamation goals for potential water management scenarios (that are within its discretionary authority) are to seek to maximize sustainable economic development, to seek to avoid the unwise or impactful use of floodplains, and to protect and restore the functions of natural systems. Legal authorities, the Rio Grande Compact, contractual relationships, tribal trust responsibilities and agreements, availability, timing, or other water governance policies may affect the implementation of these potential water management scenarios. [Additional information on some of these or other potential water management scenarios was described by U.S. Army Corps of Engineers et al. 2007, U.S. Army Corps of Engineers 2009; U.S. Bureau of Reclamation 2016; or Audubon 2016)]

Scenario	Water Management Scenario Name	Volume of Water/year	Description of scenario with some constraints listed (cfs = mean daily flow in cubic feet per second)	Guesstimate of costs - this is a rough conjecture of estimated costs
1	Cochiti Lake Deviation	up to 40,000 acre-feet	With approvals, when Rio Grande flows exceed downstream demands during early spring runoff (~April), Corps could temporarily store 5,000 to 40,000 acre-feet of water in Cochiti Lake. That water would likely be released on the descending limb of the runoff hydrograph to create spawning flow or overbanking habitat. All stored water must released by June 15th.	Water temporarily stored at Cochiti Lake would also evaporate or be lost. Some entity would likely have to account for those water losses. Best guess is $100/acre foot. If losses were 1,000 to 3,000 acre feet, then costs could range from $60K to $300K. There would likely be additional staff time costs.
2	Supplemental Water in a DRY year	up to 35,000 acre-feet	Reclamation often leases San Juan-Chama water to support water needs of listed species. Water for lease is based on availability. Reclamation generally uses this acquired water to reduce rate/extent of river drying, but it could also be used to augment spring runoff. In general, about 10,000 to 15,000 ac-ft is available in a single year. In extraordinarily dry years Reclamation has sometimes been able to acquire additional water that could only be used to prevent or reduce river drying.	Only when it is available, San Juan-Chama water can be leased at costs ranging from $60 to $100/acre feet (or more). Leased SJC water can have associated terms, such as its release only during low flow conditions and not during spring runoff, to maintain other water operational needs of the lessor. (Therefore, costs could range from $900K to $3.5M)
3	Supplemental Water in an AVG year	up to 25,000 acre-feet	Reclamation often leases San Juan-Chama water to support water needs of listed species. Water for lease is based on availability. Reclamation generally uses this acquired water to reduce rate/extent of river drying, but it could also be used to augment spring runoff. If this volume of water is available it generally means water has been carried over from the previous year.	Only when it is available, San Juan-Chama water can be leased at costs ranging from $60 to $100/acre feet (or more). Leased SJC water can have associated terms, such as its release only during low flow conditions and not during spring runoff, to maintain other water operational needs of the lessor. (Therefore, costs could range from $900K to $2.5M)
4	Supplemental Water in a WET year	up to 15,000 acre-feet	Reclamation generally uses this acquired water to reduce rate/extent of river drying, but it could also be used to augment spring runoff. Water for lease is based on availability. While more water could be available, less water is necessary. Reclamation often uses this acquired water to reduce rate/extent of river drying or they can augment spring runoff.	Only when it is available, San Juan-Chama water can be leased at costs ranging from $60 to $100/acre feet (or more). Leased SJC water can have associated terms, such as its release only during low flow conditions and not during spring runoff, to maintain other water operational needs of the lessor. (Therefore, costs could range from $900K to $1.5M)
5	El Vado Modification	up to 32,000 acre-feet	In 2016, the RGCC approved El Vado Modification that allowed 32,000 acre-feet held during April & May for release in late May to early June. Releases of temporarily stored water plus other flows cannot exceed channel capacity (< 1,800 cfs) downstream of Abiquiu. RGC Article VII constrains this scenario.	There was a low cost associated with this 2016 scenario. This scenario requires Rio Grande Compact Commission and stakeholder approvals. In 2016, New Mexico addressed these depletions using the Strategic Water Reserve. Some entity would need to account for lost or evaporated water, which was estimated at ~1,000 acre feet. Direct costs could be up to $100K. There would be additional staff costs.
6	Water Pumping Program	up to 10,000 acre-feet	A single pump station can pump as much as 40 cfs (usually from the Low Flow Conveyance Channel to the Rio Grande). Total pumping is capped at 150 cfs per day. Note that in a DRY year, flows in the LFCC tend to allow pumping only from one location.	If the costs of pumping are $60 to $100/acre feet, then costs to pump 5,000 to 10,000 acre feet would range from $300K to $1M.
7	End of Year Water Exchange	up to 20,000 acre-feet	Certain types of water that are not beneficially used during the irrigation season may be released at the end of irrigation season (in November and December). It may be possible to release water at other times, but such water would be subject to diversion, costs, and evaporative loss.	For this type of exchange, there would also be evaporative and conveyance losses (or depletions). If Strategic Water Reserve was not available, then some entity might have to account for such losses. If the losses ranged from 1,000 to 3,000 acre feet, then direct costs would range from $100K to $300K. There would be additional costs for staff. Depending on when this water was released the following year, there could be losses as high as ~1/3 of the water volume due to evaporation, seepage, or possible diversion.
8	Water Banking or Leasing Programs	up to 5,000 acre-feet	To date, no private/cooperative purchase and release of water has exceeded 5,000 acre-feet in a year.	Leased water would range from $60 to $100/acre feet (or more). The costs for permanent purchases of water range from $12K to $15K (and possibly more). But beyond costs, there aren't enough water rights available, transactions and permitting takes years, and run-of-the-river rights do not have a storage component, so they are not available for upstream release. Leased water could cost up to $500K, purchased water could cost up to $75M or more.
9	Abiquiu Reservoir Native Water Storage	likely to range from 20,000 to 75,000 acre-feet	Abiquiu Reservoir is operated as a flood control facility by the Corps. Provided there are storage easements, the reservoir can be used to store San Juan-Chama Project water. This reservoir is also authorized to store Rio Grande water, when storage space is not needed and numerous conditions are met. Corps has additional requirements for holding and releasing Rio Grande water, would need a NM Office of the State Engineer permit, Corps deviation from normal operations, and unanimous concurrence of the Rio Grande Compact Commission.	Costs for this potential water management scenario were estimated as high (~$95M in 1987 dollars - now estimated at ~$216M in 2020 dollars). Ownership of the water stored was unresolved. Circumstances allowing storage of Rio Grande water at Abiquiu Reservoir were considered limiting. Purchase of additional flowage easements in Abiquiu Reservoir was found to not be cost-effective for any potential local sponsors (see USACE et al. 2007 for additional information).

1. U.S. Army Corps of Engineers, Bureau of Reclamation, New Mexico Interstate Stream Commission. 2007. Upper Rio Grande Basin Water Operations Review. Final Environmental Impact Statement. U.S. Army Corps of Engineers, Albuquerque, New Mexico
2. U.S. Army Corps of Engineers. 2009. Final Environmental Assessment for a Temporary Deviation in the Operation of Cochiti Lake and Jemez Canyon Dam, Sandoval County, New Mexico. U.S. Army Corps of Engineers, Albuquerque District, Albuquerque, New Mexico
3. U.S. Bureau of Reclamation. 2016. 2016-2021 Supplement to the Rio Grande Supplemental Water Programmatic Final Environmental Assessment and Finding of No Significant Impact. U.S. Bureau of Reclamation, Albuquerque Area Office, Albuquerque, New Mexico
4. Audubon. 2016. Audubon Announces Historic Water Release to the Middle Rio Grande. National Audubon Society September 07, 2016, Press Release. Accessed online at https://www.audubon.org/news/audubon-announces-historic-water-release-middle-rio-grande

Executive Summary: Consolidation of Mesohabitats for Monitoring RGSM Trends

Noon et al. (2017:25) E3:

- "Calculate revised CPUE values as mesohabitat-specific levels and do not combine across mesohabitat types.
- "The mesohabitat specific CPUE calculated for the most abundant high density mesohabitat type should be used for assessment of trend in abundance of the RGSM population at the October sampling date."

"We propose that the current aggregated (across mesohabitat types) CPUE metric be replaced with a mesohabitat-specific metric calculated for a "high density" mesohabitat type that has substantial availability in all primary sampling reaches. The time-series of this metric should provide a more reliable indicator of trends in October abundance of RGSMs because it assumes only that catchability within this mesohabitat type are constant across years at the time of October sampling. As flows during October are probably low and have relatively little variation across years (relative to other months), we believe that this assumption is a reasonable one."

Program Goal Relevance

Revising the distribution and intensity of sampling across mesohabitat types at the sampling sites used during the Population Monitoring Program (PMP) may

1. Improve the relationship associating computed catch-per-unit-effort (CPUE) index estimates of RGSM population trends
2. Better contribute to estimating RGSM TRENDS in abundance and status in the MRG
3. Enhance the cost-effectiveness of the PMP

How did mesohabitat-based sampling come to be used for the MRG PMP?

1. Recognition that RGSM occurrence in samples occurred along the continuous physical-habitat variables weighted toward slower flows and shallower depths.
2. Due largely to the impossibility of measuring flow and depths prior to sampling without causing fish to scatter, the PMP focused on sampling within discrete mesohabitat categories as flow-depth “surrogates.”

Literature Summary

1. Platania (1993a, b) - early assessments of fish population distributions and RGSM habitat usage along the MRG
2. Dudley and Platania (1996) - in winter the majority (72.3%) of RGSM captured in mesohabitats having instream debris, over small substrata, moderate depths, and low velocity water
3. Dudley and Platania (1997) - monthly sampling July 1994 to June 1996 at two sites (Rio Rancho and Socorro)
    1. RGSM differed in habitat use by size-class based on velocity and depth
    2. **RGSM tended to be most abundant in low-velocity mesohabitats (debris piles, backwaters, and pools) and rarest in high velocity habitats (runs and riffles**)
    3. Greater proportions of RGSM occurred in higher velocity mesohabitats (main and side channel runs) in summer than winter, with the population shifting from pool and backwater habitats in summer to habitats with instream debris piles in winter

Literature Summary

4. USFWS (2010) – Summarized available information in RGSM Recovery Plan: RGSM uses only a small portion of the available habitat
    1. Most often in mesohabitats having low or moderate water velocity (e.g., eddies formed by debris piles, pools, backwaters, and embayments)
    2. Rarely in habitats with high water velocities (e.g., main channel runs, which are often deep and swift)
5. Dudley et al. 2020 - RGSM PMP purpose is to estimate "population trends over time using a density index (i.e., CPUE)." Mesohabitat sampling the has varied over time. The most recent approach is to seine 18-20 discrete mesohabitats (< 1.5 m long [5 ft]).
    1. Runs and shoreline pools (when available) each sampled 4 times at each site
    2. Backwaters, pools, and riffles each sampled 2 times (when available)
    3. Any remaining samples were taken in shoreline runs (to obtain a total of 18 to 20 samples)
    4. Mesohabitats with similar conditions, which did not exceed reasonable depths or velocities for efficient seining, were sampled regardless of flow conditions
    5. [Slower flow habitats sampled ≤ 8x; faster flow habitats sampled ≥ 10-12x]

Literature Summary

6. Braun et al. 2015 - USGS, USACE, and USFWS evaluated the physical habitat characteristics and fish assemblage compositions of available mesohabitats over a range of streamflows at 15 MRG sites during winter 2011–12 and summer 2012
    1. RGSM were weakly associated with sand substrates, relatively moderate velocities, and relatively shallow depths in the winter of 2011–12
    2. RGSM were associated with run mesohabitats, relatively high velocities, sand substrates, and relatively moderate depths in summer 2012
    3. Measured the physical characteristics of mesohabitats in proportion their abundance, with 20 mesohabitats assessed at each site
    4. Measured depths and velocities varied greatly by mesohabitat type, site, and sampling period; based on area-weighting for depths and velocities reported shallower mean depths and slower mean velocities for RGSM during summer when discharges were lower relative winter discharges
    5. Measured depths and velocities for each of the 8 mesohabitat types assessed during each season at each assessed sampling site show considerable overlapping distributions for both flows and depths across all mesohabitat types within each site by season and in total

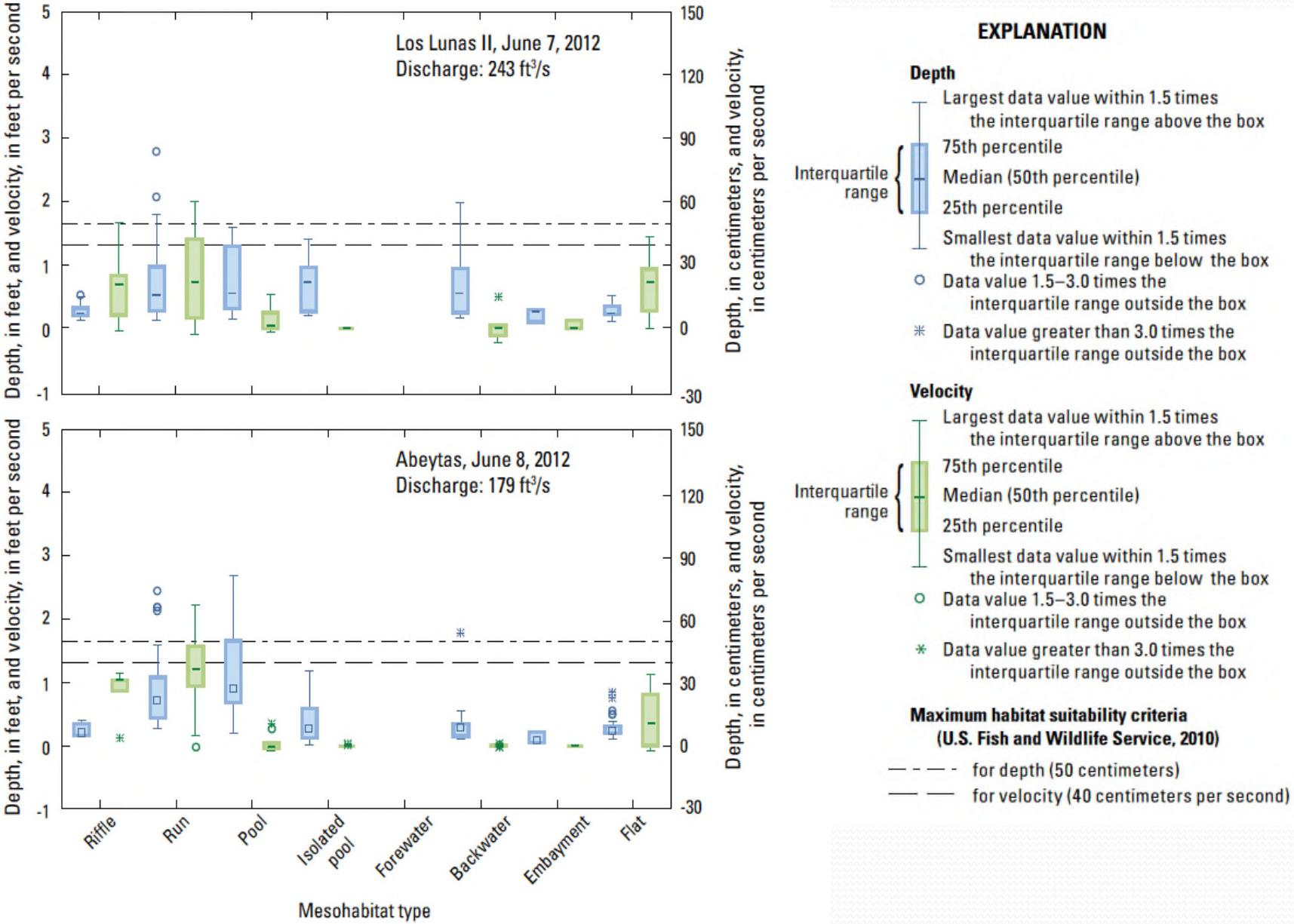
From Braun et al. 2015

Table 2. Description of mesohabitat types (modified from Platania, 1993) and channel features that were mapped on the Middle Rio Grande, New Mexico, 2011–12.

[ft/s, feet per second; ft, feet; NA, not applicable]

Mesohabitat type	Description	Velocity minimum to maximum (ft/s)	Depth minimum to maximum (ft)
Riffle	Relatively shallow and low to moderate velocity feature characterized by moderately turbulent water	-0.05–4.80	0.01–2.58
Run	Relatively high-velocity feature with laminar flow and a nonturbulent surface	-1.05–5.39	0.02–4.31
Pool	Feature with little or no velocity that may be deep in places	-2.14–1.70	0.04–4.40
(a) Channel	Type of pool where current moves in the same flow direction as the channel		
(b) Eddy	Type of pool where current moves in the opposite direction relative to flow		
Isolated pool	Type of pool that is separate from the main channel; frequently a portion of a former backwater or forewater that has become disconnected from a secondary channel	-0.06–0.21	0.01–2.40
Forewater	Slackwater feature oriented into the principal direction of flow	-0.10–0.08	0.01–1.00
Backwater	Slackwater feature oriented in an opposing direction to the principal flow direction	-0.23–2.25	0.01–2.87
Embayment	Slackwater feature located adjacent to the channel and oriented perpendicular to flow	-0.27–1.02	0.03–1.26
Flat	Very shallow, low-velocity feature typically located on the periphery of an existing point or channel bar; caused by a slight rise in stage	-0.62–3.13	0.01–2.4

From Braun et al. 2015

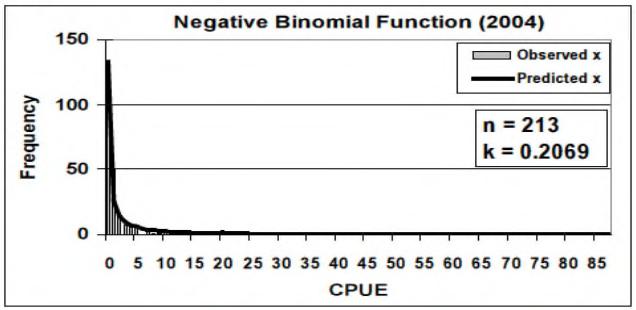


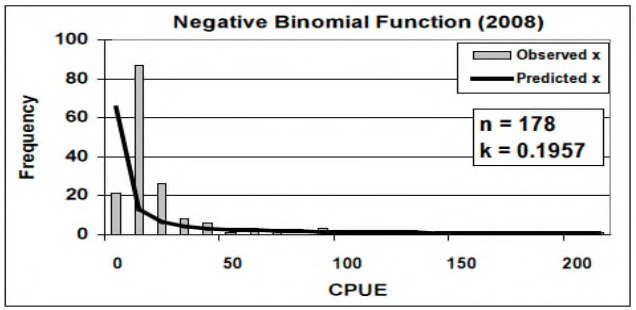
Literature Summary

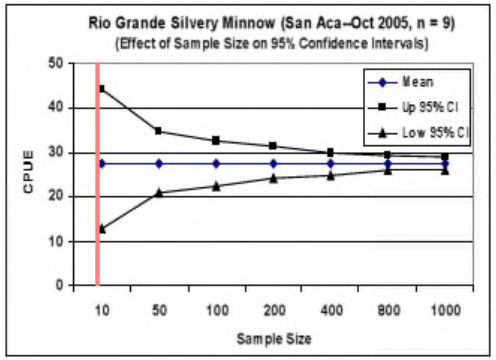
7. Valdez (2013) for the PMWG - Assessed the attributes and uses of the CPUE estimates
    1. High level of heterogeneity in the collection data indicated a mismatch between the spatial distribution of sampling units (i.e., seine hauls) and the distribution of RGSM, which usually occur as large concentrations (i.e., schools) in preferred habitats that are disconnected and uncommon
    2. Placing seine hauls proportional to mesohabitat areas misses many of the small, uncommon, important habitats occupied by RGSM, producing a disproportionately large number of zero catches for sampled mesohabitats, with considerably higher CPUE estimates in certain mesohabitat types (negative binomial distribution, see next slide)
    3. Of 2,414 raw CPUE data points (pooled CPUE from 20 seine hauls per site for 1993-2010), 679 (28%) were 0 (i.e., no RGSM were caught in the sample) and 543 (22%) were 0.1-1.0; hence, 50% of all CPUEs were 1.0 or less.
    4. Samples taken at different times of year can yield dramatically different CPUEs (see next slide).
    5. Precision and variability can be improved by increasing sample size, e.g., increasing sample size from 10 to 50 can improve change detection from about 120% to 50% but the cost of sampling is tripled (see next slide).

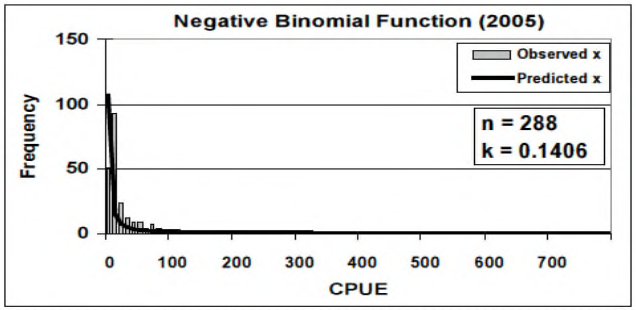
From Valdez (2013)

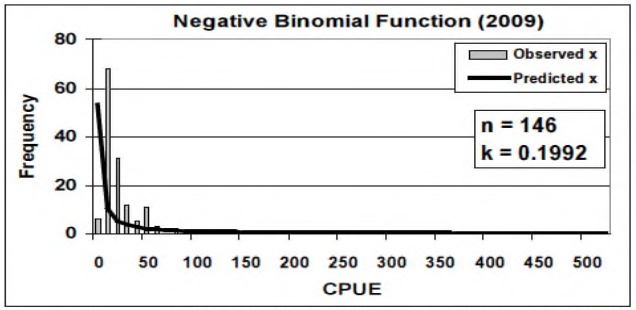
Figure 24. Negative binomial fit to frequency of pooled CPUE data by year, 1993-2003. Sample size (n) and over-dispersion coefficient (k) are displayed on each graph. CPUE bin sizes may differ by graph.

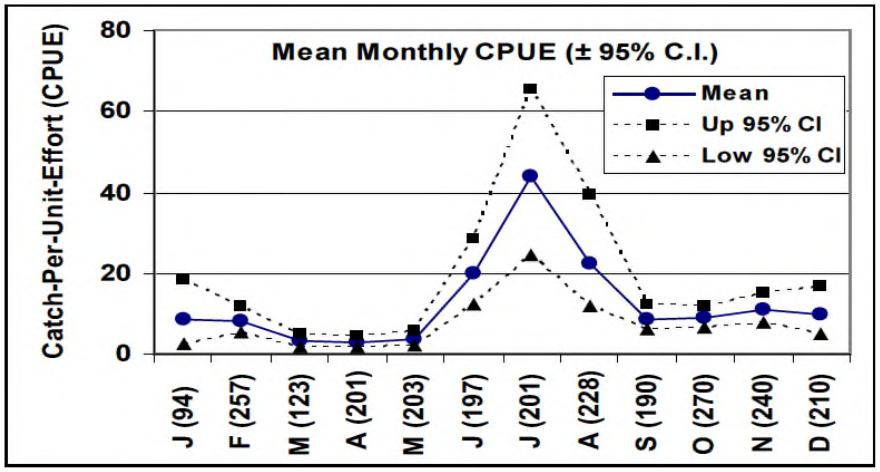


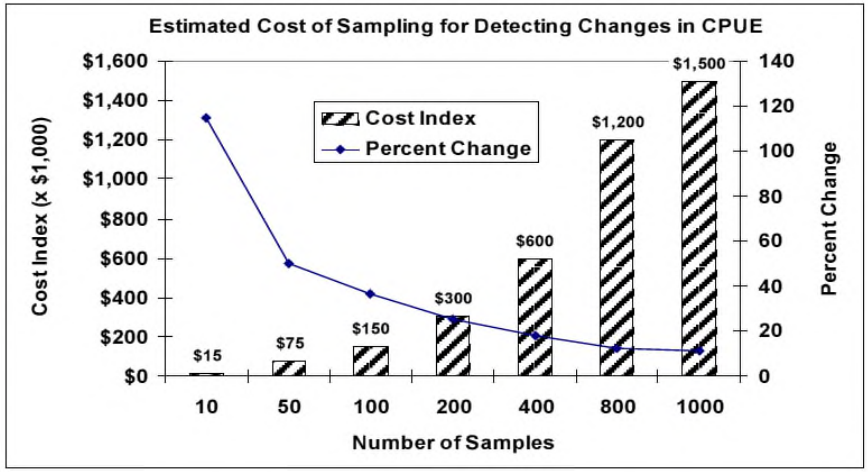






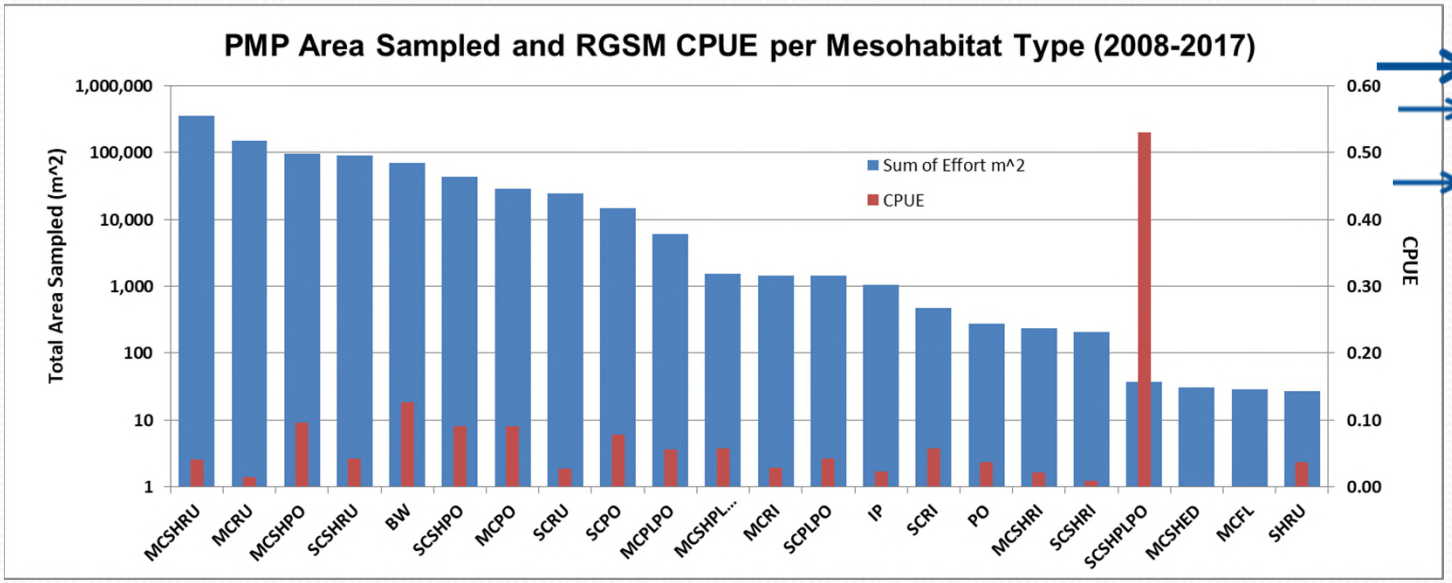


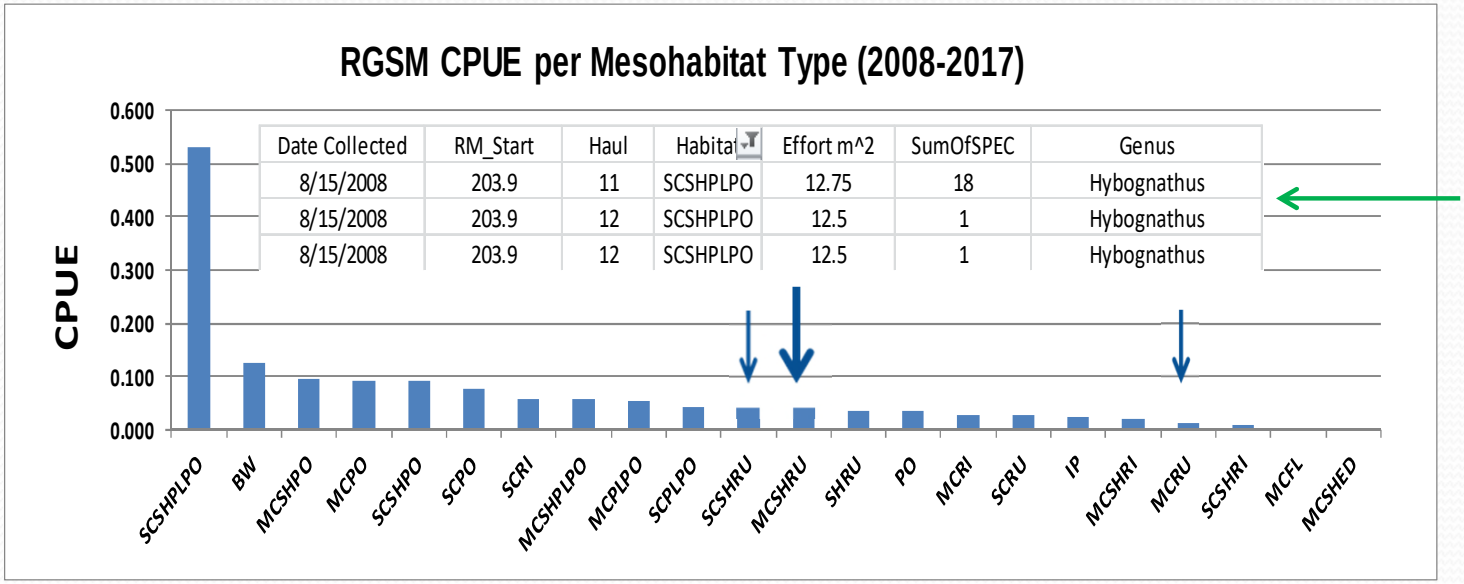




Literature Summary

7. Marcus (2019) for the PMWG - During 2008 to 2017 total numbers of RGSM collected varied by more than four orders of magnitude across the sampled mesohabitat types (data histogram plots, no CPUE calcs)
    1. Suggested that limiting the numbers of mesohabitat types sampled to those in the top three classifications having the greatest numbers of RGSM collected (~~**mid-channel shoreline runs**~~ ~~and~~ pools plus backwaters) might be done without meaningful loss of information
    2. Hauls with >50 RGSM collected occurred most frequently in mid-channel shoreline pools followed by backwater mesohabitats
    3. Two mesohabitats having the greatest frequency of hauls lacking RGSM were mid-channel runs and **mid-channel shoreline runs [?????? See next slide]**





Date Collected	RM_Start	Haul	Habitat	Effort m^2	SumOfSPEC	Genus
8/15/2008	203.9	11	SCSHPLPO	12.75	18	Hybognathus
8/15/2008	203.9	12	SCSHPLPO	12.5	1	Hybognathus
8/15/2008	203.9	12	SCSHPLPO	12.5	1	Hybognathus

2008-2017

Mesohabita	Total m^2	%
MCSHRU	352,885	40.0%
MCRU	148,867	16.9%
MCSHPO	97,253	11.0%
SCSHRU	89,421	10.1%
BW	70,046	7.9%
SCSHPO	42,843	4.9%
MCPO	29,096	3.3%
SCRU	24,581	2.8%
SCPO	14,791	1.7%
MCPLPO	6,139	0.7%
MCSHPLPO	1,561	0.2%
MCRI	1,462	0.2%
SCPLPO	1,443	0.2%
IP	1,043	0.1%
SCRI	468	0.1%
PO	276	0.0%
MCSHRI	235	0.0%
SCSHRI	208	0.0%
SCSHPLPO	38	0.0%
MCSHED	31	0.0%
MCFL	29	0.0%
SHRU	27	0.0%
	882,741	

The 3 run habitats comprised 67% of area sampled.

Literature Summary

9. Valdez (2018) for the PMWG - specifically addressed Noon et al. (2017) E3, assessed CPUE estimates calculated for each of the most abundant mesohabitat types with highest fish density to determine whether the trend in abundance of RGSM could be assessed using only one or a few of the mesohabitat types
    1. Using one mesohabitat type only, mid-channel pools, yields a distribution and magnitude of CPUEs not significantly different from that computed using all mesohabitats types using a limited sample size (283 seine hauls)
    2. Sample sizes could be increased while maintaining computed CPUE estimates not significantly different from those reported by the PMP using only the main channel pools and backwaters; the total numbers of samples were less that an order of magnitude fewer than the total in the PMP
    3. Combining the six mesohabitat types with highest CPUEs (five pool types plus backwaters) produced larger sample sizes, again with CPUEs not significantly different from those reported by the PMP for all mesohabitat types, using 65% fewer samples
    4. Recommendation were suggested to potentially reduce the numbers seine hauls needed for RGSM at differing densities.

Hypotheses from Peer Review

What more does the PMWG need to do to address Noon et al. ‘s E3 on page 17:

“E3. Currently Calculated Catch-Per-Unit-Effort Values Cannot Provide a Valid Index of Rio Grande Silvery Minnow Population **Abundance**

1. “We show that the currently calculated CPUE metric can provide a valid index of abundance only under the untenable assumption that **catchability** (proportion of fish captured compared to fish subjected to sampling gear) is identical across all mesohabitat types.
2. “Also, the **fraction mesohabitat area** within primary sampling units (reaches) that are sampled is not constant across sampling units, further complicating aggregation of CPUE (see Hubert et al. 2016).
3. “Mesohabitat-specific CPUE values, however, appear to have similar temporal trends across mesohabitat types (at least on a log scale: see Figure 11 in Dudley et al. 2016b), implying that CPUE for a specific **[one] mesohabitat type** (e.g., one with generally high density) should provide a reasonably valid index of total population size.”

Other Sections-Does the outline work?

[Facts Agreed to (“Settled Science” or What do we know?)]

[“Alternative Facts”]

List the Uncertainties (“Unsettled Science”)

List the Hypotheses Identified from Literature (versus from the Peer Review)

Management Implication(s) [of Hypotheses—Needed?]

Potential Approaches to Test Hypotheses (TMI for EC?)

September 9, 2020

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

Population Monitoring Work Group Program Portal Discussion

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
September 9, 2020
9:00 AM – 12:00 PM

Zoom Information:
https://west-inc.zoom.us/j/8983593120
Call-In: +1-669-900-6833; Meeting ID: 898-359-3120

Meeting Agenda

9:00 – 9:15	**Welcome, Intros, Agenda, Meeting Notes** ➢ **Decision:** Approval of Sept 9, 2020 agenda ➢ **Decision:** Approval of June 2, 2020 minutes Read aheads: ☐ June 2, 2020 PMWG meeting minutes	*PMWG Chair*
9:15 – 10:15	**Program Portal data discussion** • Program Portal Information and Discussion on the way the RGSM Population Monitoring data is being presented on the portal document archive and in the mapper. Read aheads: ☐ Program Portal RGSM Links	*Shay Howlin* *Catherine Murphy*
10:15– 10:25	**Break**	
10:25 – 11:45	**Open Discussion:** **Report to EC on Current Fish Monitoring Program (FMP)** • What are the purpose and objectives of the FMP? • How well does FMP track trend and status of RGSM? • What is current precision and accuracy of RGSM CPUE? • Can FMP detect change in RGSM with management actions? • What are ancillary benefits of data collected by FMP? Read aheads: ☐ None	*Rich Valdez*
11:45 – 12:00	**Wrap-Up** • Announcements • Action Items • Next Meeting	*Rich Valdez*
12:00	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
Meeting Minutes

September 9, 2020; 9:00 AM–12:00 PM
Location: Zoom Meeting

Decisions:

- ✓ Approval of September 9, 2020 PMWG meeting agenda
- ✓ Approval of June 2, 2020 PMWG meeting minutes

Action Items:

Who	What	By When
Catherine Murphy and Rich Valdez	Discuss the executive summary process	9/30/2020
Shay Howlin	Send feedback from the PWMG on the mapper to U.S. Geological Survey (USGS)	9/9/2020
Shay H.	Give an update on the mapper at the next meeting	9/30/2020
Rich V.	Use the outline developed by the PMWG to begin framing the report to the Executive Committee (EC)	9/30/2020
Program Support Team (PST)	Schedule the September 30, 2020 PMWG meeting	9/11/2020
PST	Send out the Archdeacon and Reale paper	9/9/2020

Next Meeting: September 30, 2020; 1:00 – 4:00 PM

Meeting Summary

Welcome, Intros, Agenda, Meeting Notes

Rich Valdez, SWCA Environmental Consultants, opened the meeting. Debbie Lee, PST, introduced everyone in the meeting. The PMWG approved the September 9, 2020 meeting agenda and June 2, 2020 meeting minutes. Rich V. reviewed action items from the previous meeting. The following comments were made:

- Catherine Murphy, PST, and Mike Marcus, Assessment Payers Association of the Middle Rio Grande Conservancy District, were working on revising the Consolidation of Mesohabitats for Monitoring Rio Grande silvery minnow (RGSM) executive summary. The first drafts of the executive summaries have shown that they are tackling too many issues at once. The executive summaries will be broken into smaller, more manageable pieces and handled by the Science and Adaptive Management Committee and Science and Technical Ad Hoc Groups.
    - Rich V. and Catherine M. will discuss the executive summary process before the next meeting.

- Charles Yackulic and Rich V. were working to develop an approach to look at modeling scenarios. Charles Y.'s model will be finalized in the next couple weeks. Rich V. will continue working with him on modeling scenarios.

✓ **Decision**: Approval of September 9, 2020 PMWG meeting agenda
✓ **Decision**: Approval of June 2, 2020 PMWG meeting minutes
➢ **Action Item**: Catherine M. and Rich V. will discuss the executive summary process

Program Portal Data Discussion

Shay Howlin, PST, presented on the Program Portal's functionalities. USGS, currently developing the Portal for the Program, requested input on how the Portal's geospatial mapper displays RGSM population monitoring data. Shay H. walked the PWMG through how the data is being housed on the Portal and opened discussion. The following are the main points from the discussion:

- Are the datasets from American Southwest Ichthyological Researchers, L.L.C. (ASIR) comprehensive?
    - ASIR is likely only sending the current year's monitoring data and it is up to managers to add it to the database.
    - Be cautious when using provisional monthly data, as they tend to include the surveys from multiple months. To avoid redundant data, it is better to use end of the year data.
- How is monthly and annual data segregated?
    - Monthly data is linked to the monthly report. It's stored as a downloadable Excel file in the document archive. The aggregated 1993 – 2019 data has its own data page under Datasets.
        - The PST will request that the date range be added to the data page.
- What is the "RGSM Population Monitoring Repeated" dataset housed on the RGSM Population Monitoring page?
    - These are the repeated November surveys.
    - This should be titled "Occupancy" instead as most people would understand that better.

Shay H. presented the Portal's geospatial mapper. The mapper is currently in development and not live. When you enable the RGSM layer, every dot shown is a survey site. The dots are linked to the aggregated population monitoring data. The PMWG was asked to provide input on how data should be displayed on the mapper. These were the responses:

- Are the orange dots the 20 standard sampling sites?
    - The dots indicate every site that has been sampled since 1993.
- Pop-Up Discussion:
    - What is currently included in the pop-up window when you click a dot?
        - A summary of data parameters from the population monitoring reports, including the number of wild fish, the number of marked fish, and some water quality parameters.
        - A link straight to the datasheet would be more helpful.
    - The information in a pop-up is for one location on a given day.
        - You can use arrows to change between days.
        - It's possible to limit the days shown by a time component.
        - The pop-up does not present days in chronological order, but we could ask for that.

    - It may be useful to include a water quality layer and separate it from the pop-up window.
    - Could you select a specific date range and get a simple graph of absolute numbers by date?
        - USGS can include some graphs. They could use absolute numbers or catch per unit effort (CPUE).
    - It would be helpful to have filter buttons for date range and other parameters you can choose to see in the pop-up.
    - Suggestion for the filter to use different colors to indicate sites for different dates and locations.
    - The first thing you'd want to know when clicking a dot is a general overview of the data in time series from 1993-2019. There should be a data point from every sampling that can be compared, like CPUE. Then, you can focus on a particular point in time, like one year or the same month every year.
        - In past mapping efforts, there's often been a summary analysis that links back to the spreadsheet data.
    - Add more metadata into the pop-up, including the range of years that occurred at the site, the most recent sampling year, a table or two with more detail.
        - Or just a figure that plots numbers out in a time series.
    - There are no filters for the RGSM layer. A filter could include these options.
    - Suggestion to focus on an October graph, as it is the key one for the U.S. Fish and Wildlife Service. For other graphs, users could go back to the dataset.
    - As the website is publically facing, the Program may want to be cautious of what results are shown on a graph.
        - The end-of-the-year data from ASIR is no longer provisional; it has been quality checked and is available to the public.
        - The PMWG agrees to not use provisional data on the mapper.
    - Suggestion to include photos of sites.
        - ASIR does not take set photos of a site.
    - What should the Y-axis be on the graph?
        - CPUE
- Has the mapper been shared with any other group?
    - No, the PST wanted to show it to the technical experts first.
- Program members would need to play with the mapper more to give better feedback.
    - Shay H. will ask USGS when they'll have a draft ready for testing.
- How much use do managers get out maps like these?
    - Some maps get a good amount of use, but it's important to talk to managers and administrators to see how they'd use it. Technical experts would be more likely to access the datasheets.
    - One issue for managers in the past is how long it takes to figure out details for a site. Taking into account adaptive management (AM), managers would like to know if an AM action is making a difference or not. It would be useful to know where the restoration projects are, what the flow components were in a given year, etc. This would help create a story about what is being done for adaptive management.
        - EC members likely won't use the mapper, but some managers would.
- Suggestion to make the dots for the 20 standard stations from the population monitoring program a different color and slightly larger.
- What's the general direction for the mapper from here?

- Shay H. will send notes from the PMWG meeting to USGS.
- The final form of the mapper should be out by the end of the year.
- Shay H. will present an update on the mapper at the next meeting.

- **Action Item**: Shay H. will send feedback from the PWMG on the mapper to USGS
- **Action Item**: Shay H. will give an update on the mapper at the next PMWG meeting

Open Discussion

Rich V. opened discussion on the report to the Executive Committee (EC) on the current fish monitoring program (FMP). The PMWG was charged with three principle tasks. Task 2 is reviewing the Middle Rio Grande FMP. The PMWG will present a report to the EC on task 2 before it sunsets. The PMWG was asked to give feedback to guide how the report is written. These were the five questions discussed by the group:

- What are the purpose and objectives of the FMP?
- How well does FMP track trend and status of RGSM?
- What is current precision and accuracy of RGSM CPUE?
- Can FMP detect change in RGSM with management actions?
- What are ancillary benefits of data collected by FMP?

Rich V. produced an outline from the discussion and will use it to start framing the report.

- **Action Item**: Use the outline developed by the PMWG to begin framing the report to the Executive Committee (EC)

Wrap-Up

- The next meeting is scheduled for September 30, 2020 from 1:00 – 4:00 PM.
- Thomas Archdeacon announced the publication of three recent papers he co-authored. Two were sent out by the PST. The third will be sent out as soon as possible.
- Lynette Giesen, U.S. Army Corps of Engineers (USACE), announced that her funding for involvement with the Program was cut to zero. Starting October 1st, USACE will not be involved with the Program outside of the EC.

- **Action Item**: The PST will schedule the September 30, 2020 PMWG meeting
- **Action Item**: The PST will send out the Archdeacon and Reale paper

Participants

Andy Dean	U.S. Fish and Wildlife Service
Anne Marken	Middle Rio Grande Conservancy District
Aubrey Harris	U.S. Army Corps of Engineers
Catherine Murphy	Program Support Team
Charles Yackulic	U.S. Geological Survey
Debbie Lee	Program Support Team
Eric Gonzalez	U.S. Bureau of Reclamation
Grace Haggerty	New Mexico Interstate Stream Commission
Lynette Giesen	U.S. Army Corps of Engineers
Michelle Tuineau	Program Support Team
Mick Porter	U.S. Army Corps of Engineers
Mike Marcus	Assessment Payers Association of the Middle Rio Grande Conservancy District
Mo Hobbs	Albuquerque Bernalillo County Water Utility Authority
Rich Valdez	SWCA Environmental Consultants
Shay Howlin	Program Support Team
Thomas Archdeacon	U.S. Fish and Wildlife Service
Trevor Birt	New Mexico Interstate Stream Commission

Population Monitoring Work Group (PMWG)
September 9, 2020

Program Portal Discussion

The purpose of this discussion is to review the tentative plans for presenting the RGSM Population Monitoring data on the Program Portal. There are currently three locations the data are presented, each described below.

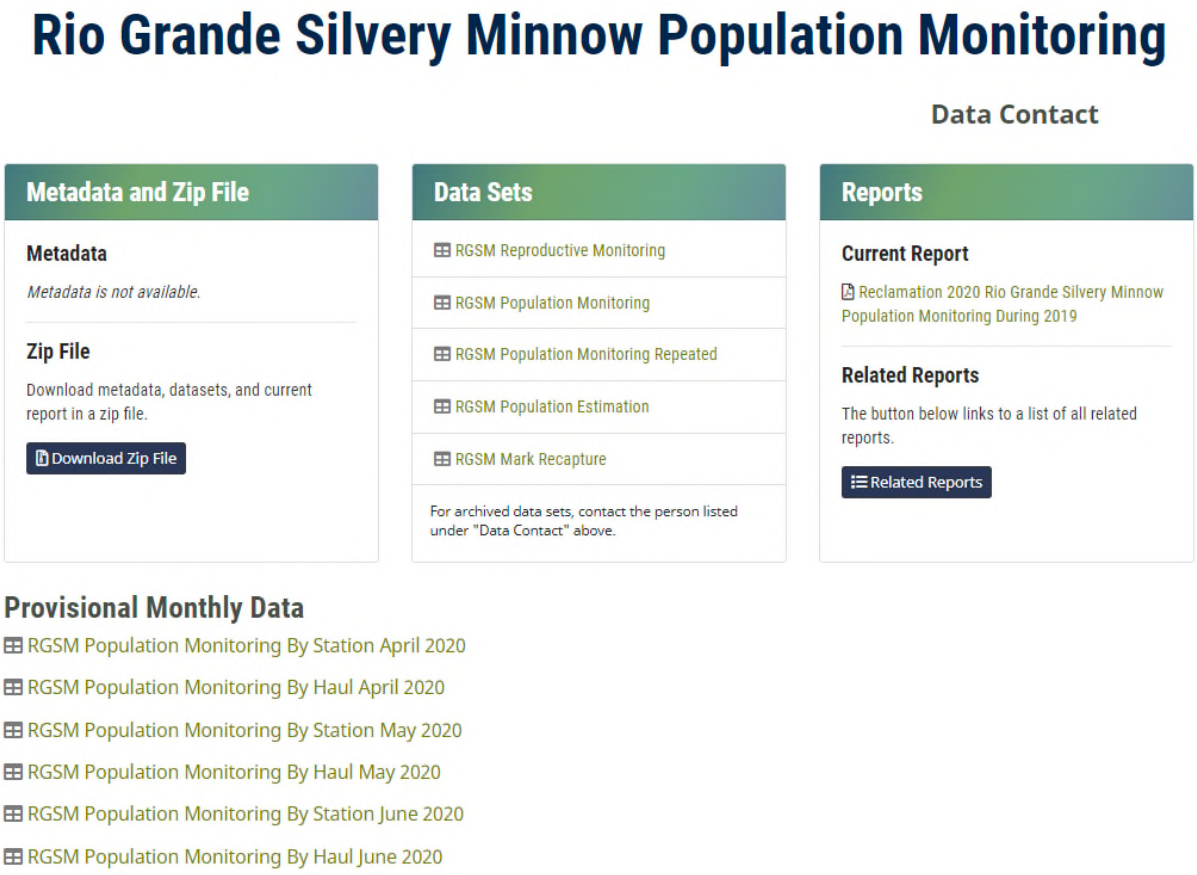
I. Document Archive: Monthly ASIR Report and Provisional Data

- Program office posts monthly and sends an email and link
- 2 xlsx files: by haul and by station
- Example: https://webapps.usgs.gov/MRGESCP/documents/rio-grande-silvery-minnow-population-monitoring-during-june-2020



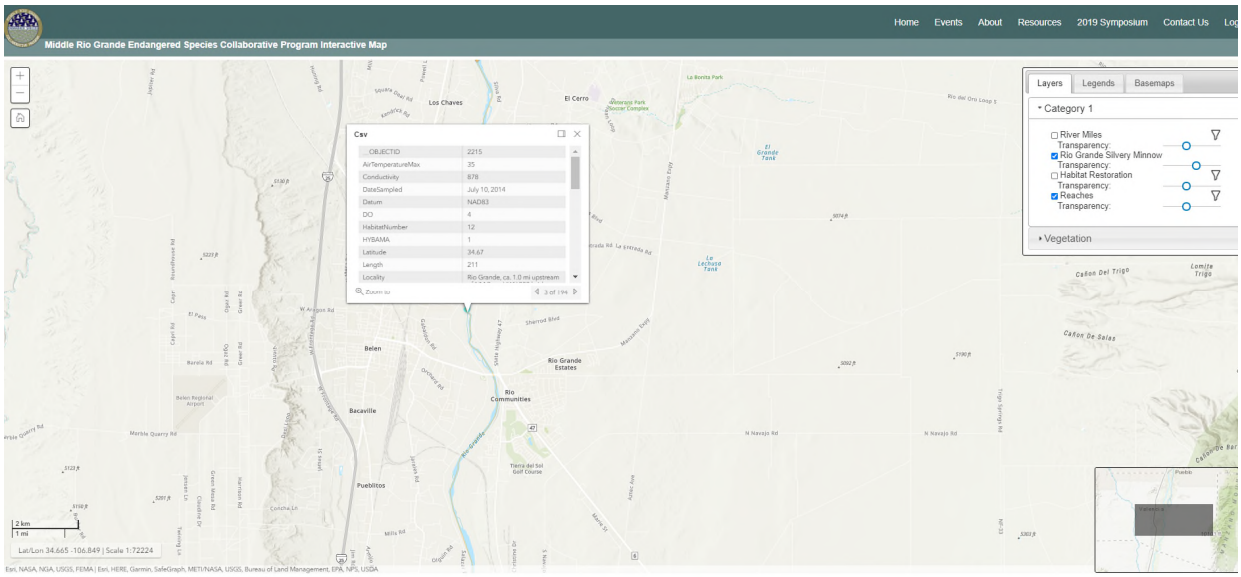
II. **Resources: Datasets Page**

- Accumulated Final Data in Analysis Format
- Links to Monthly Document Archive pages
- 1993 to prior year data in “analysis ready” format
- Posted annually in May
- https://webapps.usgs.gov/MRGESCP/data/rio-grande-silvery-minnow-population-monitoring



III. Mapper: Spatial Representation of the RGSM Population Monitoring Data

- Visual Display with a clickable point for each sample location
- Text box shows data at that point
- What data should be visible?



Example Pop-up

RGSM Population Monitoring Data

Rio Grande, ca. 10.0 mi downstream of San Marcial Railroad bridge crossing, San Marcial.

Site ID: 24 **Reach:** San Acacia
Date: 4/1/2019 **Time:** 10:25 - 11:10
River Miles Start: 58.6 **River Miles Stop:** 58.5

Silvery Minnow Data

UNMARKED HYBAMA Age	Caught
Zero	0
One	2
Two	0
No Age	0

VIE PRESENT
 # Caught 1
Color: Yellow
Location: Dorsal fin
Seine Length: 211

TOTAL HYBAMA CAUGHT: 3

Water-Quality Data

Air Temperature, Max:	11	Salinity:	0.18
Conductivity:	275.9	Secchi Depth:	2
DO:	9.25	Specific Conductance:	377.9
pH:	7.49	Water Temperature, Max:	10.9

September 30, 2020

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

Approval of 1st Task for Review of the Collaborative Program Fish Monitoring Program for the Rio Grande Silvery Minnow: A Proposal for a Catch Per Unit Effort Metrics and Methodologies Workshop

Draft Review of Middle Rio Grande Fish Population Monitoring Plan [draft, not included]

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
September 30, 2020
1:00 PM – 4:00 PM

Zoom Information:
https://west-inc.zoom.us/j/8983593120
Call-In: +1-669-900-6833; Meeting ID: 898-359-3120

Meeting Agenda--Revised

1:00 – 1:15	**Welcome, Intros, Agenda, Meeting Notes** ➢ **Decision:** Approval of September 30, 2020 meeting agenda ➢ **Decision:** Approval of September 9, 2020 meeting minutes Read aheads: ☐ September 9, 2020 PMWG meeting minutes	*PMWG Chair*
1:15 – 1:45	**Program Portal data update** Program Portal information update on how the Rio Grande silvery minnow (RGSM) Population Monitoring data is presented on the portal document archive and in the mapper.	*Shay Howlin*
1:45 – 2:15	**Update on Integrated Model** • Flow Scenarios • Other Questions for Model	*Charles Yackulic*
2:15 – 2:30	**Break**	
2:30 – 3:45	**Report to EC on Current Fish Monitoring Program (FMP) Task 2 Objectives – Open Discussion:** • Primary Goals and Tasks • Evaluate and Refine Sampling Design • Evaluate and Refine Sampling Methods • Evaluate and Refine Data Collection Protocols • Evaluate and Refine Data Analyses • Identify Other Data Needs for Concurrent Sampling • Evaluate How Modeling May Assist in Refining Monitoring Read aheads: ☐ EC Approval of Workgroup and CPUE Workshop ☐ PMWG Task 2 Report-Draft 1.0	*PMWG Chair*
3:45 – 4:00	**Wrap-Up** • Announcements • Action Items • Next Meeting	*PMWG Chair*
4:00	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Population Monitoring Work Group (PMWG)
Meeting Minutes

September 30, 2020; 1:00 PM–4:00 PM
Location: Zoom Meeting

Decisions:

- ✓ Approval of September 30, 2020 PMWG meeting agenda
- ✓ Approval of September 9, 2020 PMWG meeting minutes

Action Items:

Who	What	By When
Program Support Team (PST)	Schedule the October 22, 2020 PMWG meeting	10/1/2020
PST	Schedule Flow Scenarios Small Group meeting for October 7, 2020, with the following participants: • Mo Hobbs, Albuquerque Bernalillo County Water Utility Authority • Joel Lusk, U.S. Bureau of Reclamation • Charles Yackulic, U.S. Geological Survey • Stephen Zipper, SWCA Environmental Consultants • Mick Porter (if funding is available), U.S. Army Corps of Engineers	10/1/2020
Debbie Lee	Send table with recommendations from the science panels to Mike Marcus and Mo H.	10/2/2020
Mick P.	Send Charles Y. the draft environmental flow analysis report	10/5/2020
Mike M.	Summarize Task 1 objectives with a table and connect Task 1 and 2	10/22/2020
Mo H. and Mike M.	Document progress made on recommendations from the science panels	10/22/2020
Rich Valdez	Begin writing the executive summary and introduction sections for the report to the Executive Committee	10/22/2020
Eric Gonzales	Share information about the Utah State University (USU) model workshop with the PMWG	10/22/2020

Next Meeting: October 22, 2020; 1:00 – 4:00 PM

Meeting Summary

Welcome, Intros, Agenda, Meeting Notes

PMWG Chair Rich V., SWCA Environmental Consultants, opened the meeting and Debbie L., PST, introduced the meeting attendees. Rich V. reviewed the September 30th agenda, September 9th minutes, and September 9th action items. The following comments were made:

- Following up on a previous action item, Catherine Murphy, PST, and Rich V. discussed the executive summaries. They agreed that the executive summaries needed to be reviewed further. The review process is still being developed.
    - One executive summary from Rich V. was reviewed by PMWG members and the PST. It will continue to be reviewed.
    - The other executive summaries have topics that are too large. They will be handed to the Science and Adaptive Management Committee (SAMC) to be broken down into smaller, more manageable research topics. The SAMC will reinitiate the executive summary process with appropriately scaled questions.

- ✓ **Decision**: Approval of September 30, 2020 PMWG meeting agenda
- ✓ **Decision**: Approval of September 9, 2020 PMWG meeting minutes

Program Portal Data Update

Shay Howlin, PST, gave an update on the Program Portal geospatial mapper. These are the main points from the update and following discussion:

- Shay H. sent a summary of PMWG suggestions for the Portal mapper to U.S. Geological Survey (USGS). Shay H. also met with USGS to discuss the mapper.
- USGS split the suggestions into three categories: things they can do under the current scope and budget, things they need more information about, and things they cannot do under the current scope and budget.
    - Can do:
        - Build in filters to narrow down what data appears in a pop-up.
            - For example, users will be able to filter for data from July 2017 to present.
        - Make a separate map layer for water quality and include filters.
        - Change the size and color of symbols for the 20 main monitoring sites.
        - Provide a version of the mappers that users can give feedback on, hopefully in a month or two.
    - Need more information:
        - Adding in trend figures.
            - USGS may need to move the figures to a dashboard if users want the ability to compare two sites.
            - USGS wants to know the big picture on the potential use of the mapper before creating the figures. USGS wants the larger intent of the mapper to inform design of the figures.
            - The figures will wait until after the initial mapper is out.
        - Filtering before exporting data.

- Although USGS can implement most of the suggestions, USACE will not be funding the Portal after January. The Program cannot plan for additional development at this time.
- Are there any particular questions USGS wants the PMWG to answer?
    - USGS will need opinions from the mapper's likely user base. They want to discuss the scope of the mapper with members of the PMWG.
        - This conversation will likely wait until next year. First, USGS needs to complete development of a functional mapper.
- Members of the PMWG are encouraged to use the Program Portal to find potential bugs or identify new functions they would like to see.
- If users notice any errors on the Portal, please email Michelle Tuineau, PST.

Update on Integrated Model
Flow Scenarios
Other Questions for Model

Charles Y. gave an update on the integrated model and opened discussion on flow scenarios. These are main points from the discussion:

- The model has been presented to the PMWG a few times already.
- A few loose ends need to be tied up before the structure is finalized.
    - That includes looking at different approaches for habitat availability, expanding the model to include additional age classes, testing whether the model can incorporate relationships from Colleen Caldwell's work, and considering how to incorporate salvage data.
- Flow scenarios:
    - The flow scenarios tie into work by USU. The USU model is being designed to allow users to run various flow scenarios and assess the estimated outcomes.
    - Charles Y. is interested in having people think like water managers instead of looking immediately at the data.
        - Think about how different biologists would shape a fixed amount of water available in the spring. Consider how that would change if there was double that amount of water.
        - The different hydrograph shapes would represent various flow scenarios.
        - This exercise will identify where there is disagreement over how to manage water.
            - If there is disagreement, the model may offer a path forward for determining which approaches are most beneficial.
        - This goal of the model is to inform managers working in the system.
    - Is it possible to model how alternative management actions play out in the future based on possible climate and flow conditions?
        - Yes, that relies on how much we know about future hydrology. If there is a sense of future water availability and possible choices managers might make, this can be done.
        - The more difficult task is thinking of the two or three different ways managers would manage the water.
    - Would it be helpful for PMWG members to look at an annual hydrograph, real or manipulated, and come up with the best ways to distribute water that year?

        - It would be better to first focus on moving a fixed amount water within a season, and then consider how to move water between seasons.
    - Do we first need to determine how much water is needed to produce Rio Grande silvery minnow (RGSM)?
        - Instead, we could model scenarios with different volumes of water, such as the amounts available in 2019, 2018, 2015, and 2012. At these different volumes of water, determine the management options.
        - Find out if everyone agrees on what aspects of the hydrograph (e.g., timing, magnitude, duration, rates of rising and falling limbs) to focus on. Determine what people optimize to benefit RGSM. The key is to find contrasts in management decisions.
    - Joel L. suggests a scenario of flooding 15,000 acres of habitat at the right depth and velocity within season to create RGSM nursery conditions. He posits that management is less about water and more about soil movement and soil interaction with the riverscape.
        - Joel would like to model this scenario to determine the level of response that would be detectable with the current (or a more precise) monitoring program. This would help managers determine what to monitor to find out if there was a landscape-level effect on a population.
    - What is the best way to provide scenarios to Charles Y.?
        - Suggestion to form a small group to formulate a plan for eliciting responses.
            - The group may want to create a spreadsheet with a couple different scenarios and ask people to reshape a hydrograph as they see fit.
            - Note the differences between responses and determine how to quantify those differences.
            - Mo H., Joel L., Charles Y., Stephen Z., and Mick P. (if funding is available) volunteer to be on the Flow Scenarios Ad Hoc Group.
            - The meeting is set for October 7, 2020 from 2:00 PM to 3:30 PM.
        - Mick P. has finished a rough draft of a paper analyzing the effect of environmental flow on RGSM recruitment.
    - Consider what other questions you would want a model to answer outside of hydrology (e.g., how much augmentation affects population).

- **Action Item**: The PST will schedule a Flow Scenarios Small Group meeting for October 7, 2020, with the following participants:
    - Mo Hobbs, Albuquerque Bernalillo County Water Utility Authority
    - Joel Lusk, U.S. Bureau of Reclamation
    - Charles Yackulic, U.S. Geological Survey
    - Stephen Zipper, SWCA Environmental Consultants
    - Mick Porter (if funding is available), U.S. Army Corps of Engineers
- **Action Item**: Mick Porter will send Charles Yackulic the draft environmental flow analysis report

Report to EC on Current Fish Monitoring Program (FMP)
Task 2 Objectives – Open Discussion:
Primary Goals and Tasks
Evaluate and Refine Sampling Design
Evaluate and Refine Sampling Methods
Evaluate and Refine Data Collection Protocols

Evaluate and Refine Data Analyses
Identify Other Data Needs for Concurrent Sampling
Evaluate How Modeling May Assist in Refining Monitoring

Rich V. opened discussion on the FMP report to the EC. Rich V. prepared a document to guide the discussion around the six objectives included on the EC report. The group continued to fill out an outline for the report. The following are some of the points made during the discussion:

- The six objectives in the outline were taken from Task 2 of "Approval of 1st Task for Review of the Collaborative Program Fish Monitoring Program for the RGSM: A Proposal for a CPUE Metrics and Methodologies Workshop."
    - The document is 8 years old, and there may be issues with using it to guide a report today, especially with the Program moving towards adaptive management and the SAMC. We do not know what direction the SAMC will take with PMWG's work.
        - We do not want to change the objectives but may need to refine and update them with what we know now.
- Is there any information on the USU model?
    - A workshop on the USU model is planned for early next year. The purpose of the workshop is to explain the model and provide source code, so others can use it to model hydrologic scenarios.
    - Eric G., U.S. Bureau of Reclamation, will get more information about the USU model and workshop and share it with the PMWG.
- It may be useful to include a table with the objectives from Task 1, as it relates to Task 2.
    - Mike M., Assessment Payers Association of the Middle Rio Grande Conservancy District, will summarize Task 1 objectives with a table and connect Task 1 and 2.
- The report should include a summary of the recommendations from the science panels in Task 1 and the progress made on each since.
    - Mo H. and Mike M. will document progress made on recommendations from the science panels.
    - Ashley Tanner, former Deputy Science Coordinator on the PST, previously compiled a list of recommendations from the science panels with the progress of each. Debbie Lee will send that list to Mo H. and Mike M.
- Rich V. will begin writing the report's executive summary and introduction based on the outline.
- When should the report reach the EC?
    - The final EC meeting of the year is on December 17th.
    - The report may not be completed by that time.
    - The work of PMWG will carry on through the SAMC. The SAMC will break down large tasks into smaller, more manageable tasks and assign them to Science and Technical Ad Hoc Groups.

- **Action Item**: Eric Gonzales will get more information about the USU model and workshop and share it with the PMWG
- **Action Item**: Mike Marcus will summarize Task 1 objectives with a table and connect Tasks 1 and 2
- **Action Item**: Mo Hobbs and Mike Marcus will document progress made on recommendations from the science panels

- **Action Item**: Debbie Lee will send table with recommendations from the science panels to Mike Marcus and Mo Hobbs
- **Action Item**: Rich Valdez will be begin writing the executive summary and introduction sections for the report to the EC

Wrap-Up

- At the next meeting, the PWMG will finish discussion on temporal sample design and engage in discussion on spatial sample design.
- The next meeting is tentatively scheduled for October 22nd from 1-4 PM.

- **Action Item**: The PST will schedule the October 22, 2020 PMWG meeting

Participants

Andy Dean	U.S. Fish and Wildlife Service
Catherine Murphy	Program Support Team
Charles Yackulic	U.S. Geological Survey
Debbie Lee	Program Support Team
Eric Gonzalez	U.S. Bureau of Reclamation
Grace Haggerty	New Mexico Interstate Stream Commission
Joel Lusk	U.S. Bureau of Reclamation
Lynette Giesen	U.S. Army Corps of Engineers
Michelle Tuineau	Program Support Team
Mick Porter	U.S. Army Corps of Engineers
Mike Marcus	Assessment Payers Association of the Middle Rio Grande Conservancy District
Mo Hobbs	Albuquerque Bernalillo County Water Utility Authority
Rich Valdez	SWCA Environmental Consultants
Shay Howlin	Program Support Team
Stephen Zipper	SWCA Environmental Consultants
Thomas Archdeacon	U.S. Fish and Wildlife Service

Attachment 3

Approval of the 1st Task for Review of the Collaborative Program Fish Monitoring Program for the Rio Grande Silvery Minnow

A Proposal for a CPUE Metrics and Methodologies Workshop

Submitted to
The Executive Committee of the
Middle Rio Grande Endangered Species Collaborative Program

July 13, 2012

Executive Committee Action Requested:

- Approval to Conduct a Workshop on Catch-per-Unit-Effort (CPUE) Methodology used by the Current Rio Grande Silvery Minnow Population Monitoring Program (i.e., Task 1, see Appendix A).

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Introduction

Background

This document was developed by the RGSM Population Monitoring workshop organizers at the request of the Executive Committee (EC) of the Middle Rio Grande Endangered Species Collaborative Program. The document outlines a proposed approach for evaluating and updating the fish monitoring plan for the Middle Rio Grande, New Mexico. This proposed approach helps to address issues identified in a scientific review of the Rio Grande silvery minnow (RGSM) population monitoring program and by the U.S. Fish and Wildlife Service (Service) in a letter dated March 23, 2012. The Service's letter recommended, as a step toward resolution, that the EC host a facilitated science workshop to discuss outstanding issues over the use of catch-per-unit-effort (CPUE) for monitoring the RGSM. Task 1 of this proposed approach addresses the Service's recommendation as part of a broader effort to develop a fish monitoring plan.

Primary Goal

The primary goal of this proposed approach is to evaluate and update the fish monitoring plan for the Middle Rio Grande. The focus of this plan shall be on the endangered Rio Grande silvery minnow, along with the identification and development of population demographic parameters that will best meet the needs of the Collaborative Program and the Recovery Implementation Program (RIP). The EC of the Collaborative Program has expressed the need to reliably measure the effects of Middle Rio Grande water management actions and conservation measures on the RGSM, and the Service seeks to determine the best population demographic parameter(s) for gauging species recovery and for measuring sufficient progress for the RIP. The proposed approach is intended to resolve how the RGSM population monitoring program can provide a reliable, precise, and accurate measure of the status and trend of the species for these purposes and that is also reasonably attainable (i.e., reasonable expenditure).

Proposed Approach

The workshop organizers believe that three major steps are needed to achieve the stated goal:

- Task 1 focuses on addressing technical questions concerning use of CPUE in the current RGSM monitoring program (see detailed write-up of Task 1 in Appendix A). This task should be approved and implemented as soon as possible to provide sufficient time to identify and invite qualified scientists to participate in the workshop process and to plan and organize the workshop.
- Task 2 is a review of the current monitoring program including temporal and spatial aspects of sampling design, data collection protocols, and data analyses.
- Task 3 is the development of a formal Fish Monitoring Plan with details of sampling design (e.g., number and location of samples, frequency of sampling, gear types, etc.), data collection protocols (e.g., data to be collected, manner of storage, etc.), and analytical methods (e.g., CPUE computation, relationship of CPUE to population estimates, use in PVA models, etc.).

Overview of current fish population monitoring

The fishes of the Rio Grande between Velarde and Elephant Butte Reservoir and their habitat associations were first reported in 1987 (Platania 1993). Monitoring of the fish population with catch-per-unit-effort (CPUE) and specifically the endangered Rio Grande silvery minnow began in 1993 and has been carried out annually except for 1989 (e.g., Dudley and Platania 2011). The current monitoring program continues to provide annual, as well as more or less monthly, CPUE estimates for each of three reaches of the Middle Rio Grande:the Angostura, Isleta, and San Acacia reaches. Sampling has generally been conducted at 15-20 sites for up to 10 months in a year. Fish are taken with multiple seine hauls at a given sample site, and CPUE is computed for each species at each sample site as the pool of seine hauls expressed as the number of individuals per 100 m^2 (surface area) of water seined.

Outline of Actions by Task

The following is an outline of the three major tasks of this proposed approach with objectives and actions identified for each.

1. **Task 1. Conduct a Workshop on Catch-per-Unit-Effort (CPUE) Methodology used by the Current Rio Grande Silvery Minnow (RGSM) Population Monitoring Program (see Appendix A for details)**

Objectives:

- Evaluate statistical properties and interpretations of the current RGSM monitoring program, including precision and accuracy of CPUE.
- Discuss, evaluate, and reconcile areas of concern/disagreement over CPUE.
- Discuss and evaluate population estimation for RGSM and compare and correlate with CPUE,
- Identify and evaluate other methods for monitoring the RGSM, including methods used in other river systems.
- Identify, discuss, and reconcile uses of CPUE for RGSM, including demographic recovery criteria, sufficient progress metrics, and inputs and parameter estimates for Population Viability Analysis.

Actions:

- Retain two or three external scientists with expertise in CPUE, fish sampling design for small-bodied fishes, and other methodologies to participate in data examination, workshop presentation/interaction, and assist in preparing workshop report.
- Distribute and provide for independent examination, the existing monitoring data (and available population estimation data) to evaluate existing and potential precision and levels of detectable change in abundance of RGSM.
- Conduct a 3-day workshop that includes an introduction session with EC members (2-3 hr) followed by technical presentations, discussion, and draft report preparation.
- Prepare and present a report of the CPUE Workshop to the EC (report to be prepared jointly by workshop organizers and external scientists).

2. Task 2. Review Middle Rio Grande Fish Population Monitoring Plan

Objectives:

- Evaluate and refine sampling design, including statistical properties of spatial aspects (longitudinal locations of sample sites, habitats in which samples are taken) and temporal aspects (frequency of sampling, times of year when samples are taken).
- Evaluate and refine sampling methods, including gear types, sampling strategies, etc.
- Evaluate and refine data collection protocols, including types of data collected, recording methods, quality control, electronic storage, and data custody.
- Evaluate and refine data analyses.
- Identify other data needs for concurrent sampling during fish monitoring to support other studies (e.g., augmentation, fish movement, drying, genetics, adaptive management) as part of a programmatic monitoring program
- Evaluate how PVA may assist in refining monitoring.

Actions:

- Retain two or three external scientists with expertise in sampling design to participate in the workshop, evaluate and revise the fish monitoring plan, and prepare the workshop report.
- Conduct workshops and work sessions that address elements necessary for long-term fish population monitoring program development, including what other monitoring is needed that can be performed in conjunction with fish monitoring. Prepare and present a report to the EC as guidance to update the Fish Monitoring Plan for the Middle Rio Grande.

3. Task 3. Update the Collaborative Program Middle Rio Grande Fish Monitoring Plan

Objectives:

- Update the current Fish Monitoring Plan with revisions that may include sampling design, data collection, quality control, storage, and custody; cost estimates; and responsibilities.
- Define the metrics of interest for the initial phase of the Monitoring Plan (3 yrs), define how they will be calculated from the monitoring data, and document data precision and accuracy for the desired performance (such as precision and correlation with some "ground truth").
- Implement the updated Fish Monitoring Plan for a 3-year period for evaluation and refinement.
- Ensure that the needs of the Collaborative Program and the RIP are met with a monitoring program for RGSM sufficiently sensitive to:
  a. Detect changes in RGSM abundance with management actions;
  b. Provide reliable demographic recovery criteria for RGSM; and
  c. Provide reliable metrics for sufficient progress for the RIP.
  d. Utilize past data and analyses to be comparable to any proposed changes

Actions:

- Integrate the findings of Tasks 1 and 2 and update the Fish Monitoring Plan with emphasis on the RGSM.

  Implement and evaluate the Fish Monitoring Plan for meeting needs of the EC and the Service for monitoring species response(s) to management actions; demographic recovery criteria; and sufficient progress metrics.

Anticipated Time Schedule

An anticipated time schedule for this proposed approach is provided in Table 1. The following summarizes the schedule for each task and action.

Task 1: CPUE Workshop

- EC approval of Task 1 in July, 2012.
- Contract 2 or 3 external scientists that have the ability and time to participate in CPUE workshop.
- Independent data examination by external scientists and by Collaborative Program scientists to start as soon as data can be provided (the Program does not have the Population Estimation data at present, and some details are still missing from the Population Monitoring data). A reasonable period of time for this analysis is 3 months (Aug-Oct; given possible time conflicts of scientists and actual data analysis).
- Distribute pertinent existing reports concerning the population monitoring to all anticipated workshop participants at the same time that the data are made available.
- 3-day workshop by end of October 2012.
- Report to EC by December 2012.

Task 2: Review Monitoring Program

- Evaluate and refine aspects of fish monitoring program; workshops may be scheduled in January and February of 2013.

Task 3: Update the current Fish Monitoring Plan

- An updated draft RGSM Population Monitoring Plan will be vetted through the federal agencies and RIP so that it can be funded and implemented in FY2014.
- It is assumed that the current monitoring program will continue until a new or revised program is implemented, evaluated, and refined.

Table 1. Proposed time schedule for revision of the Fish Monitoring Plan.

Tasks	2012						2013					
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1. CPUE Workshop												
• EC Approval	X											
• Contract Scientists		X										
• Data Examination		X	X	X								
• 3-Day Workshop				X								
• Report to EC					X	X						
2. Evaluate Monitoring						X	X	X				
3.Update Plan								X	X	X	X	X

Estimated Costs

- The costs for Task 1 are estimated at $30,000 of federal funding (USFWS and Reclamation/CP) with cost share contributions from nonfederal signatories anticipated. The majority of this cost ($20-25,000) is for contracting external scientists' time and per diem. The costs for participation by the Collaborative Program participants or their contractors are not factored into this estimate.
- The costs of Tasks 2 and 3 are undetermined at this time. Each workshop for Task 2 is estimated to cost about the same as for Task 1 ($30,000).

Workshop Organizers

The CPUE Metrics and Methodologies workshop planners include:

- Rick Billings, Albuquerque-Bernalillo County Water Utility Authority
- Jim Brooks, U.S. Fish and Wildlife Service
- Michael Porter, U.S. Army Corps of Engineers
- Grace Haggerty, New Mexico Interstate Stream Commission
- Daniel Goodman, Montana State University
- Richard Valdez, SWCA
- Jason Remshardt, U.S. Fish and Wildlife Service

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Appendix A: Task 1 Description.

Task 1. Conduct a Workshop on Catch-per-Unit-Effort (CPUE) Methodology used in the Current Rio Grande Silvery Minnow (RGSM) Population Monitoring Program

This task is intended to explore and reconcile issues and concerns with using CPUE to monitor the RGSM. This task will accomplish the first necessary step in developing a better understanding of the current methodologies used to monitor the species and ways to improve and refine the monitoring program. This task will also begin to establish better communications among the scientists, managers, and the EC over the meaning and use of monitoring information. The workshop will also review methodologies for monitoring used in other river systems, as well as analytical methods that may help to improve a fish monitoring program for the Middle Rio Grande.

Objectives:

- Evaluate statistical properties and interpretations of the current RGSM monitoring program, including precision and accuracy of CPUE.
- Discuss, evaluate, and reconcile areas of concern/disagreement over CPUE.
- Discuss and evaluate population estimation for RGSM and compare and correlate with CPUE, with available population estimation data.
- Identify and evaluate other methods for monitoring the RGSM, including methods used in other river systems.
- Identify, discuss, and reconcile uses for CPUE, including recovery demographic criteria, sufficient progress metrics, and inputs and parameter estimates for Population Viability Analysis.

Actions:

- Retain 2-3 external scientists with expertise in CPUE, fish sampling design for small-bodied fishes, and other methodologies to participate in data examination, workshop presentation/interaction, and assist in preparing workshop report.
- Distribute and provide for independent examination, existing pertinent reports and the existing monitoring data (and available population estimation data_) to evaluate existing and potential precision and levels of detectable change in abundance of RGSM.
- Conduct a 3-day workshop, with EC members participating in a 2-hour introduction followed by technical presentations, discussion, and report preparation.
- Prepare and present a report of the CPUE Workshop to the EC (report to be prepared jointly by workshop organizers and external scientists).

Proposed Structure and Process:

- Workshop tentatively scheduled for 3 days in the last week of October, 2012. Draft agenda for the workshop (to be refined with the assistance of the external scientists) is:
    - Day 1—Morning: Presentation to EC of background, workshop objectives and EC/scientists dialogue/questions/comments.

- Day 1—Afternoon: Technical presentations and discussions on RGSM current monitoring.
- Day 2—Morning: Continuation of presentations and discussion of other methods used, data analyses, etc (to be further defined).
- Day 2—Afternoon: Discussion session (facilitated).
- Day 3—Morning: Technical presentations and discussion on demographic metrics for sufficient progress and recovery milestones (facilitated).
- Day 3—Afternoon: Report preparation by Participating Scientists.

- This workshop will involve a detailed evaluation of CPUE collection and analysis methodologies. It is recommended that primary attendees are scientists familiar with fish population monitoring in the MRG and that participating scientists are well prepared. A list of scientists will be developed jointly by the workshop organizers and the EC; that list will be used to form the discussion groups and to write the Workshop Report. A list of technical participants will be distributed to the EC for approval prior to the workshop. A cross section of knowledgeable scientists from the diverse agencies/entities is encouraged.
- Other attendees may participate as observers and be allowed to provide comments or questions only during specified comment/question periods, most likely at the end of each presentation and discussion session. This is done to ensure that the workshop stays on schedule with technical issues. However, this is a public meeting.
- Two to three scientists not currently involved in the Collaborative Program and with expertise in sampling methodologies/statistical analysis/CPUE monitoring for small-bodied river fishes will be contracted to participate in data examination, workshop participation, and report preparation. Availability will most likely be a determining factor in who is contracted. Prior to contracting with these individuals, their names and CVs will be provided to the EC members for approval.
- The contracted external scientists are not considered to be a science panel or peer reviewers but will participate as other scientists do in the workshop and will assist in drafting the Workshop Report on the last day of the meeting and following the workshop.
- A facilitator will be used to lead the workshop. The facilitator shall be experienced at leading technical workshops. One or two additional assistants may be requested to help with workshop materials, monitor and record discussion sessions, etc. The facilitator's contract may be with any of the EC members and the facilitator's name and CV will be provided to the EC for approval at the same time the information is provided to external scientists.
- The workshop organizers will remain in place to assist in selection and contracting the external scientists, setting up the workshop, and finalizing the Workshop Report. Technical editing and technical and administrative assistance will be provided by the Collaborative Program PMT and EC contributions.

Products/Outcomes:

- Workshop Report written by the workshop organizers and the external scientists to include:
  - Summary of CPUE issues as used in the MRG.

  - Effectiveness of current program and CPUE to address Collaborative Program and RIP needs.
  - Recommendation to the EC on continued use and refinement of CPUE.
  - Other uses for CPUE (e.g., survival, recruitment).
  - Recommendation to the EC for additional sampling methods for monitoring the RGSM.
  - Provision for minority reports to document alternative views or opinions on content of report.
- Electronic and hard copies of workshop proceedings and presentations.
- Summary of discussion group dialogue.
- Proposed outline to help guide Tasks 2 and 3.

Appendix B: Suggested External Scientists (Preliminary)

The following are recommended scientists and a list of their qualifications who are not directly involved with the Collaborative Program and who could provide an objective evaluation of the RGSM monitoring program and data:

- Dr. Wayne Hubert (retired)
  - Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, WY
  - Lead author: Relative Abundance and Catch-per-Unit-Effort, Chapter 7 *in* Analysis and Interpretation of Freshwater Fisheries Data
- Dr. Ron Ryel
  - Department of Forest, Range, and Wildlife Sciences, Utah State University, Logan, UT
  - Teaches classes in Inventory, Monitoring and Assessment
- Dr. Brett Johnson
  - Associate Professor, Colorado State University, Ft. Collins, CO
  - Co-author: Predator-Prey Interactions, Chapter 16 *in* Analysis and Interpretation of Freshwater Fisheries Data
- Dr. Carl Walters
  - University of British Columbia, Vancouver, BC
- Dr. Josh Korman
  - Ecometrics, Vancouver, BC
- Dr. William Pine
  - University of Florida, Gainesville, FL
- Dr. Lewis Coggins
  - NOAA's Southeast Fisheries Science Center, National Marine Fisheries Service, Beaufort, NC
- Dr. Ray Hilborn
  - School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA
- Dr. Mike C. Runge
  - US Geological Survey Patuxent Wildlife Research Center, Laurel, MD

Scientists will provide curriculum vitae to the Collaborative Program and the EC as part of the selection process for participating in the CPUE workshop.

Mary Fabrizio
Phaedra Budy
David Gale

SCIENCE AND HABITAT RESTORATION WORK GROUP MEETINGS

October 17, 2019

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

- *U.S. Army Corps of Engineers Adaptive Management Workshop - Team Conceptual Ecological Models*
- *Bibliography of Southwestern Willow Flycatcher Literature*
- *Bibliography of Yellow-Billed Cuckoo Literature*
- *Caplan Rio Grande Silvery Minnow Conceptual Models*
- *Middle Rio Grande Endangered Species Collaborative Program: Adaptive Management Plan Version 1 Conceptual Model for the Rio Grande Silvery Minnow*
- *Middle Rio Grande Endangered Species Collaborative Program: Adaptive Management Plan Version 1 Conceptual Model for the Southwestern Willow Flycatcher*
- *Rio Grande Silvery Minnow Conceptual Models [presentation]*
- *Southwestern Willow Flycatcher Basic Conceptual Ecological Model for the Lower Colorado River*
- *Technical Report Appendix F: Southwestern Willow Flycatcher Breeding Habitat Prediction Modeling*
- *Southwestern Willow Flycatcher Breeding Habitat Conceptual Model*
- *Western Yellow-Billed Cuckoo Basic Conceptual Ecological Model for the Lower Colorado River*

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Science and Habitat Restoration Work Group (ScW/HR)

October 17, 2019
9:00 AM – 12:00 PM

U.S. Fish and Wildlife Service
2105 Osuna Rd NE

Meeting Agenda

9:00 – 9:10	**Welcome, Introductions, and Agenda Review** ➢ **Decision**: Approval of October 17, 2019 meeting agenda	*Program Support Team*
9:10 – 9:20	**Review of September 4, 2019 ScW/HR Meeting** • Review Action Items ➢ **Decision**: Approval of September 4, 2019 meeting minutes	*Program Support Team*
9:20 – 9:45	**Conceptual Ecological Model Discussion** • Discuss the different formats used in the models distributed as read-aheads	*Group Discussion*
9:45-10:45	**Conceptual Ecological Model Development** • Break into two, small groups to review existing models and develop models for the following species: o RGSM o SWFL and YBCU	*Group Discussion*
10:45-10:55	**Break**	*Group Discussion*
10:55 – 11:55	**Conceptual Ecological Model Development Continued**	*Group Discussion*
11:55-12:00	**Additional Items and Next Meeting Date** ➢ **Action Item**: Determine agenda items for the next ScW/HR meeting ➢ **Action Item**: Set date(s) for future meeting(s)	*Group Discussion*
12:00	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Science and Habitat Restoration Work Group (ScW/HR)
Meeting Minutes

October 17, 2019
Location: U.S. Fish and Wildlife Service
2105 Osuna Rd NE

Decisions:

- Approval of the October 17, 2019 ScW/HR meeting agenda
- Approval of the September 4, 2019 ScW/HR meeting minutes

Actions:

WHO	ACTION ITEM	BY WHEN
Program Support Team (PST)	Distribute presentation slides to ScW/HR	ASAP
PST	Develop draft conceptual models based on small group discussions	November 14

Next Meeting: November 21, 2019, 9am – 12pm

Meeting Notes

Welcome and Introductions

- **Decision:** The October 17, 2019 meeting agenda was approved

Review of the September 4, 2019 meeting

- **Decision:** The September 4, 2019 meeting minutes were approved

Presentation: Conceptual Ecological Models for the MRG by Ashley Tanner (PST)
Following the presentations and recommendation from the U.S. Army Corp of Engineers Engineering Research and Development Center (USACE ERDC), Ashley T. presented on some considerations for the group to keep in mind during the development of conceptual ecological models (CEM).

The following comments were made regarding the MRG Systems Model displayed in the presentation:

- The model may represent both the spatial distribution of vegetation (a cross-section of the river) and vegetation changes through time at one particular location (succession).
- The temporal line may be too far into the "river" portion of the picture.

- There was some discussion on whether the systems model was too idealistic. More specifically, the depiction of succession in the center of the model may represent succession that we don't really see today with the influence of invasive species and other issues.
- It was suggested that the group keep in mind what management options exist within the system. The group could spend a lot of time identifying uncertainties, but they may not be important to address if they're not related to something that can be modified. It would be helpful to know where management decisions can be made. It was suggested that the adaptive management piece may need to come first.
    - In response, it was cautioned that the group could limit itself by saying something is "not possible." It was stated that a lot of management changes have taken place over the past 15 years. While management should certainly be kept in mind, it might not be best to constrain the group to only what is "possible" under current management conditions.

The following comments were made regarding other aspects of the presentation:

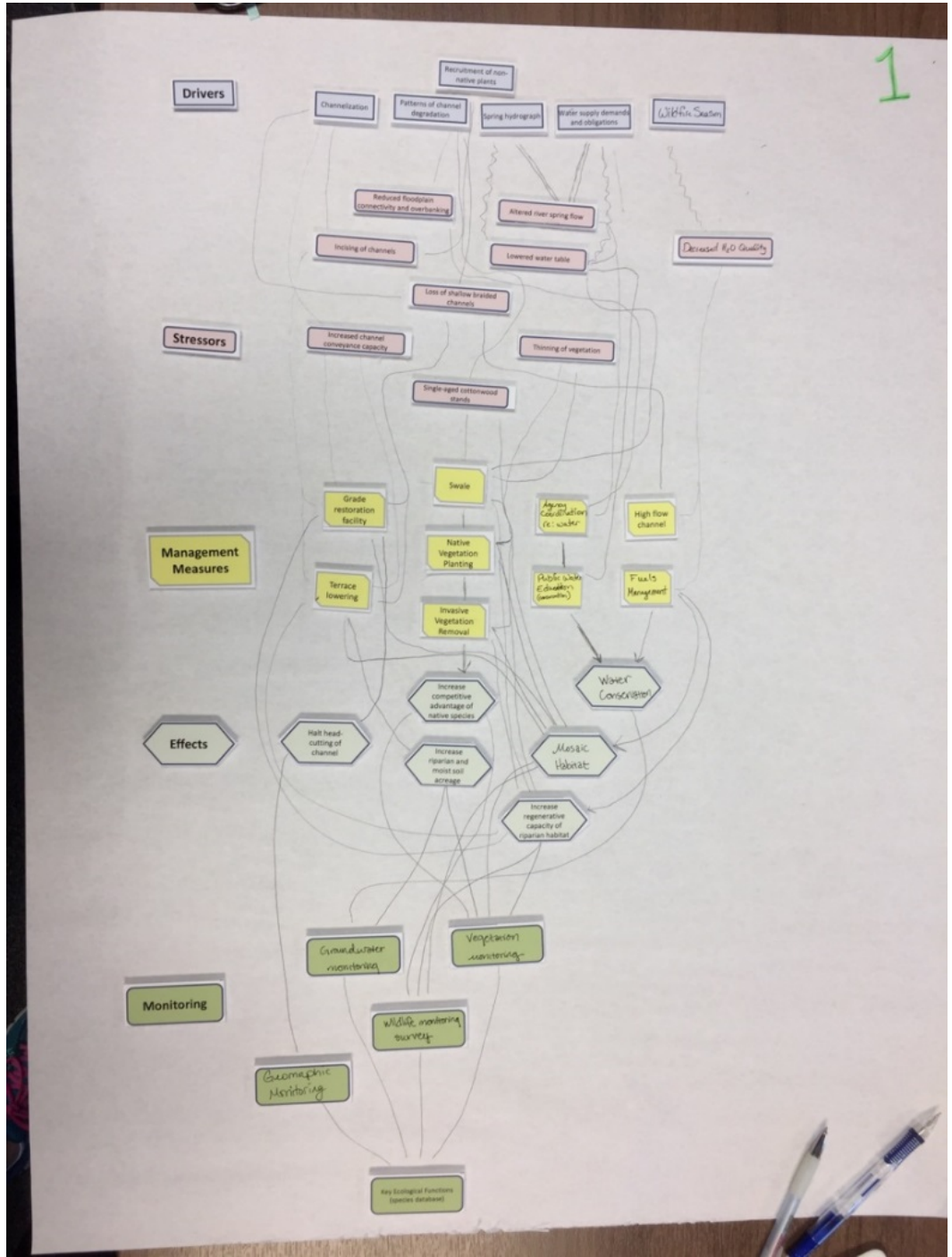
- It was suggested that the critical factors analyses done by the U.S. Fish and Wildlife Service (USFWS) for each listed species may be easily incorporated into the species-specific conceptual models.
- The group discussed 3 levels of models: a systems model, species-specific models, and models derived from the first two that are more specific to a relationship that warrants further examination.

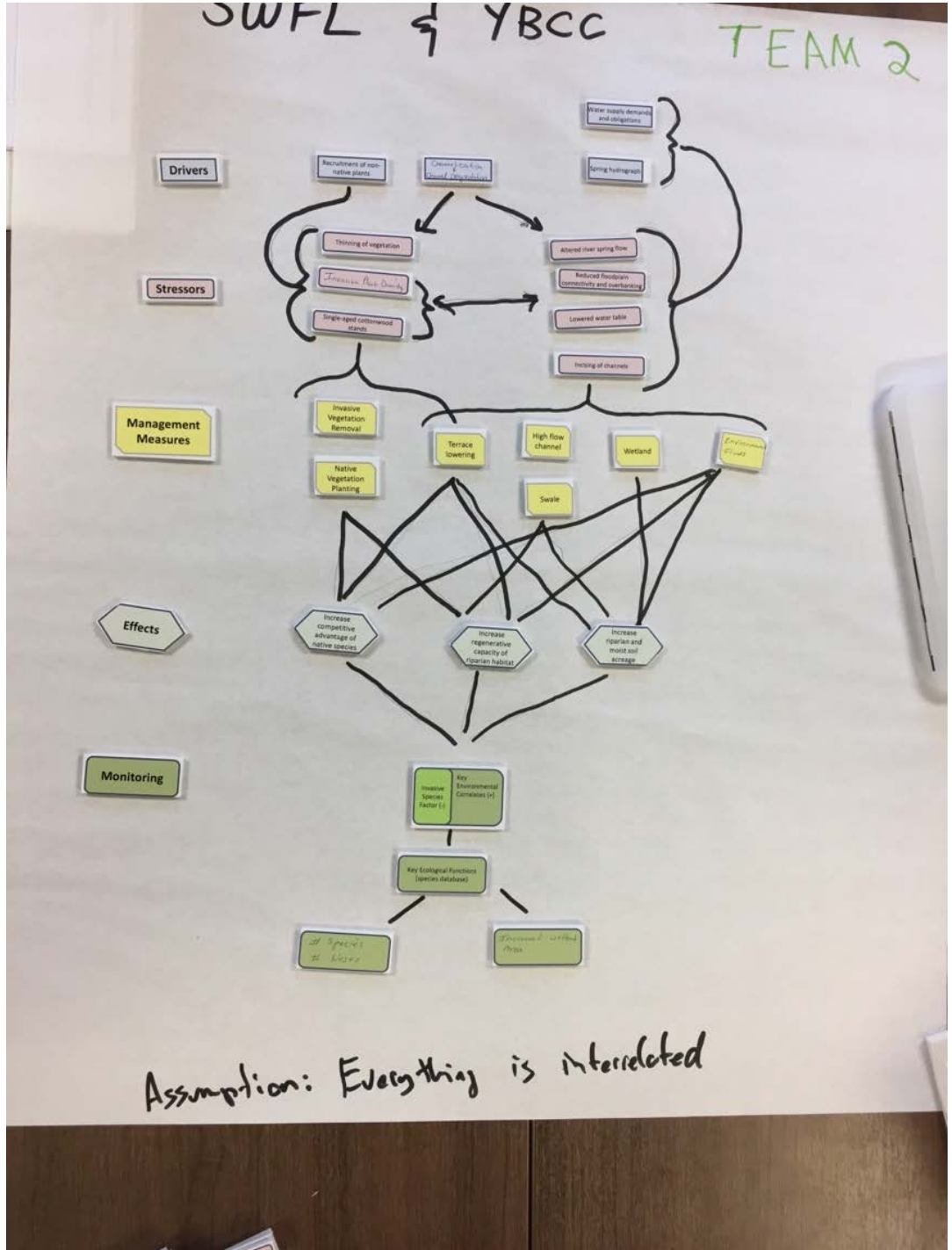
Conceptual Ecological Model Development

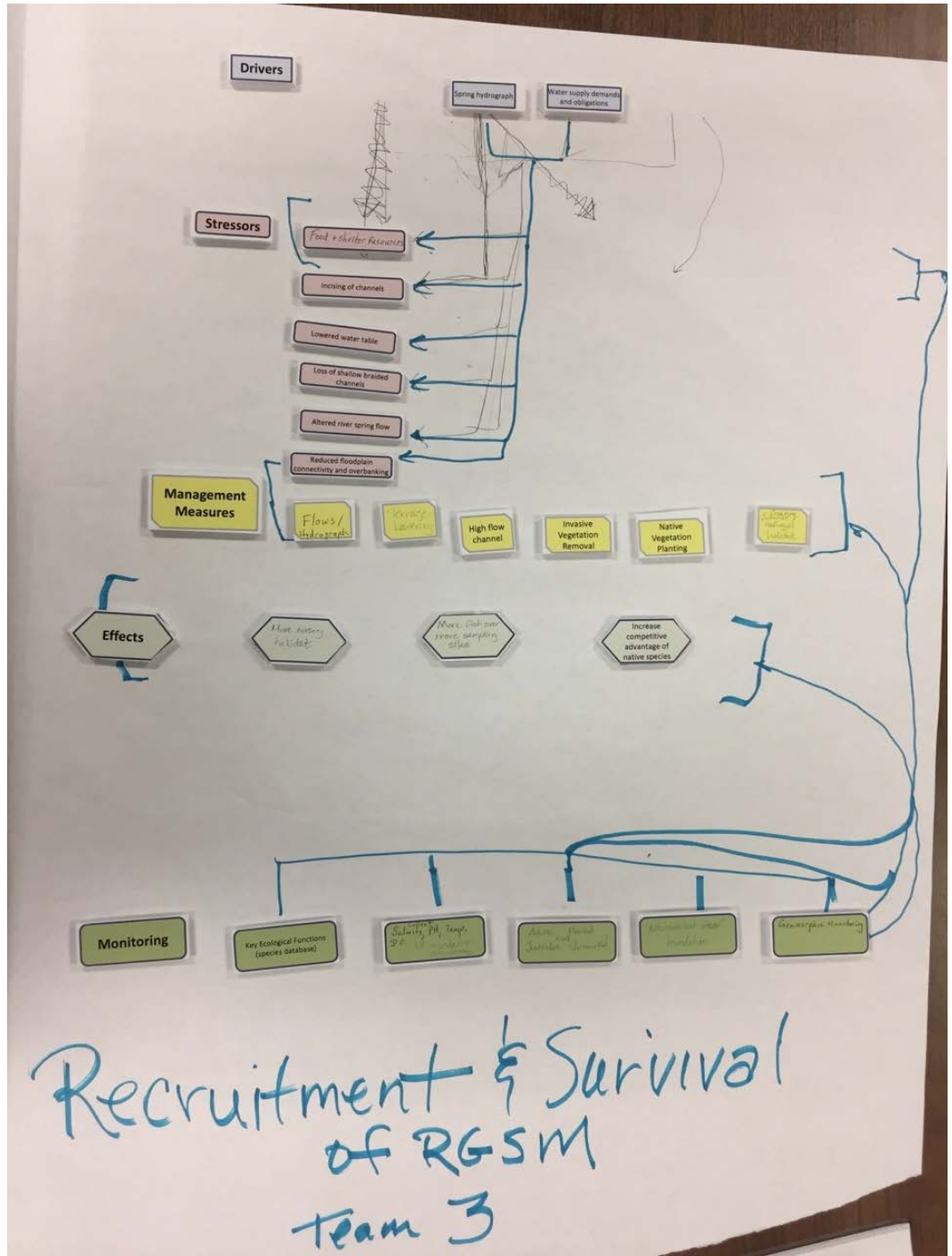
The work group proceeded to divide into two groups: one developing a model for the Rio Grande silvery minnow (RGSM) and one for the southwest willow flycatcher (SWFL) and yellow-billed cuckoo (YBCU). Notes were not taken during this workshop portion of the meeting.

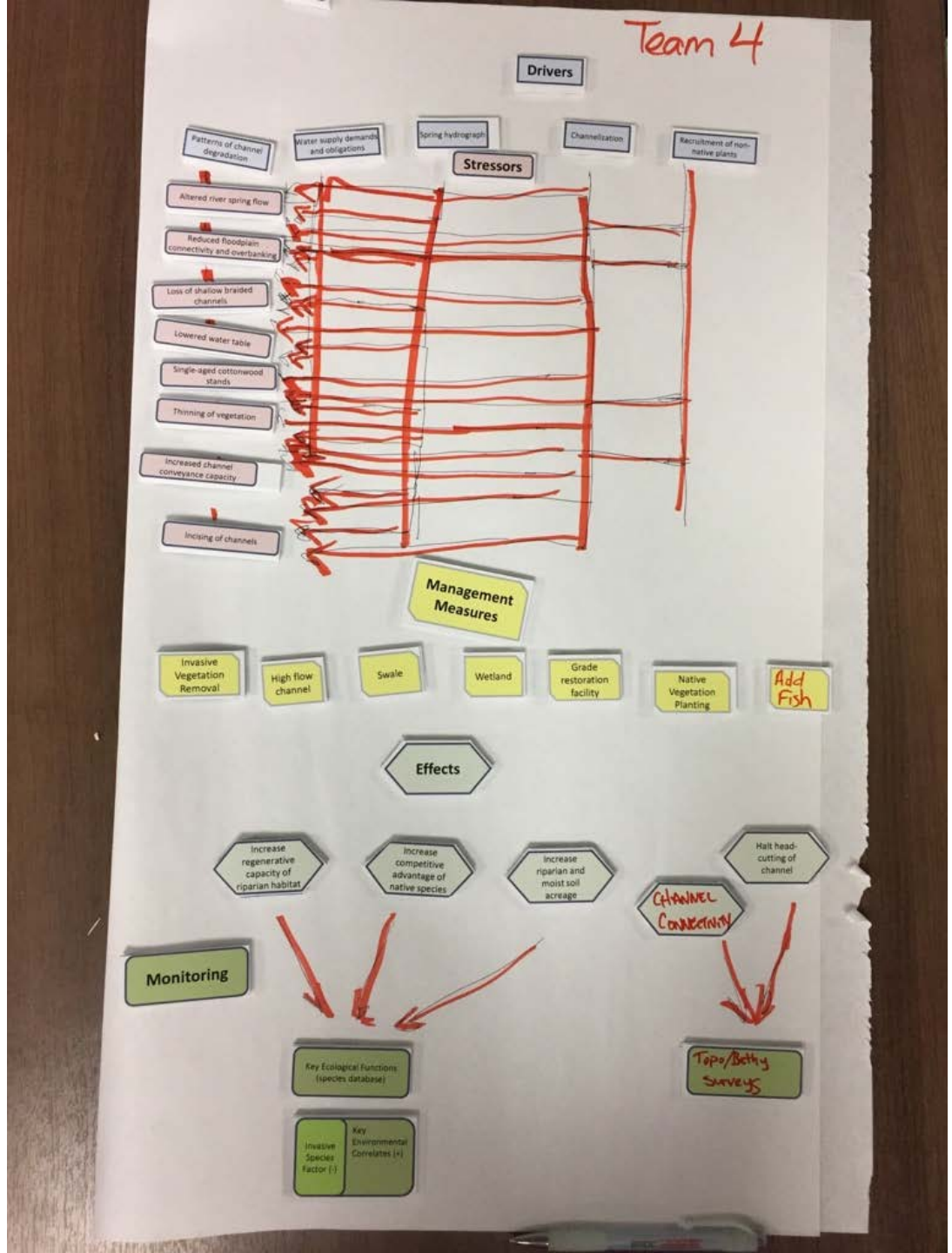
Meeting Participants

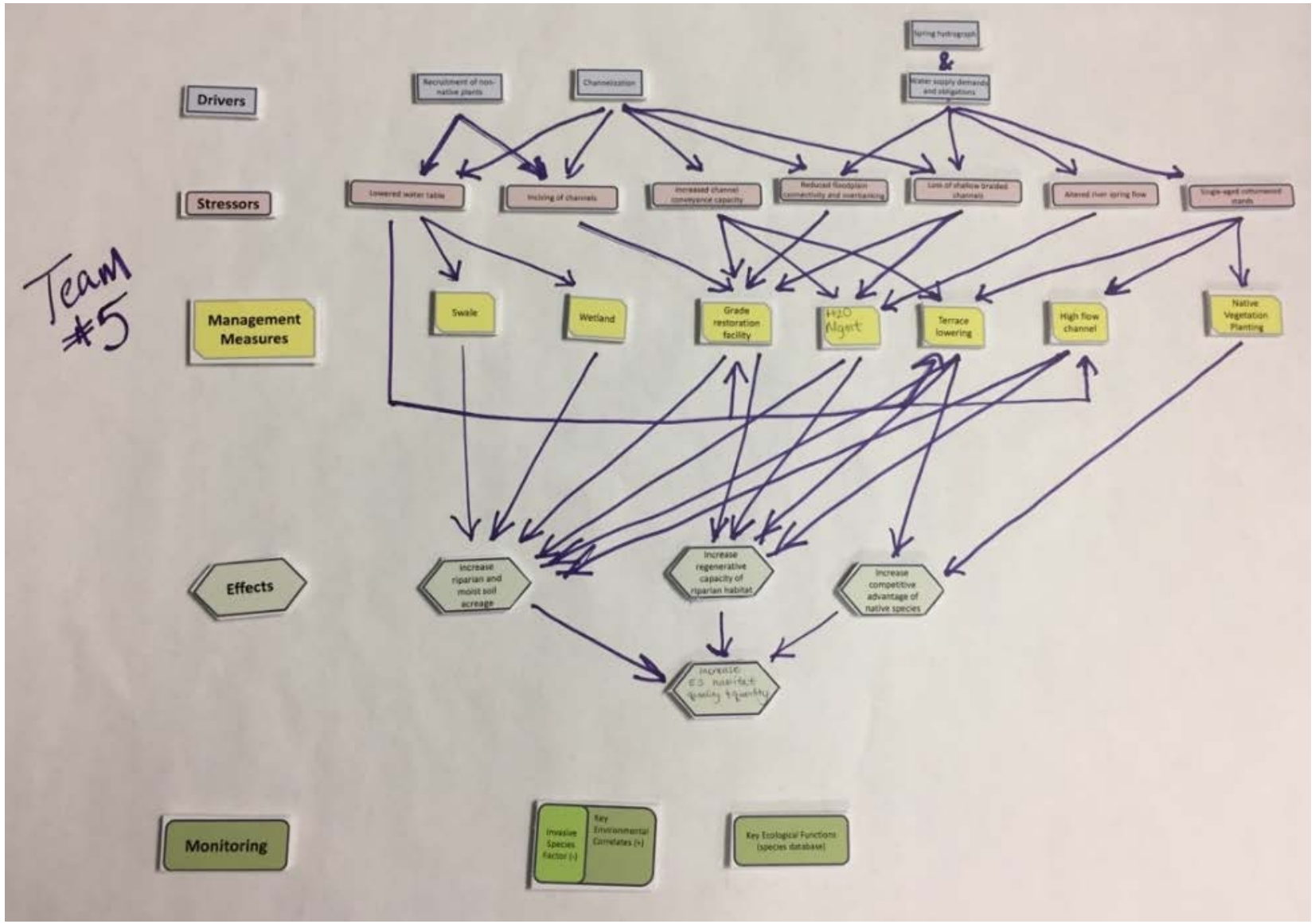
Participant	Organization
Ashley Tanner	PST
Aubrey Harris	USACE
Cathy Nishida	Pueblo of Santa Ana
Chuck Hayes	NMDGF
Clint Smith	USFWS
Dana Price	USACE
Danielle Galloway	USACE
Debbie Lee	PST
Grace Haggerty	NMISC
Meghan Conway	NMDGF
Mike Marcus	APA
Mo Hobbs	ABCWUA
Nathan Schroeder	Pueblo of Santa Ana
Rich Valdez	SWCA
Steven Ryan	USACE
Terry McDill	NMISC
Trevor Birt	NMISC
Vicky Ryan	USFWS


1
Drivers
Recruitment of non-native plants
Channelization
Patterns of channel degradation
Spring hydrograph
Water supply demands and obligations
Wildfire Season
Reduced floodplain connectivity and overbanking
Altered river spring flow
Incising of channels
Lowered water table
Decreased H2O Quality
Loss of shallow braided channels
Stressors
Increased channel conveyance capacity
Thinning of vegetation
Single-aged cottonwood stands
Management Measures
Swale
Grade restoration facility
Agency Coordination (re: water
High flow channel
Native Vegetation Planting
Public Water Education
Fuels Management
Terrace lowering
Invasive Vegetation Removal
Water Conservation
Effects
Increase competitive advantage of native species
Halt head-cutting of channel
Increase riparian and moist soil acreage
Mosaic Habitat
Increase regenerative capacity of riparian habitat
Monitoring
Groundwater monitoring
Vegetation monitoring
Wildlife monitoring survey
Geomorphic Monitoring
Key Ecological Functions (species database)


SWFL & YBCC
TEAM 2
Drivers
Recruitment of non-native plants
Water supply demands and obligations
Spring hydrograph
Stressors
Thinning of vegetation
Single-aged cottonwood stands
Altered river spring flow
Reduced floodplain connectivity and overbanking
Lowered water table
Incising of channels
Management Measures
Invasive Vegetation Removal
Native Vegetation Planting
Terrace lowering
High flow channel
Swale
Wetland
Effects
Increase competitive advantage of native species
Increase regenerative capacity of riparian habitat
Increase riparian and moist soil acreage
Monitoring
Invasive Species Factor (-)
Key Environmental Correlates (+)
Key Ecological Functions (species database)
Assumption: Everything is interrelated


Drivers
Spring hydrograph
Water supply demands and obligations
Stressors
Food + shelter Resources
Incising of channels
Lowered water table
Loss of shallow braided channels
Altered river spring flow
Reduced floodplain connectivity and overbanking
Management Measures
Flows/ Hydrograph
High flow channel
Invasive Vegetation Removal
Native Vegetation Planting
Effects
Increase competitive advantage of native species
Monitoring
Key Ecological Functions (species database)
Recruitment & Survival of RGSM
Team 3


Team 4
Drivers
Patterns of channel degradation
Water supply demands and obligations
Spring hydrograph
Channelization
Recruitment of non-native plants
Stressors
Altered river spring flow
Reduced floodplain connectivity and overbanking
Loss of shallow braided channels
Lowered water table
Single-aged cottonwood stands
Thinning of vegetation
Increased channel conveyance capacity
Incising of channels
Management Measures
Invasive Vegetation Removal
High flow channel
Swale
Wetland
Grade restoration facility
Native Vegetation Planting
Add Fish
Effects
Increase regenerative capacity of riparian habitat
Increase competitive advantage of native species
Increase riparian and moist soil acreage
Halt head-cutting of channel
CHANNEL CONNECTIVITY
Monitoring
Key Ecological Functions (species database)
Invasive Species Factor (-)
Key Environmental Correlates (+)
Topo/Bathy Surveys


Team #5
Drivers
Stressors
Management Measures
Effects
Monitoring
Recruitment of non-native plants
Channelization
Spring hydrograph
&
Water supply demands and obligations
Lowered water table
Incising of channels
Increased channel conveyance capacity
Reduced floodplain connectivity and overbanking
Loss of shallow braided channels
Altered river spring flow
Swale
Wetland
Grade restoration facility
H2O Mgmt
Terrace lowering
High flow channel
Native Vegetation Planting
Increase riparian and moist soil acreage
Increase regenerative capacity of riparian habitat
Increase competitive advantage of native species
Invasive Species Factor (-)
Key Environmental Correlates (+)
Key Ecological Functions (species database)

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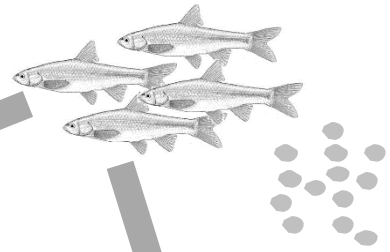
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Ultimate Cue
Photoperiod?
Temperature?

Proximate Cue
Rising hydrograph
Δ temperature?
Δ salinity, etc.?

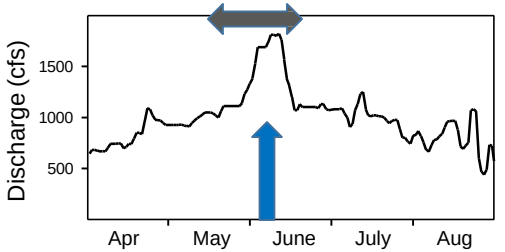
Spawning
Single or multiple spawns?
Narrow or protracted season?
Spawning on monsoonal events?



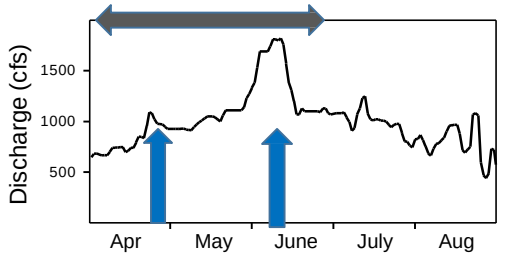
Spawning occurs in inundated areas
Low velocity in-channel (preferentially) Inundated flood plain

Spawning occurs in low velocity in-channel areas
Ova in inundated floodplains due to advection

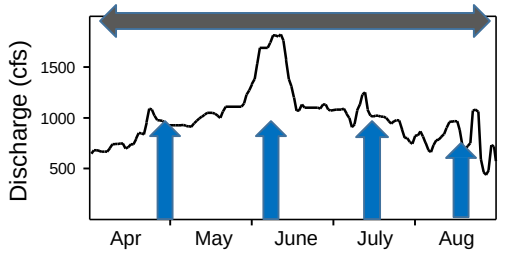
Single-batch spawn on spring peak
Narrow early-spring window



Single-batch spawn on spring peak
April-June (or later) window



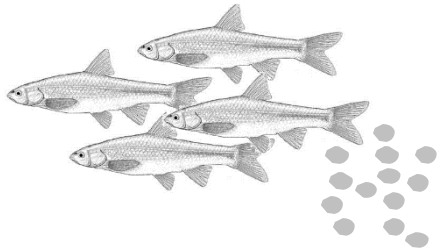
Protracted spawning on spring peak and monsoons
April-August



Ultimate Cue
Photoperiod?
Temperature?

Proximate Cue
Rising hydrograph
Δ temperature?
Δ salinity, etc.?

Spawning
Single or multiple spawns?
Narrow or protracted season?
Spawning on monsoonal events?



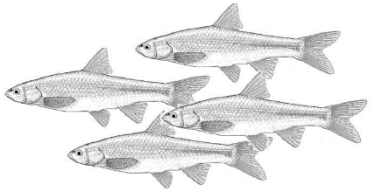
Larval fish
Ova hatch in 1-2 days
Larvae swim 5-9 days post-hatch
Survival related to descending limb of hydrograph



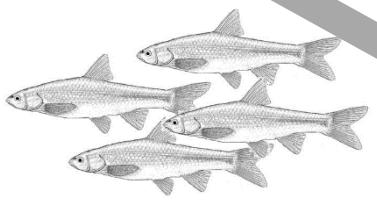
Juveniles
Survival related to maintenance of wetted habitat



Adults
Survival related to maintenance of wetted habitat
Extensive vs pools



Post-spawning survival
Absent or very low: spawn once and die
Adequate: multiple age classes



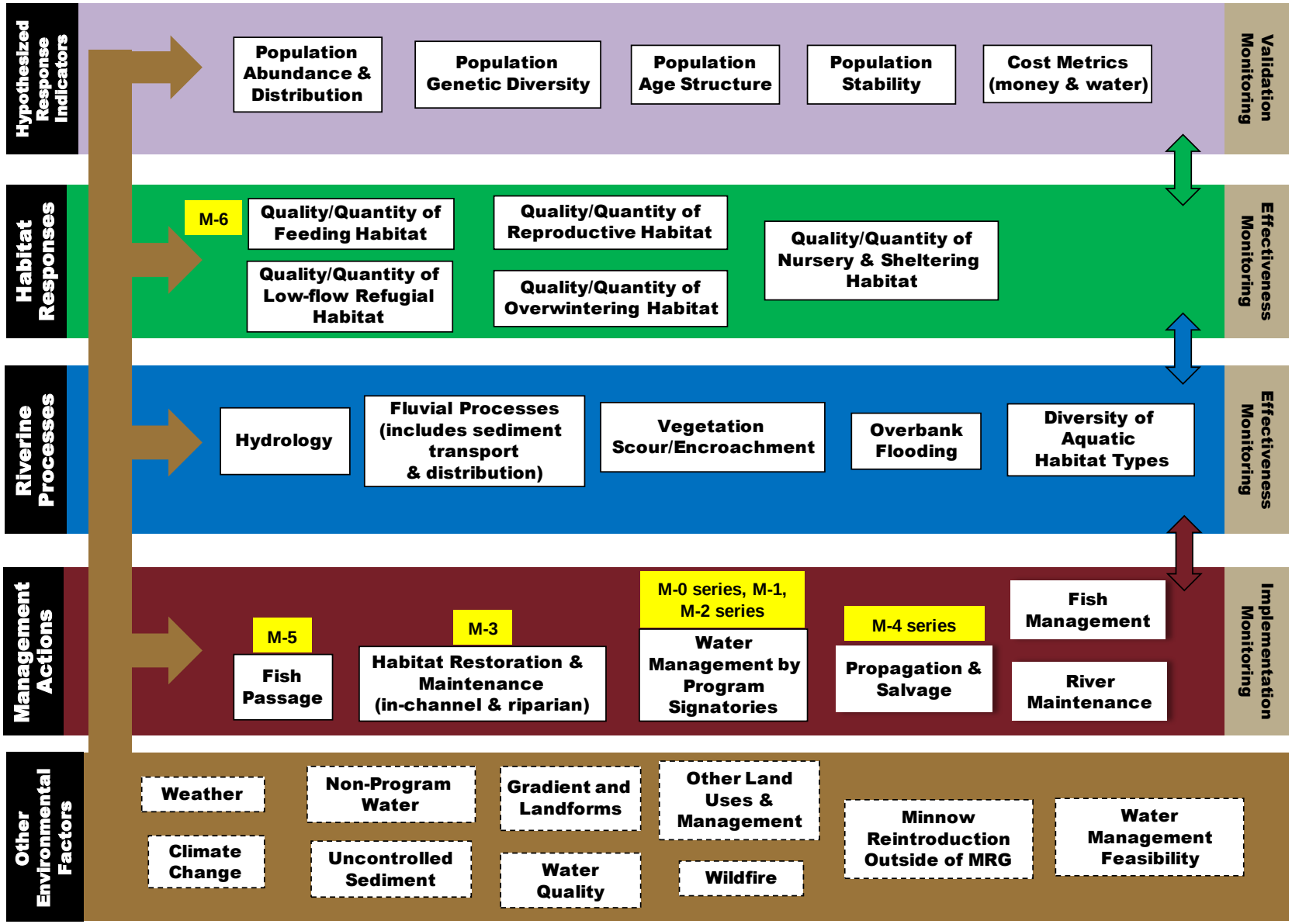


Figure 5. Conceptual model for the Rio Grande silvery minnow.

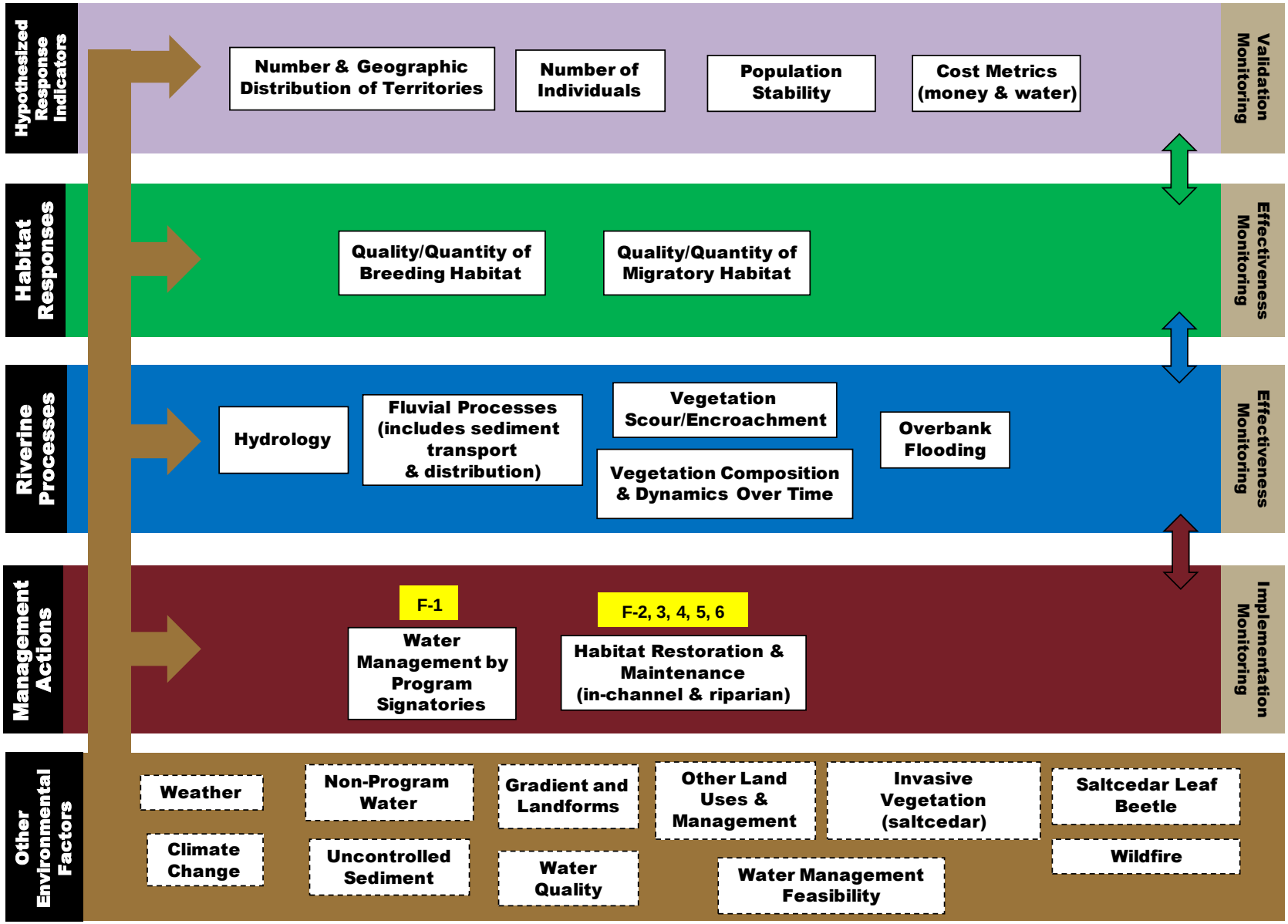


Figure 6. Conceptual model for the Southwestern Willow Flycatcher.

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- Yackulic, C.B. 2019. Developing an integrated population model for Rio Grande silvery minnow in the Middle Rio Grande. U.S. Geological Survey, Grand Canyon Monitoring and Research Center, Flagstaff, AZ.

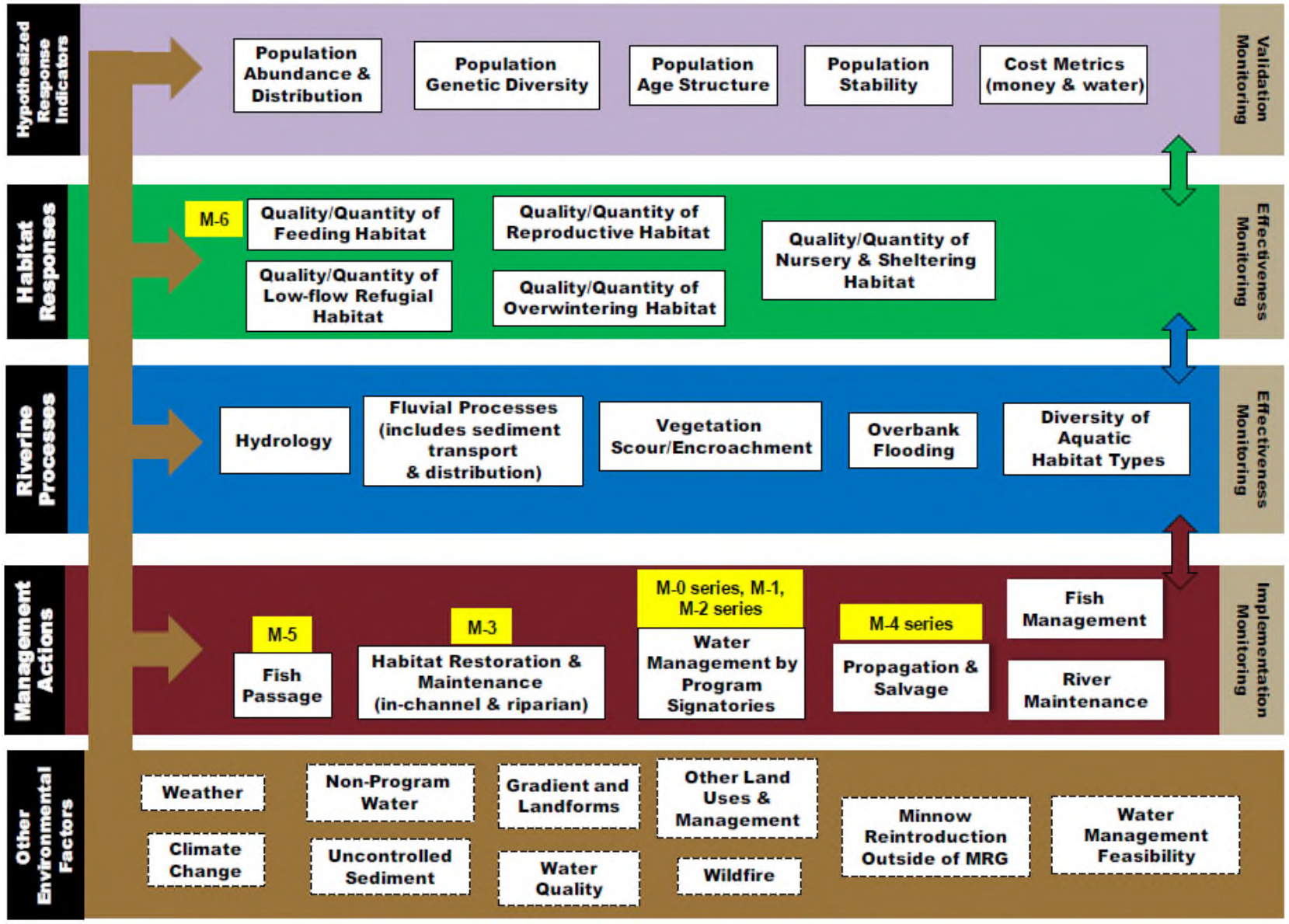
Miller, P.S. 2008. *Population Viability Assessment for the Rio Grande silvery minnow.*

$$\begin{bmatrix} N_0(t+1) \\ N_1(t+1) \end{bmatrix} = \begin{bmatrix} F_0 & F_1 \\ S_1 & 0 \end{bmatrix} \begin{bmatrix} N_0(t) \\ N_1(t) \end{bmatrix}$$

Leslie Matrix, where:

- $N_0(t+1)$ and $N_0(t)$ = numbers of individuals in age class 0 at time (t+1) and (t), respectively;
- F_0 = fecundity of age 0 individuals; and
- S_1 = survival rate of individuals in age class 1.
- Note value in the lower-right corner is automatically set to 0 because we assume that individuals do not live to see their third birthday.

Murray, C., C. Smith and D. Marmorek. 2011. Middle Rio Grande Endangered Species Collaborative Program Adaptive Management Plan Version 1. Conceptual model for the Rio Grande silvery minnow.



Noon, B., D. Hankin, T. Dunne, and G. Grossman. 2017. Independent Science Panel Findings Report: Rio Grande Silvery Minnow Key Scientific Uncertainties and Study Recommendations.

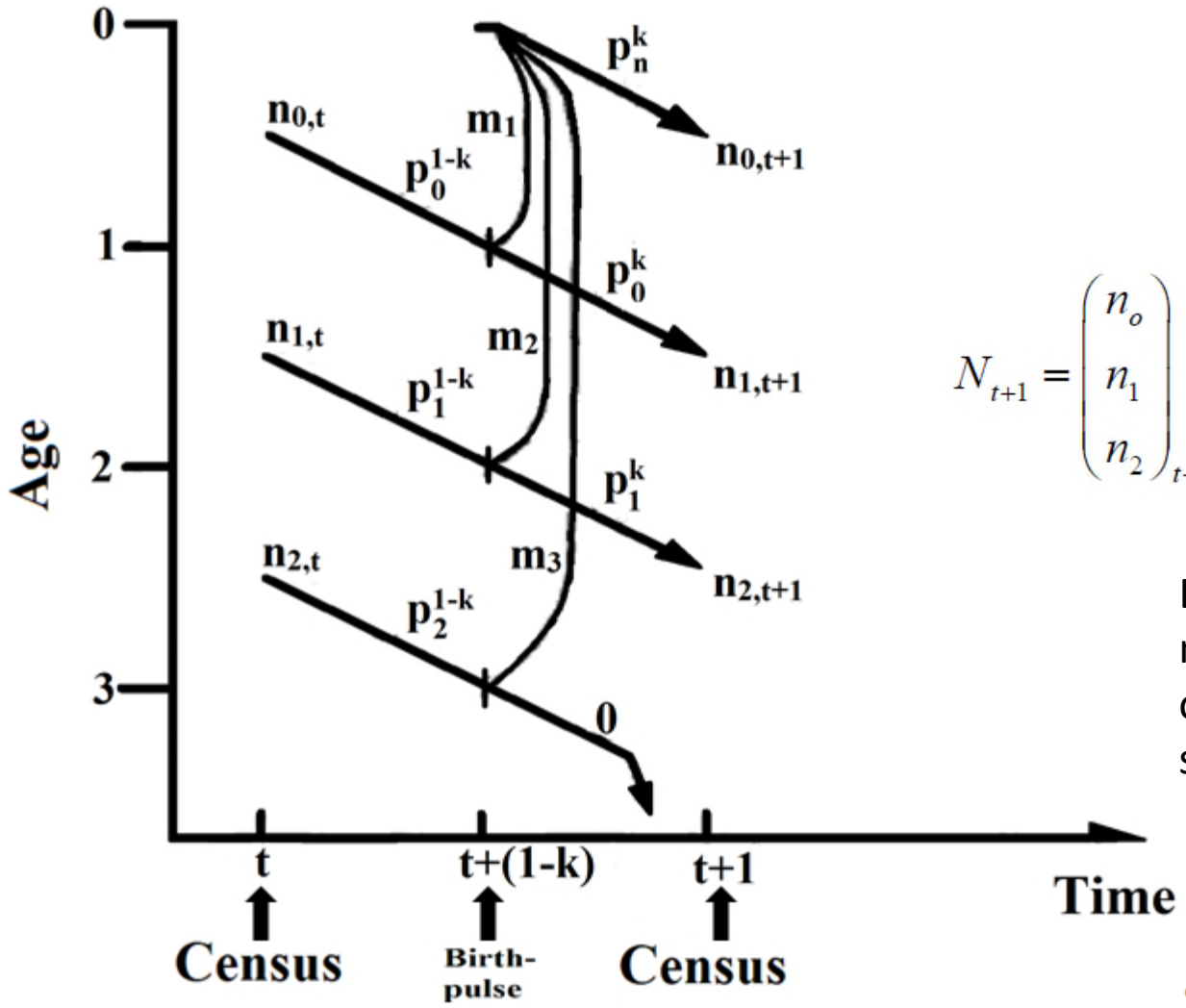


Figure 3. A general time-by-age biplot showing cohort transitions between census periods.

$$N_{t+1} = \begin{pmatrix} n_o \\ n_1 \\ n_2 \end{pmatrix}_{t+1} = \begin{pmatrix} p_0^{1-k} m_1 p_0^k & p_1^{1-k} m_2 p_0^k & p_2^{1-k} m_3 p_0^k \\ p_0^{1-k} p_0^k & 0 & 0 \\ 0 & p_1^{1-k} p_1^k & 0 \end{pmatrix} \begin{pmatrix} n_0 \\ n_1 \\ n_2 \end{pmatrix}_t = LN_t$$

Example projection matrix for Rio Grande silvery minnow, assuming the "census" to occur some fraction *k* of the year following the spawning birth-pulse.

Yackulic, C.B. 2019. Developing an integrated population model for Rio Grande silvery minnow in the Middle Rio Grande

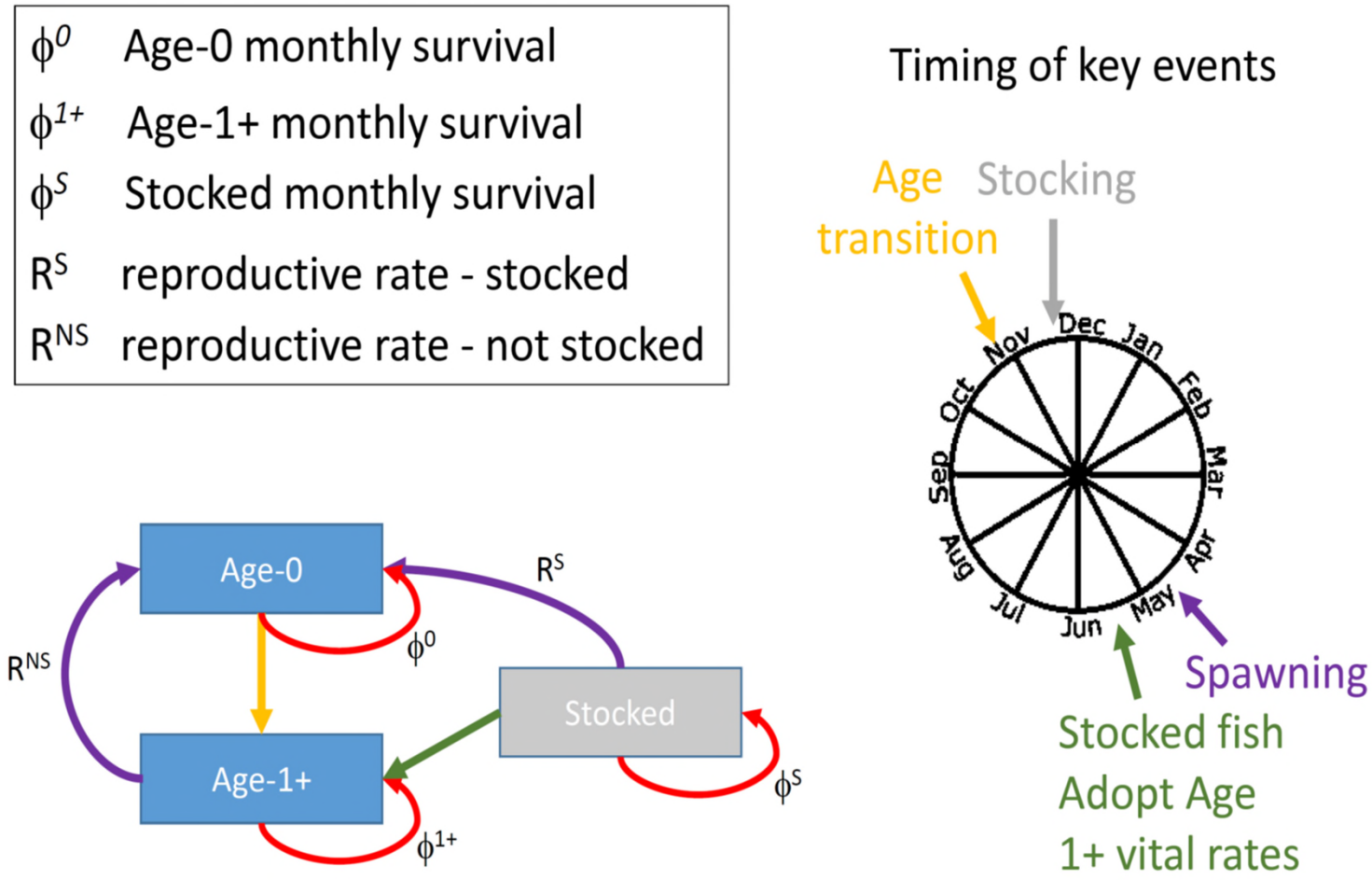


Figure 1: Schematic representation of RGSM demographics, including definition of key vital rates, representation of transitions between three states represented in the model, and timing of key events over the course of a calendar year.

Yackulic, C.B. 2019. Developing an integrated population model for Rio Grande silvery minnow in the Middle Rio Grande

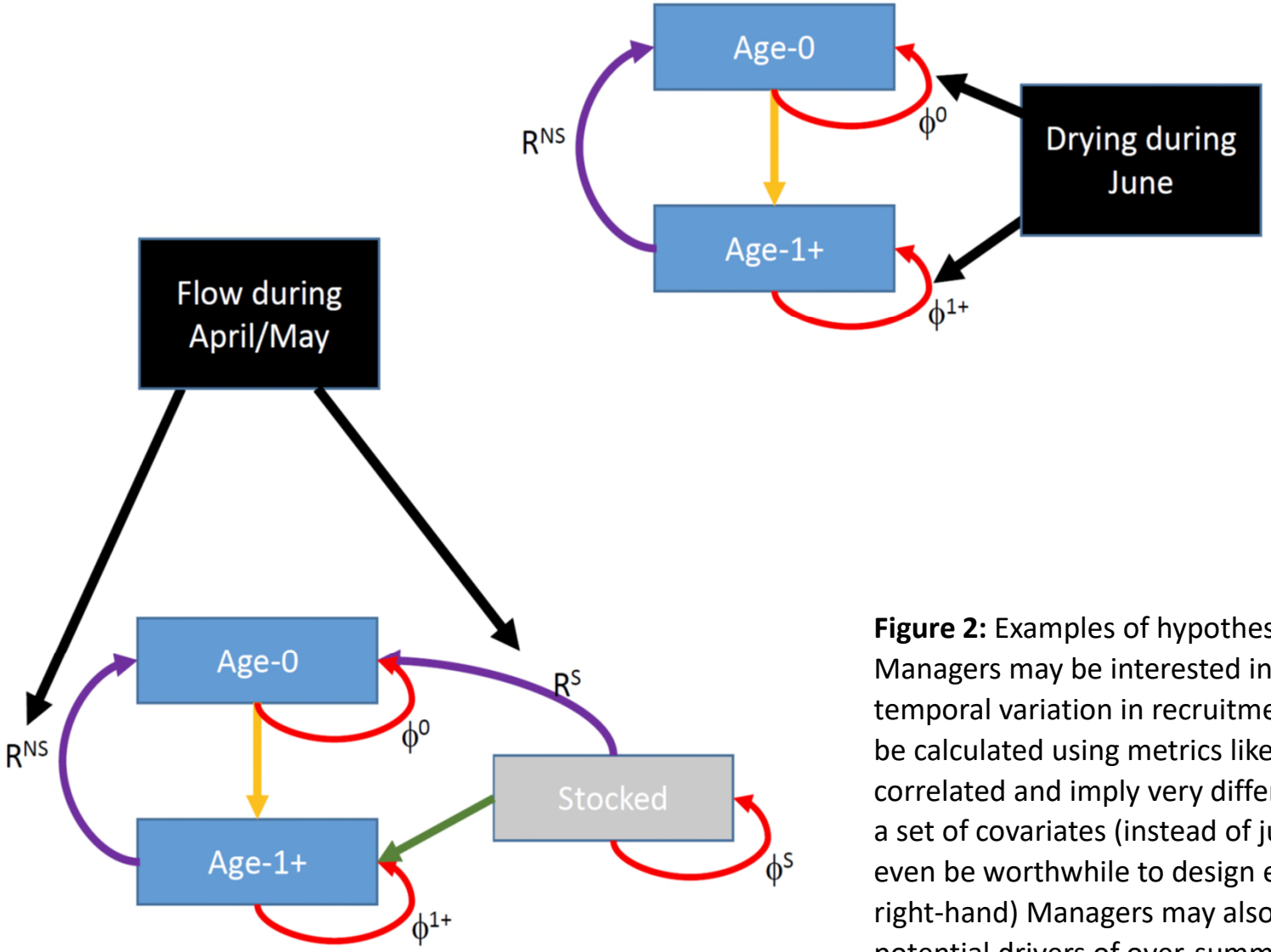
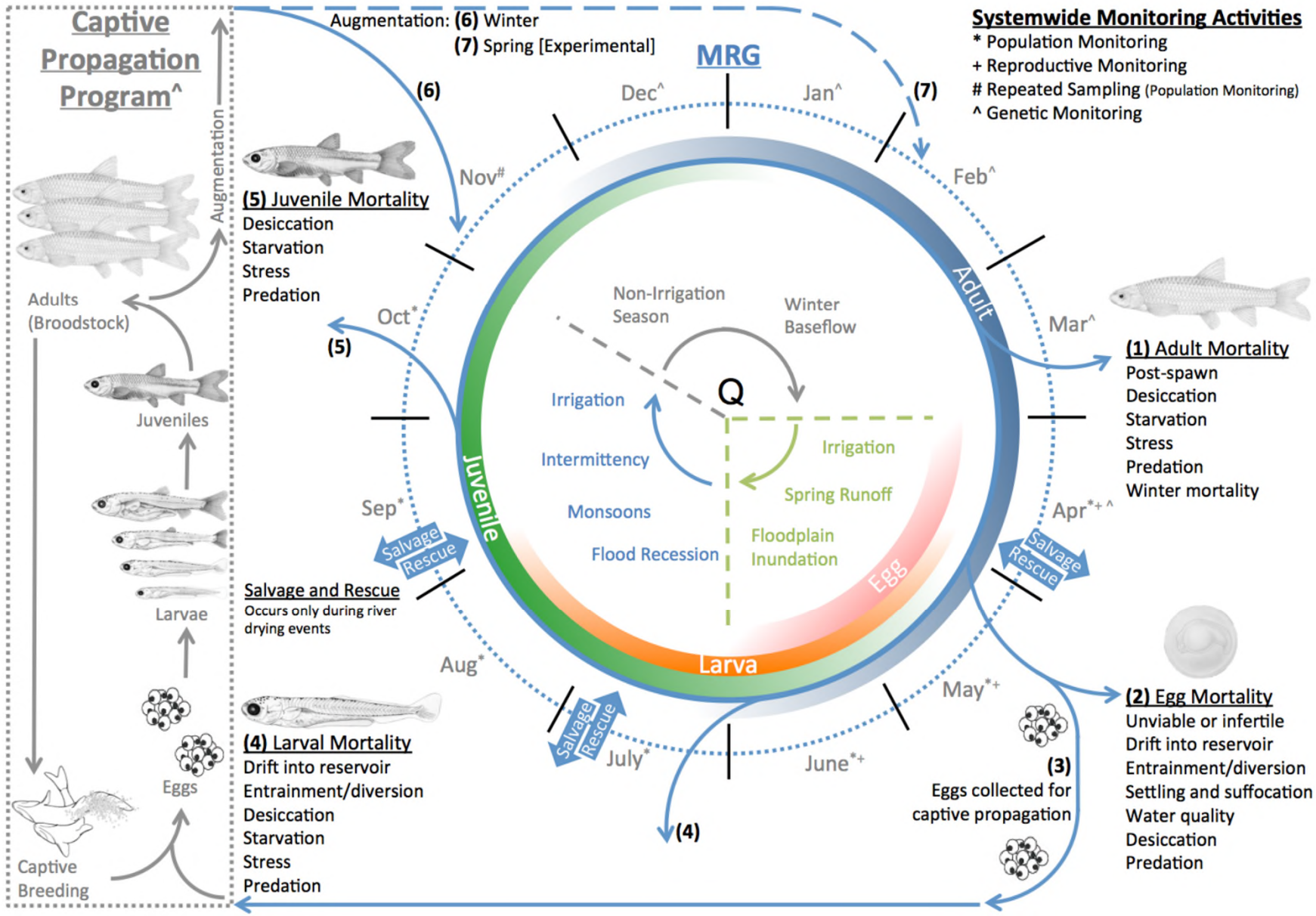
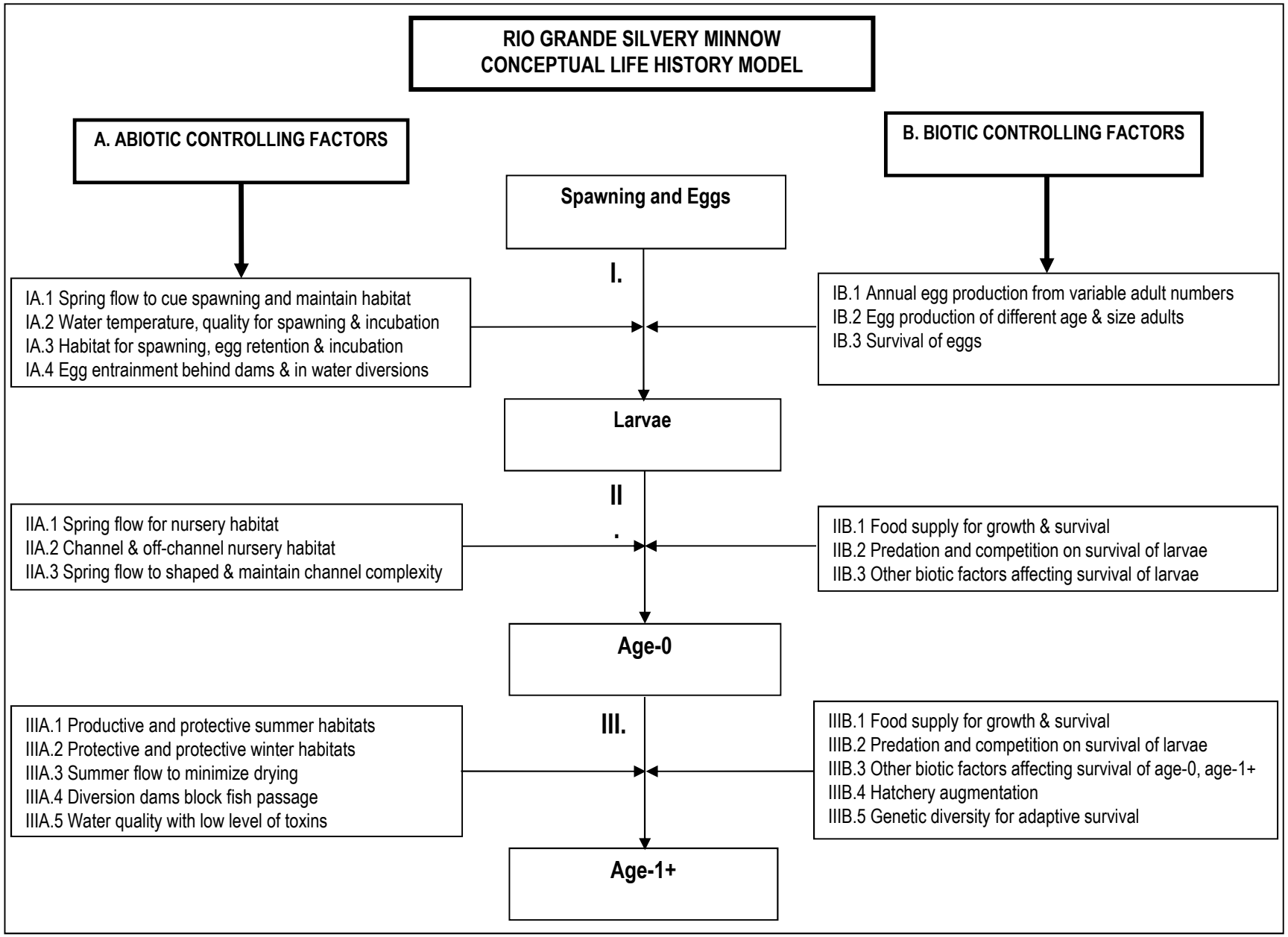


Figure 2: Examples of hypotheses for different demographic rates. (lower left-hand) Managers may be interested in how well different aspects of flow correspond to temporal variation in recruitment. Strength of evidence for different predictors can be calculated using metrics like multilevel R^2. If competing predictors are highly correlated and imply very different management, it may be worthwhile to consider a set of covariates (instead of just the "best" one) in making decisions and it may even be worthwhile to design experiments to disentangle these covariates. (upper right-hand) Managers may also want to consider hypotheses related to various potential drivers of over-summer survival in both Age-0 and Age-1+RGSM.

Mortensen, J.G., R.K. Dudley, S.P. Platania, and T.F. Turner. 2019. Rio Grande silvery minnow biology and habitat syntheses. Final Report, U.S. Bureau Of Reclamation



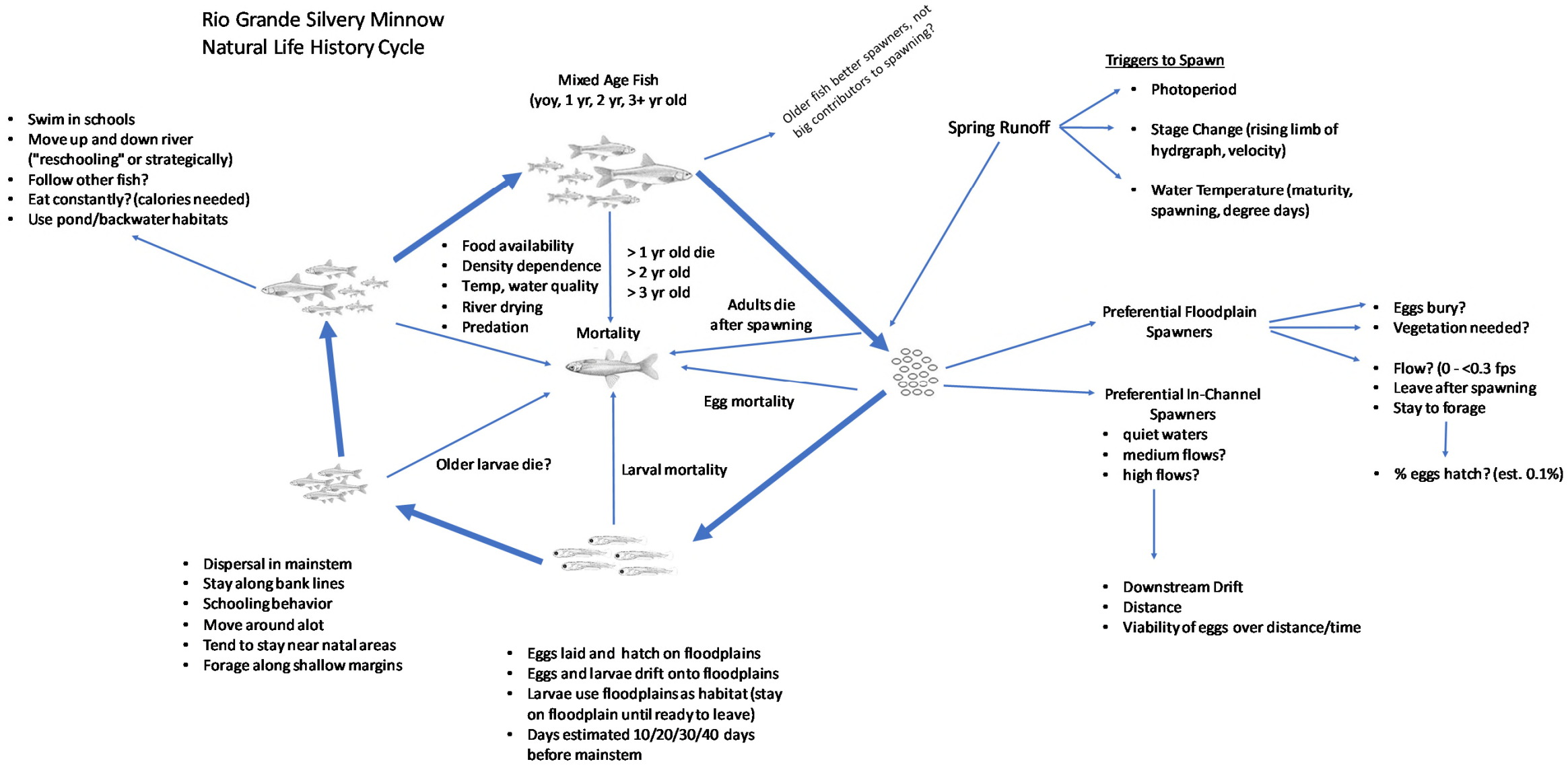
Valdez, R.A. 2018. Adaptive Management Module



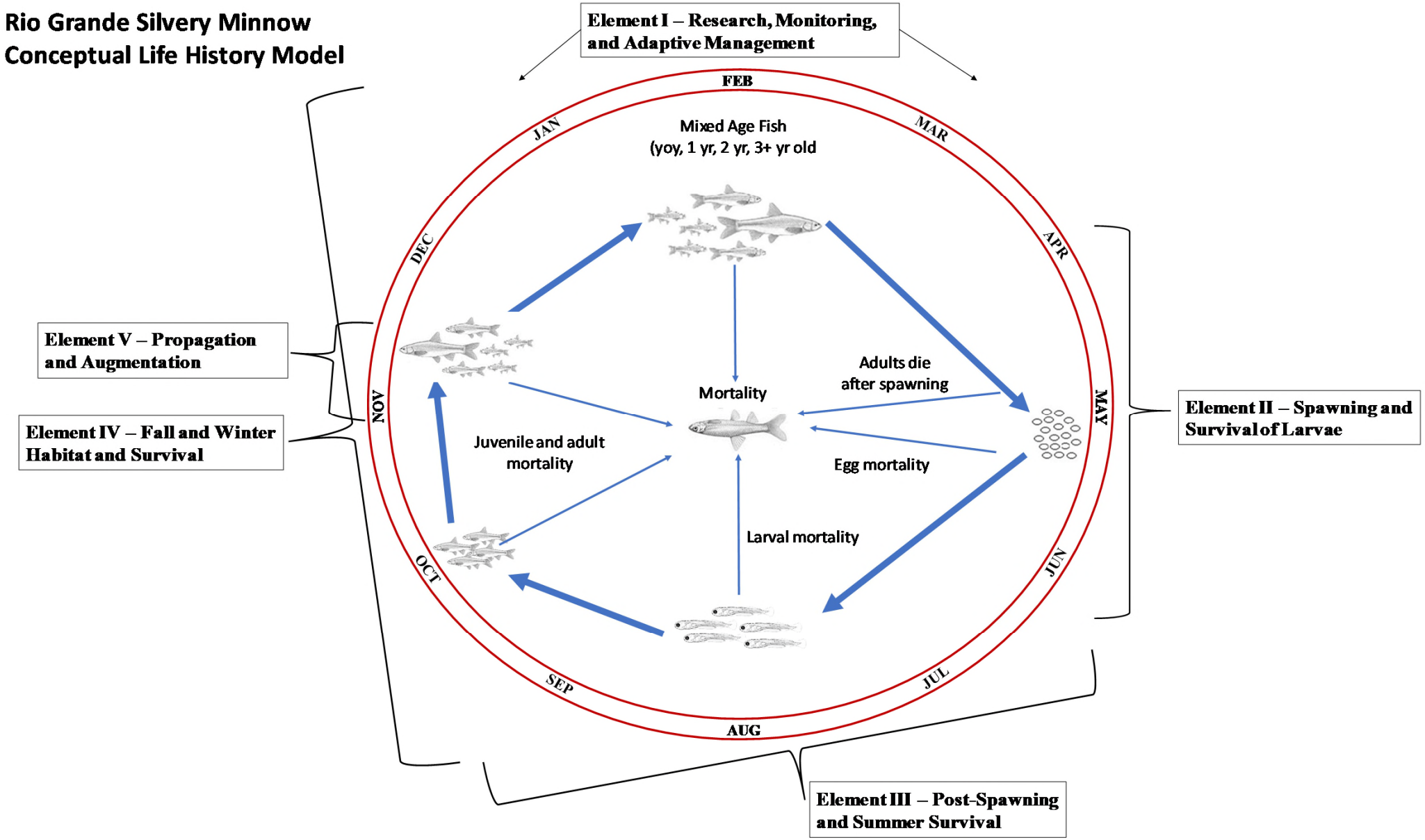
Valdez, R.A. 2019. Adaptive Management Module.

I. Spawning and Eggs to Larvae A Abiotic Factors	Critical Uncertainties	A Priori Assumptions
IA.1 Spring flow to cue spawning and maintain habitat	IA.1-1 What flow is needed to cue spawning?	IA.1-1a High spring flow is needed to cue spawning. IA.1-1b Flow spikes are more important than magnitude to cue spawning
	IA.1-2 What flow is needed to maintain spawning habitat?	IA.1-2a High spring flow is needed to maintain spawning habitat. IA.1-2b Spawning occurs at a range of flows.
IA.2 Water temperature, quality for spawning & incubation	IA.2-1 How does water temperature affect spawning & egg incubation?	IA.2-1a Temperature degree-days determine spawning readiness. IA.2-1b Spawning readiness is determined by a temperature threshold.
	IA.2-2 What other water quality factors affect spawning & egg incubation?	IA.2-2 Turbidity, salinity determine time of spawning and affect egg buoyancy.
IA.3 Habitat for spawning, egg retention & incubation	IA.3-1 Where does spawning occur?	IA.3-1a Spawning in the mainstem results in downstream transport of eggs. IA.3-1b Spawning in floodplains helps to retain eggs & larvae near natal areas.
	IA.3-2 Where is egg survival highest?	IA.3-2a Egg survival is lower in the mainstem. IA.3-2b Egg survival is higher in floodplains.
	IA.3-3 How long should floodplains persist for spawning & incubation	IA.3-3 Floodplains should persist 30 days for spawning & incubation.
IA.4 Egg entrainment behind dams & in water diversions	IA.4-1 How significant is egg entrainment behind dams?	IA.4-1 Egg entrainment behind dams is not significant to total egg production.
	IA.4-2 How significant is egg entrainment in water diversions?	IA.4-2 Egg entrainment in diversions is not significant to total egg production.
A Biotic Factors		
IB.1 Annual egg production from variable adult numbers	IB.1-1 What is effect of prior Oct CPUEs on egg production & cohort strength?	IB.1-1a Egg production is significantly correlated to 1-3 years prior Oct CPUEs. IB.1-1b Egg production is linked to floodplain inundation and egg retention.
IB.2 Egg production of different age & size adults	IB.2-1 What is effect of age & size on egg production?	IB.2-1a Older fish contribute more to egg production in years of low fish numbers. IB.2-1b Older fish are too few to contribute significantly to egg production.
IB.3 Survival of eggs	IB.3-1 How significant is downstream transport to total egg production?	IB.3-1a Downstream loss of eggs from the system is significant to total egg production. IB.3-1b Abrasion of eggs in transport is significant to egg survival.
	IB.3-2 How significant is fish predation to egg survival?	IB.3-2 Fish predation is significant to egg survival.

Haggerty, G.M. 2019. Example of Conceptual RGSM Model.



Haggerty, G.M. and R.A. Valdez. 2019. Revised Conceptual RGSM Model.



SWFL LIFE STAGE 1 – NEST

The nest stage lasts from when the egg is laid until either the young fledge or the nest fails. Success during this life stage – successful transition to the juvenile stage – involves organism survival, maturation, molt, and fledging. The organisms actively interact with their environment.

The CEM (figures 3 and 4) recognizes five (of nine) critical biological activities and processes for this life stage, ordered here as they appear on the following figures:

1. **Disease** – Although the literature does not emphasize disease as affecting population levels of SWFL, we still feel that disease bears mentioning, and it has been recommended as an area for further research (Paxton et al. 2007).

   The CEM recognizes genetic diversity and infectious agents as a habitat element affecting disease.

2. **Eating** – The nestling must eat to maintain metabolic processes.

   The CEM recognizes brood size and parental nest attendance as habitat elements affecting eating (feeding young).

3. **Nest Predation and Brood Parasitism** – Both nest predation and brood parasitism affect the survival of a nest and are affected by similar habitat elements. Brood parasitism has been identified as a threat to SWFL (Marshall and Stoleson 2000), although it likely only threatens small populations (Finch et al. 2002). We have therefore combined nest predation and brood parasitism into one process for this stage.

   The CEM recognizes anthropogenic disturbance, canopy closure, community type, intermediate structure, linear width of patch, nest predator and cowbird density, parental nest attendance, patch size, and tree density as habitat elements affecting nest predation and brood parasitism.

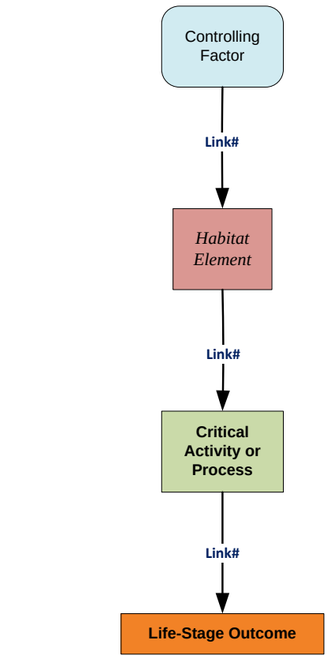
4. **Molt** – The nestling must molt into juvenal plumage.

   The CEM does not recognize any habitat elements as directly affecting molt. Other critical biological activities and processes influencing molt include those affecting energy resources such as disease and eating.

5. **Temperature Regulation** – The eggs and nestlings must maintain an optimum temperature to develop and survive.

   The CEM recognizes canopy closure, humidity, intermediate structure, parental nest attendance, and temperature as habitat elements directly affecting temperature regulation.

Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (SWFL)
Basic Conceptual Ecological Model for the Lower Colorado River



Link Magnitude

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- Low – thin line
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Link Understanding

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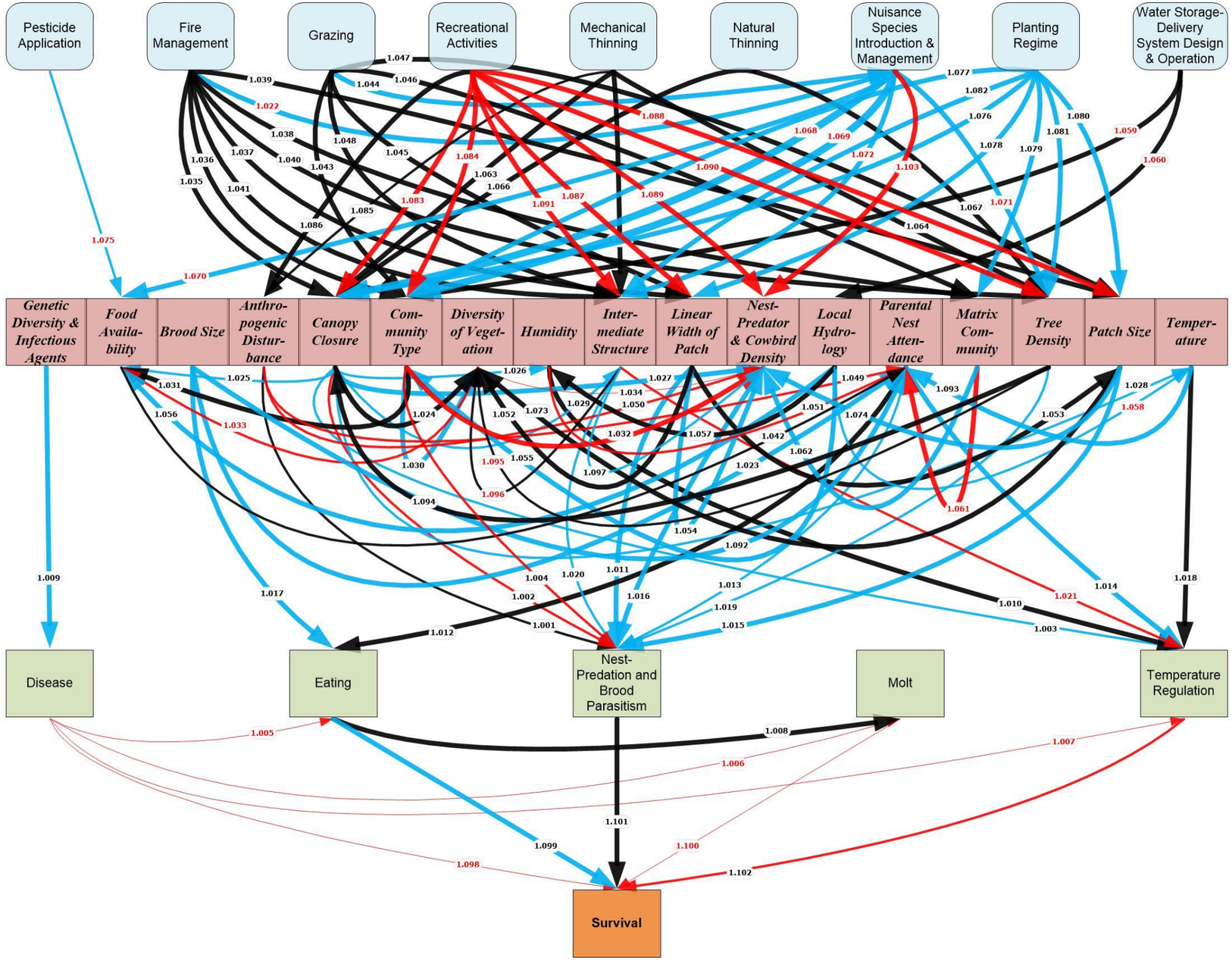
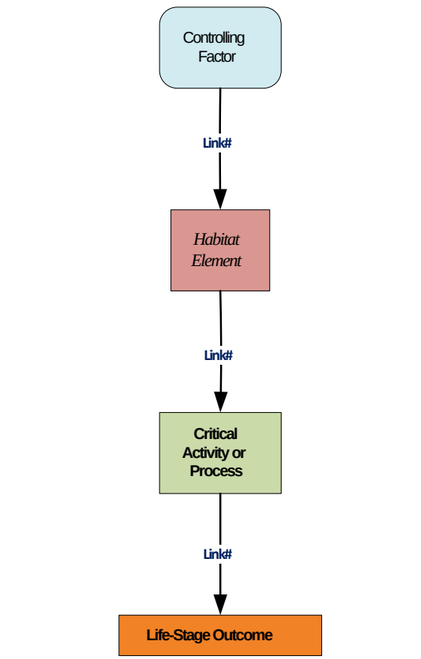


Figure 3.—SWFL life stage 1 – nest, basic CEM diagram.



Link Magnitude

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Link Understanding

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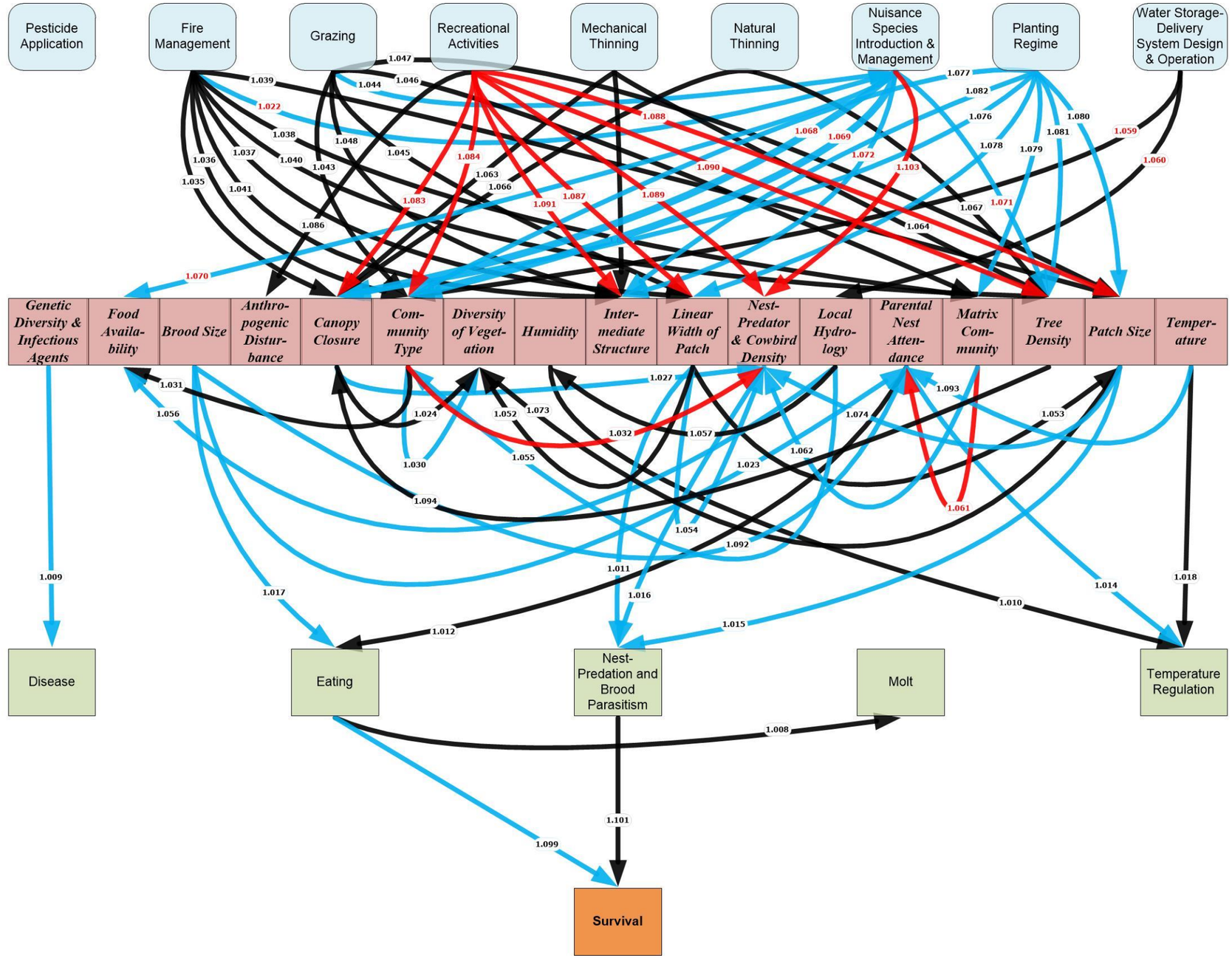


Figure 4.—SWFL life stage 1 – nest, high- and medium-magnitude relationships.

SWFL LIFE STAGE 2 – JUVENILE

The juvenile stage begins at fledging and ends when the bird engages in breeding activities, usually the following year. Success during this life stage – successful transition to the next stage – involves organism survival and maturation. The organisms actively interact with their environment.

The CEM (figures 5 and 6) recognizes four (of nine) critical biological activities and processes for this life stage, ordered here as they appear on the following figures:

1. **Disease** – Although the literature does not emphasize disease as affecting population levels of SWFL, we still feel that disease bears mentioning, and it has been recommended as an area for further research (Paxton et al. 2007).

   The CEM recognizes genetic diversity and infectious agents as a habitat element affecting disease.

2. **Foraging** – Although still fed by its parents, the juvenile can now also forage for its own food in order to eat and maintain metabolic processes. The degree to which it is dependent upon foraging relates to the feeding rate of the parents and all of the factors affecting parent survival.

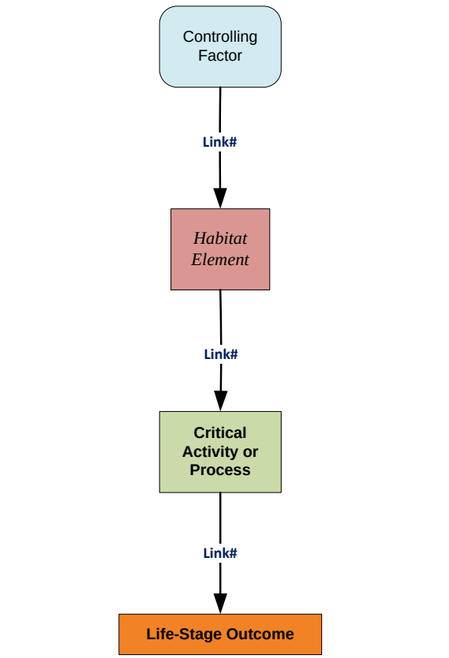
   The CEM recognizes anthropogenic disturbance, canopy closure, community type, diversity of vegetation, food availability, matrix community, and parental feeding behavior as habitat elements affecting foraging. Predator density affects foraging indirectly via predation, but nothing is known about rates for juveniles. In addition, disease can also affect the foraging efficiency of a juvenile, but it is not known to what extent.

3. **Predation** – Brood parasitism is no longer a threat to the survival of SWFL; therefore, it is no longer included with predation.

   The CEM recognizes anthropogenic disturbance, canopy closure, community type, intermediate structure, linear width of patch, parental feeding behavior, patch size, predator density, and tree density as habitat elements affecting predation.

4. **Temperature Regulation** – The juvenile must maintain an optimum temperature to survive.

   The CEM recognizes canopy closure, humidity, intermediate structure, and temperature as habitat elements directly affecting temperature regulation.



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Link Understanding

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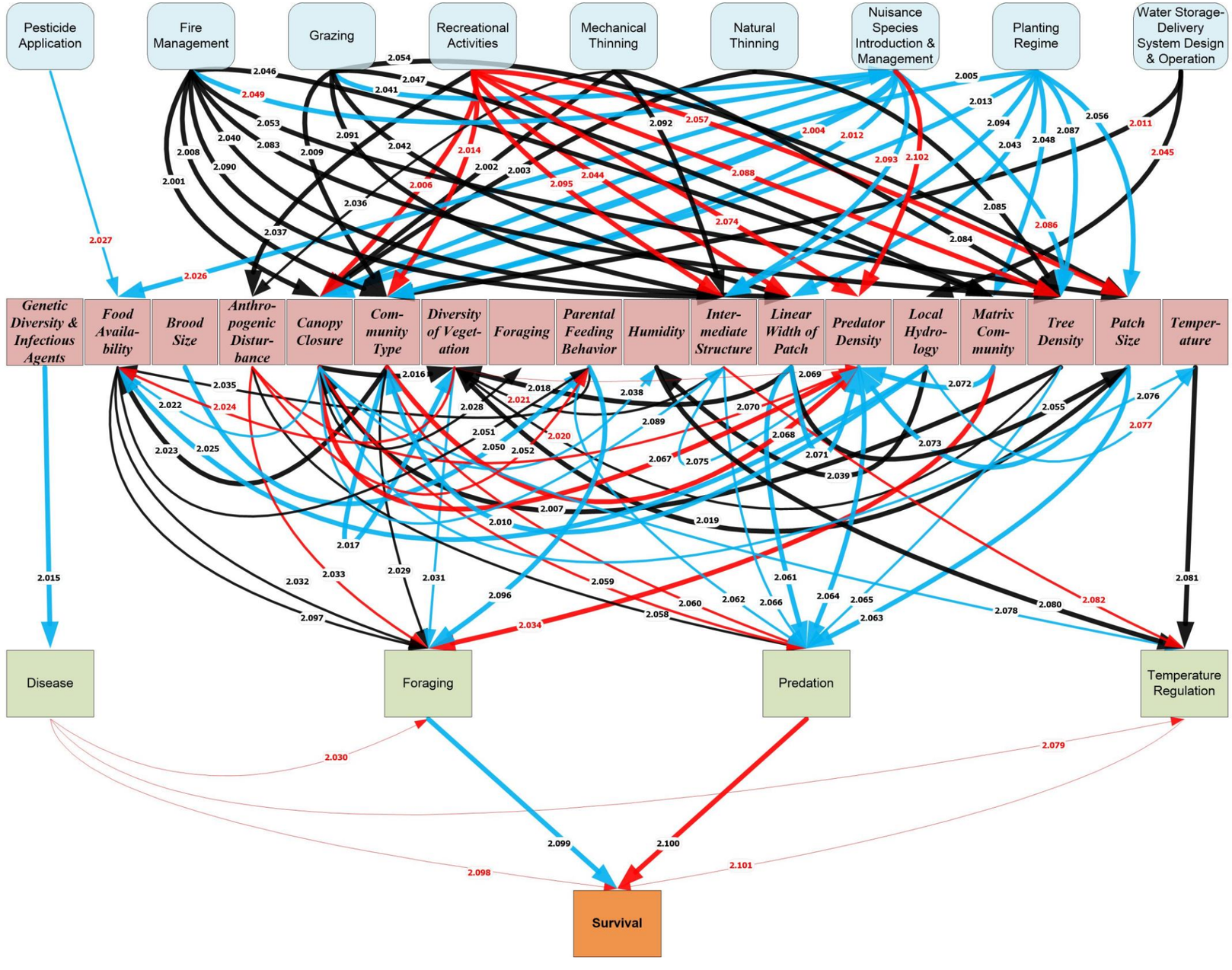


Figure 5.—SWFL life stage 2 – juvenile, basic CEM diagram. Only elements with connections within this life stage are presented.

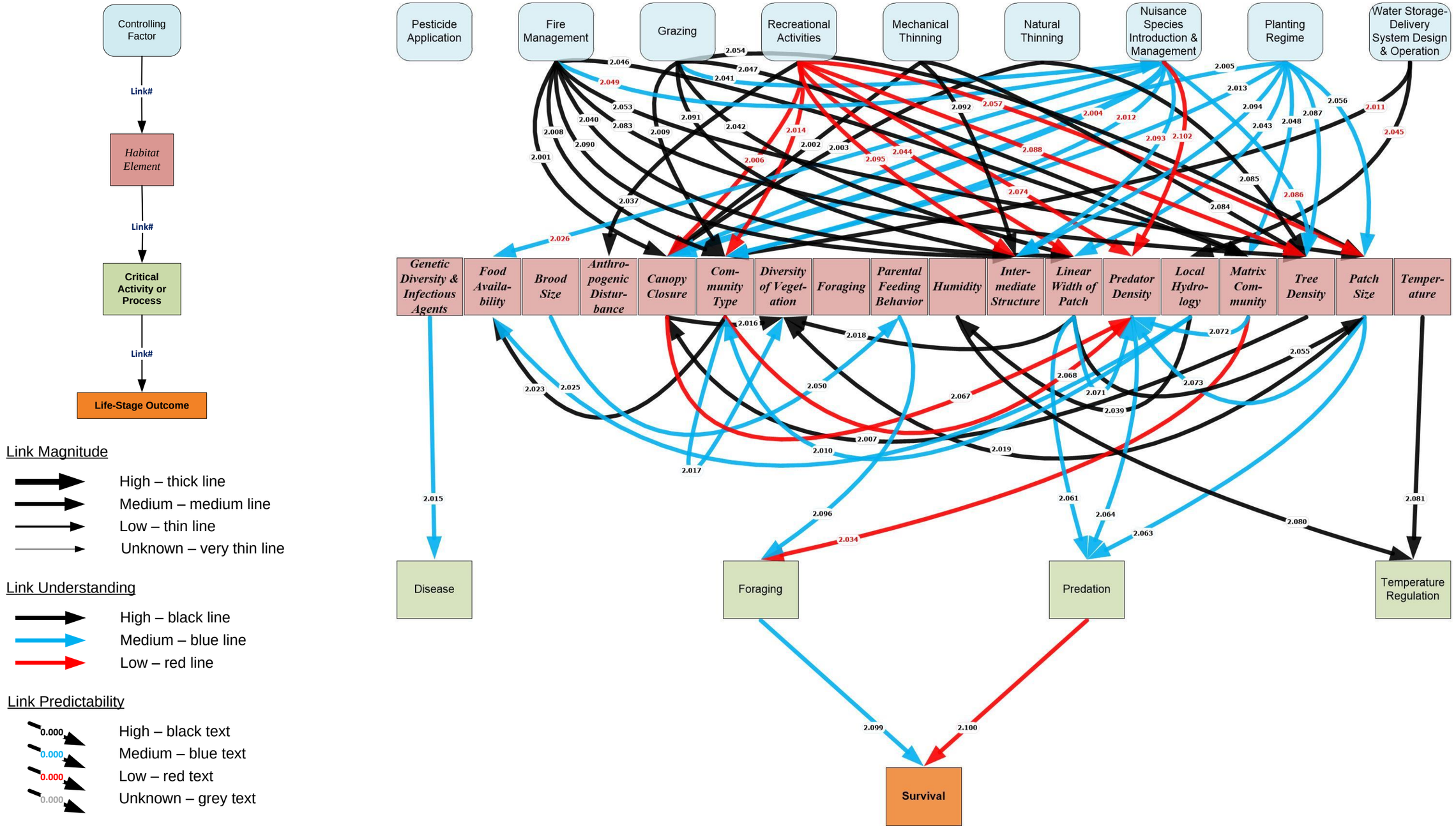


Figure 6.—SWFL life stage 2 – juvenile, high- and medium-magnitude relationships.

SWFL LIFE STAGE 3 – BREEDING ADULT

The breeding adult stage begins when the bird returns to the breeding grounds after its first or subsequent winter and ends when it departs the breeding grounds during fall migration. Success during this life stage – successful transition to the next stage – involves organism survival and breeding. Individuals that do not successfully find a territory, floaters, are also included in this category even though they do not breed. The organisms actively interact with their environment.

The CEM (figures 7 and 8) recognizes six (of nine) critical biological activities and processes for this life stage, ordered here as they appear on the following figures:

1. **Disease** – Although the literature does not emphasize disease as affecting population levels of SWFL, we still feel that disease bears mentioning, and it has been recommended as an area for further research (Paxton et al. 2007).

   The CEM recognizes genetic diversity and infectious agents as a habitat element affecting disease.

2. **Foraging** – The breeding adult must forage to feed itself and its young.

   The CEM recognizes anthropogenic disturbance, brood size, canopy closure, community type, diversity of vegetation, food availability, and the matrix community as affecting foraging.

3. **Predation** – Adults must avoid predation to survive.

   The CEM recognizes anthropogenic disturbance, canopy closure, community type, intermediate structure, linear width of patch, patch size, predator density, and tree density as habitat elements affecting predation.

4. **Nest Attendance** – The breeding adult must attend to the nest to incubate eggs, brood young, and feed young.

   The CEM recognizes anthropogenic disturbance, brood size, humidity, predator density, and temperature as habitat elements affecting nest attendance.

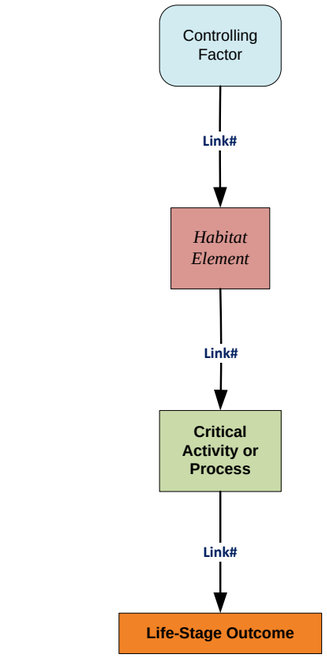
5. **Nest Site Selection** – This process includes both territory establishment and the placement of nests. Territory establishment is especially important because if a bird fails to establish a territory (or find a male with a territory in the case of females), the bird will be a floater and is unlikely to breed during that season. The breeding adult must choose where to place territories and nests, thereby affecting breeding success.

   The CEM recognizes anthropogenic disturbance, canopy closure, community type, conspecific attraction, distance to occupied patch, diversity of vegetation, humidity, intermediate structure, linear width of patch, matrix community, patch size, predator density, previous year's use, temperature, and tree density as habitat elements affecting nest site selection.

6. **Temperature Regulation** – The adult must maintain an optimum temperature to survive.

   The CEM recognizes canopy closure, humidity, intermediate structure, and temperature as habitat elements directly affecting temperature regulation.

Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (SWFL)
Basic Conceptual Ecological Model for the Lower Colorado River



Link Magnitude

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Link Understanding

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Link Predictability

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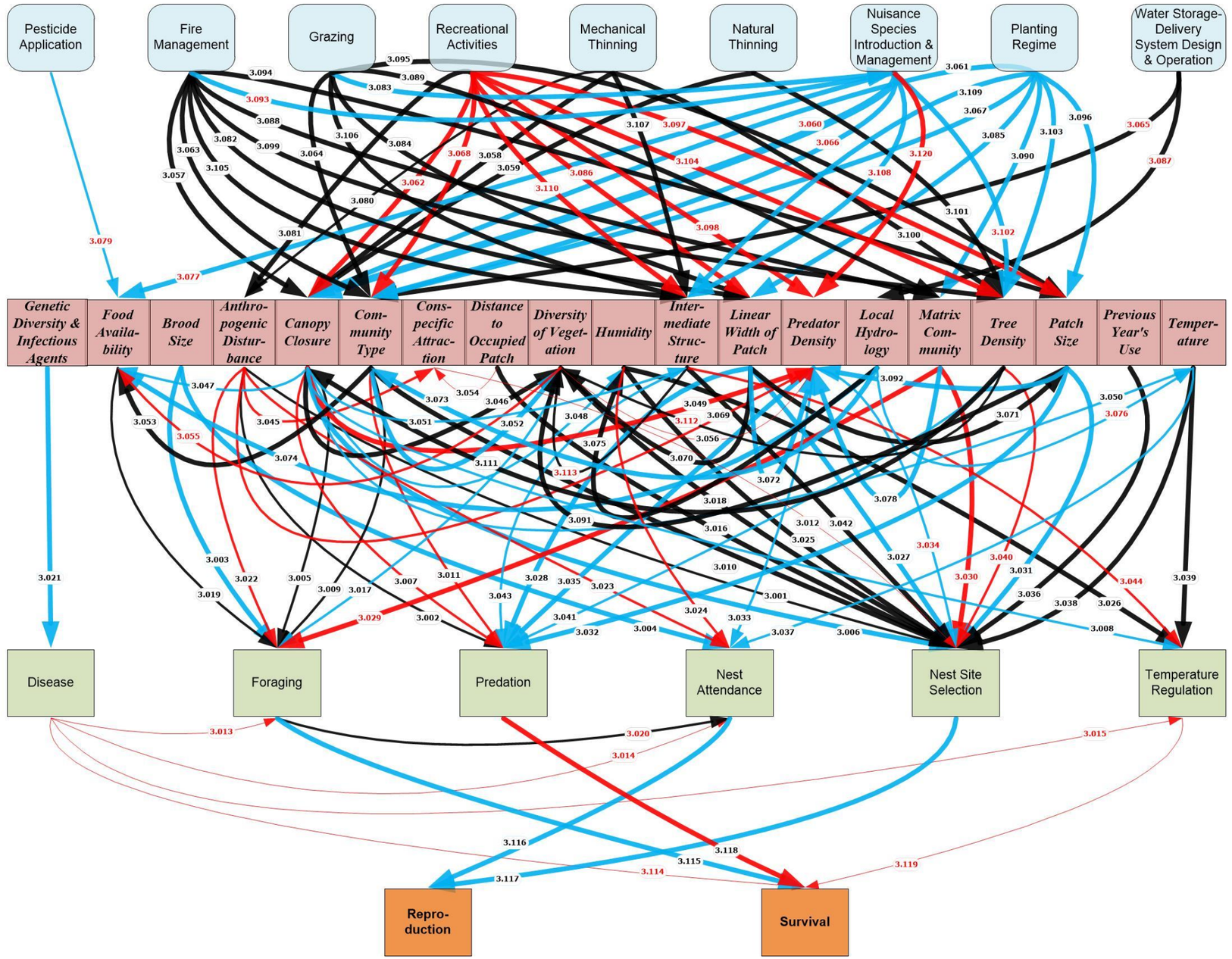
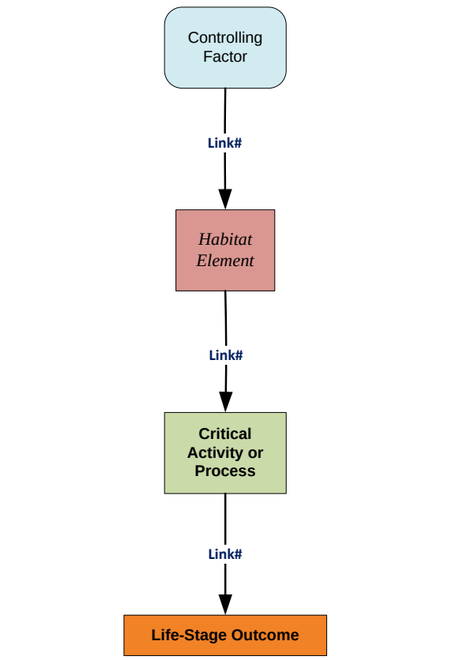


Figure 7.—SWFL life stage 3 – breeding adult, basic CEM diagram.



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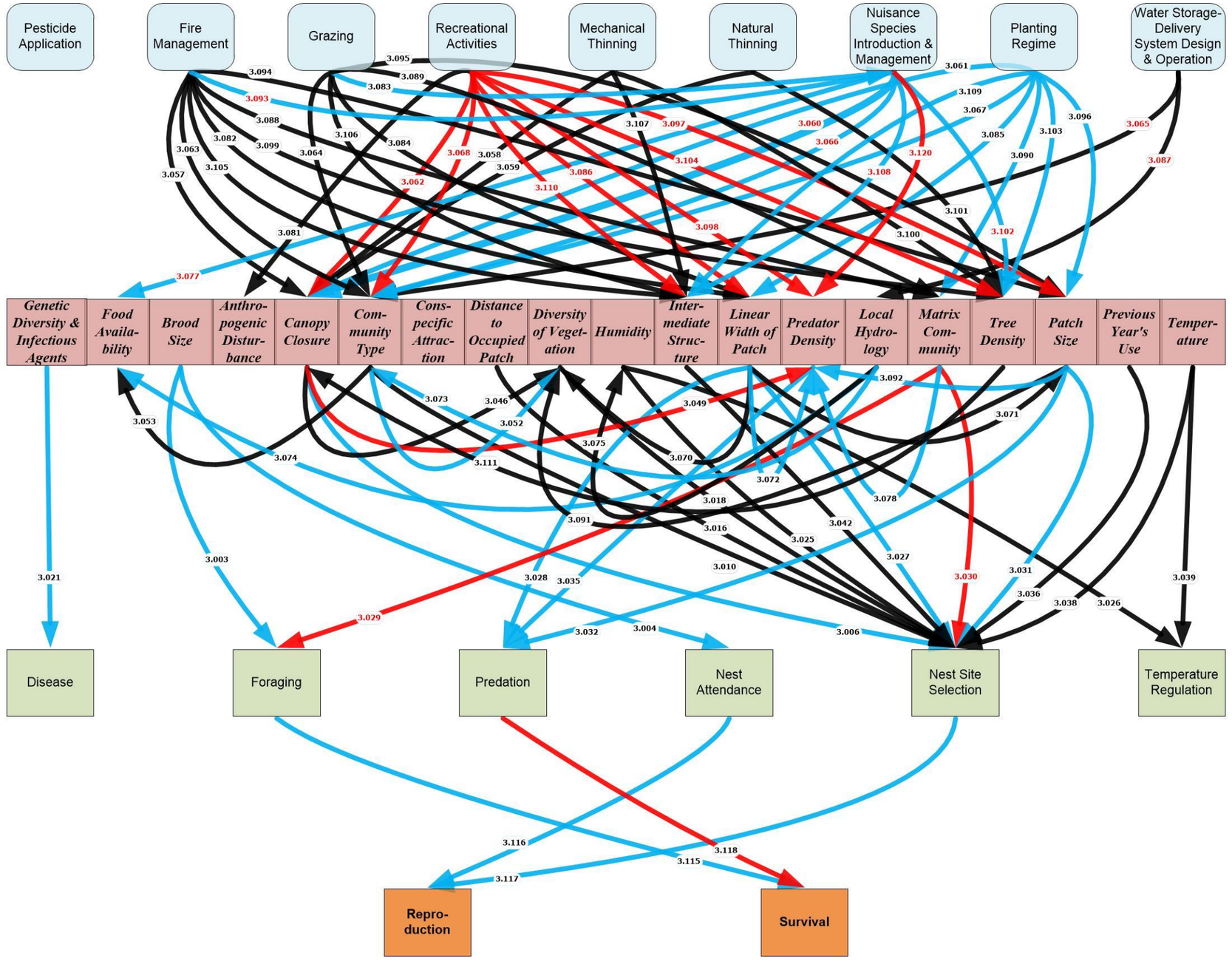


Figure 8.—SWFL life stage 3 – breeding adult, high- and medium-magnitude relationships.

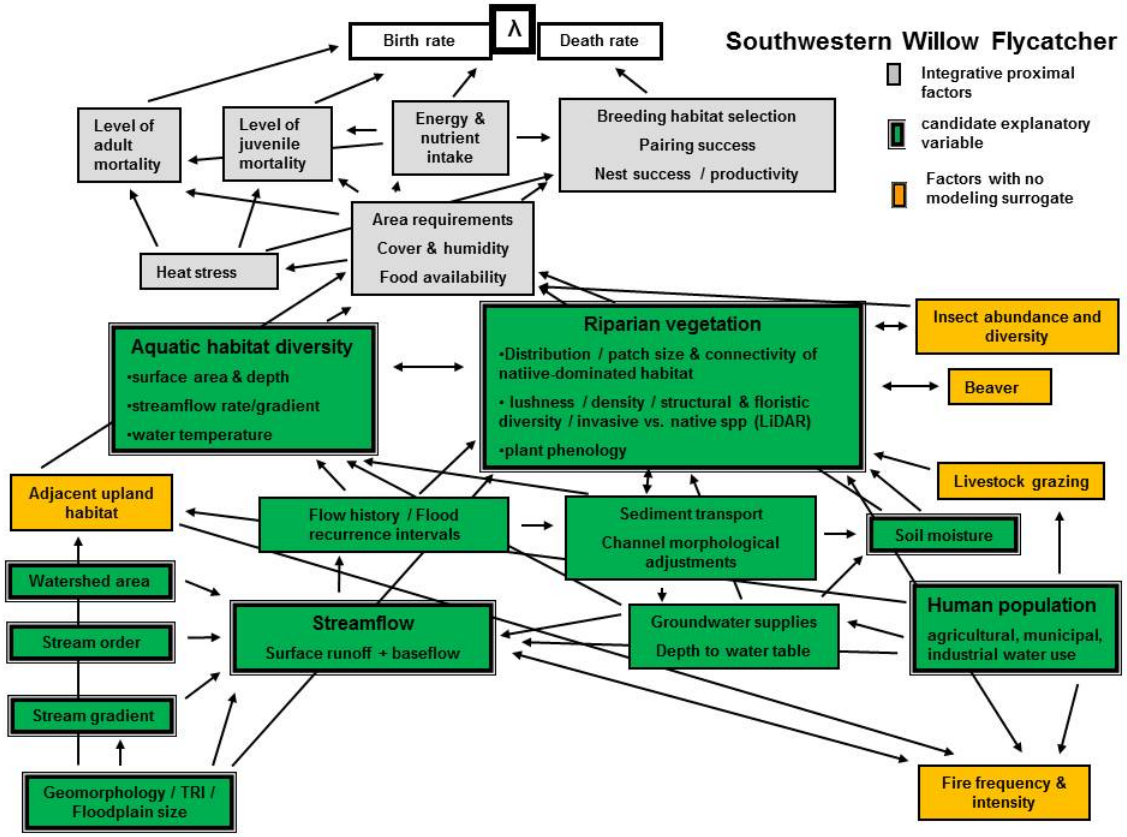


Figure F-1. Southwestern willow flycatcher conceptual model of factors that might possibly affect flycatcher and population dynamics that includes changing physiological and environmental integrative proximal factors (gray), candidate explanatory variables (green) and factors with no modeling surrogate (orange) that may affect flycatcher productivity but have no direct data to support it.

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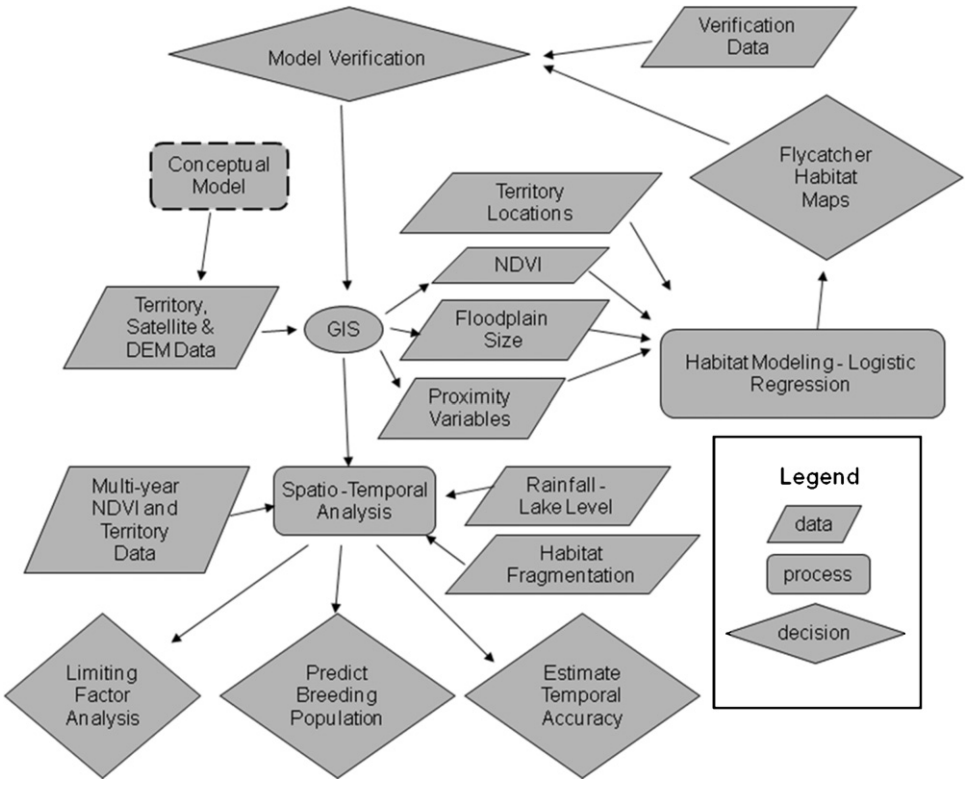


Fig. 2. A flowchart depicts the steps and processes we undertook to create and test a spatial model of Southwestern Willow Flycatcher breeding habitat at Roosevelt Lake, examine factors that limit formation of habitat, and to estimate the flycatcher breeding population.



Fig. 3. A conceptual diagram of Southwestern Willow Flycatcher breeding habitat. Habitat features thought to be important included size of floodplain, distance to water, density and heterogeneity in riparian vegetation, vegetation seral stage, and size and shape of vegetation patches.

YBCU LIFE STAGE 1 – NEST

The nest stage lasts from when the egg is laid until either the young fledge or the nest fails. Success during this life stage – successful transition to the juvenile stage – involves organism survival, maturation, molt, and fledging. The organisms actively interact with their environment.

The CEM (figures 3 and 4) recognizes five (of eight) critical biological activities and processes for this life stage. Not included are foraging, nest attendance, and nest site selection, as they are not part of the nest life stage. The critical biological processes and activities are presented here, ordered as they appear on the following figures.

1. **Disease** – Although the literature does not emphasize disease as affecting population levels of YBCU, we still feel that disease bears mentioning. Diseases and parasites are prevalent in avian populations, so it is safe to assume they have an impact on YBCU (Morishita et al. 1999). Disease and parasite impacts along the LCR is recommended as an area of potential research.

   The CEM recognizes genetic diversity and infectious agents as a habitat element affecting disease.

2. **Eating** – The nestling must eat to maintain metabolic processes.

   The CEM recognizes disease as the critical biological activity and process affecting eating, as does the habitat element of parental nest attendance.

3. **Predation** – Predation affects the survival of a nest.

   The CEM recognizes anthropogenic disturbance, canopy closure, community type, diversity of vegetation, intermediate structure, linear width of patch, parental nest attendance, patch size, predator density, and tree density as habitat elements affecting nest predation.

4. **Temperature Regulation** – The eggs and nestlings must maintain an optimum temperature to develop and survive.

   The CEM recognizes canopy closure, humidity, intermediate structure, parental nest attendance, and temperature as primary habitat elements directly affecting temperature regulation. The only critical biological activity and process having a direct impact on temperature regulation is disease.

5. **Molt** – The nestling must molt into juvenile plumage.

   The CEM recognizes the critical biological activities and processes of disease and eating as influencing molt. The CEM does not recognize any habitat elements as directly affecting molt.

Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) (YBCU)
Basic Conceptual Ecological Model for the Lower Colorado River

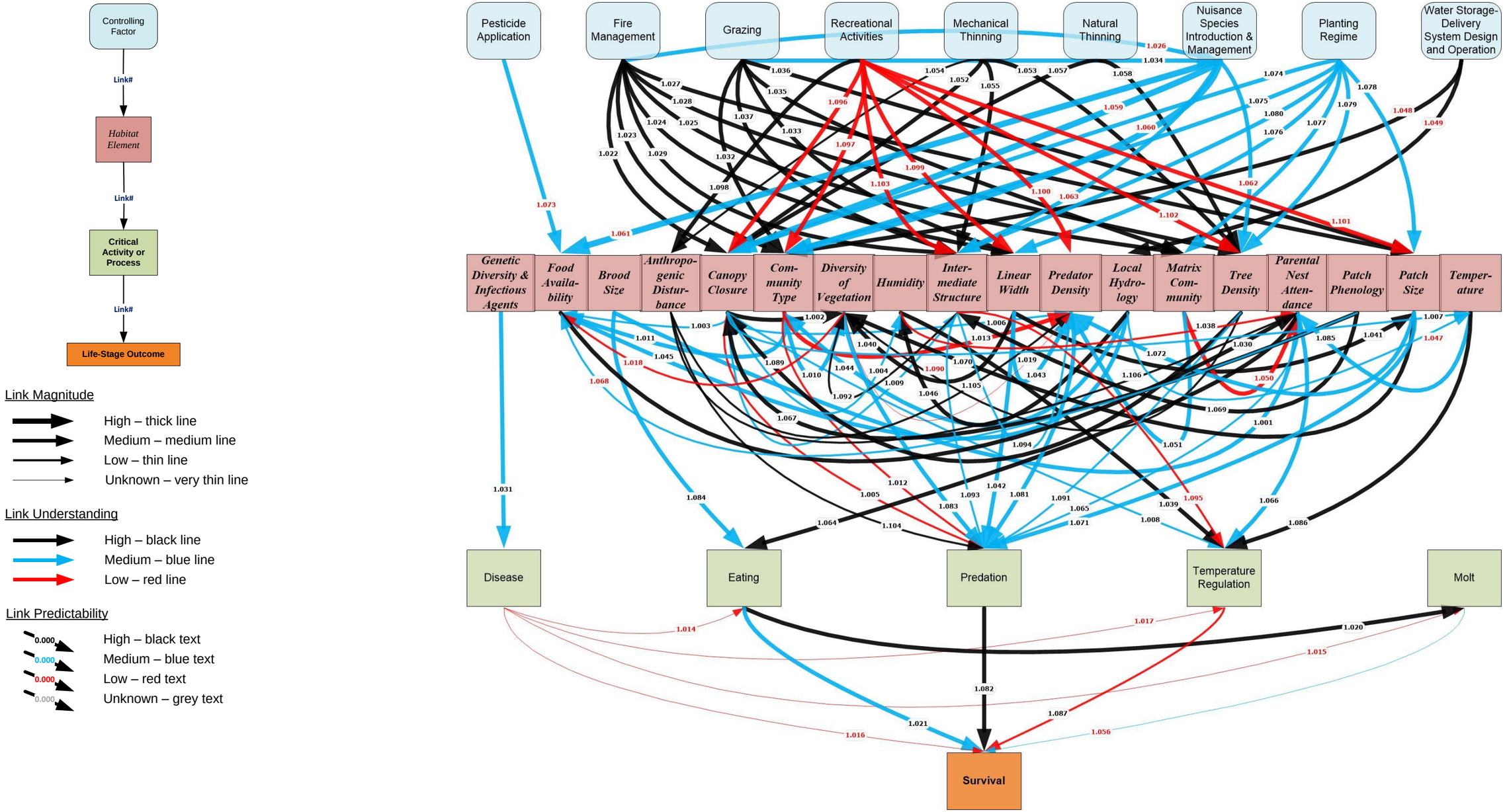


Figure 3.—YBCU life stage 1 – nest, basic CEM diagram showing the relevant controlling factors, habitat elements, and critical biological activities and processes at this life stage.

Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) (YBCU)
Basic Conceptual Ecological Model for the Lower Colorado River

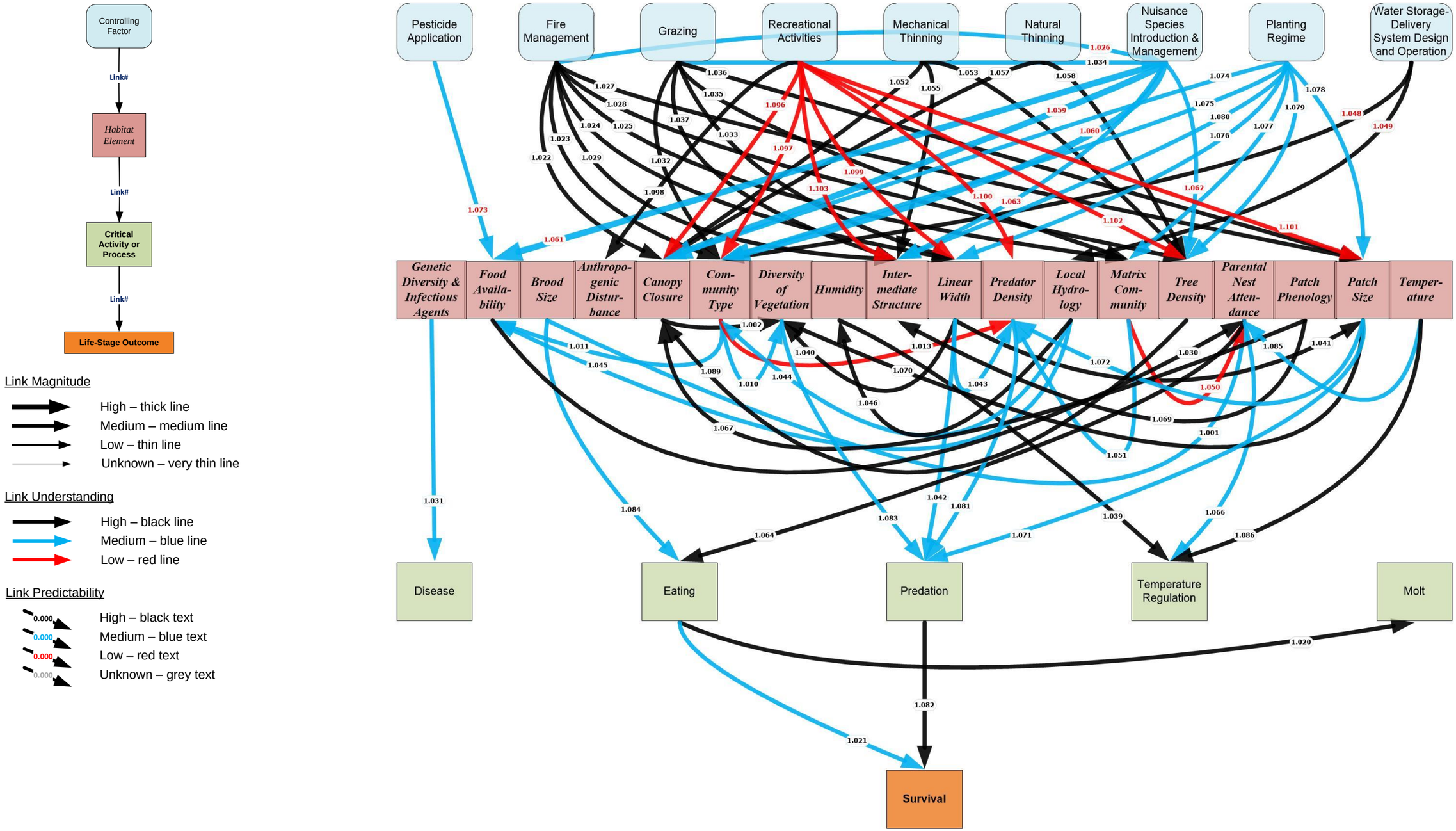


Figure 4.—YBCU life stage 1 – nest, high- and medium-magnitude relationships showing the relevant controlling factors, habitat elements, and critical biological activities and processes at this life stage.

YBCU LIFE STAGE 2 – JUVENILE

The juvenile stage begins at fledging and ends when the bird returns to the breeding grounds the next year. However, for the sake of this analysis, we will only emphasize the period between fledging and departure during autumn migration.

Success during this life stage – successful transition to the next stage – involves organism survival and maturation. The organisms actively interact with their environment.

The CEM (figures 5 and 6) recognizes five (of eight) critical biological activities and processes for this life stage. Eating, nest attendance, and nest site selection are not included, as they are part of other life stages. The critical biological processes and activities are presented here, ordered as they appear on the following figures.

1. **Disease** – Although the literature does not emphasize disease as affecting population levels of YBCU, we still feel that disease bears mentioning. Diseases and parasites are prevalent in avian populations, so it is safe to assume they have an impact on YBCU (Morishita et al. 1999). Disease and parasite impacts along the LCR is recommended as an area of potential research.

   The CEM recognizes genetic diversity and infectious agents as a habitat element affecting disease.

2. **Foraging** – Although still fed by the adult parents, the juvenile can now also forage for its own food in order to eat and maintain metabolic processes.

   The CEM recognizes anthropogenic disturbance, canopy closure, community type, diversity of vegetation, food availability, parental feeding behavior, the matrix community, and patch phenology as habitat elements affecting foraging. Foraging is directly affected by the critical biological activity and process of disease.

3. **Predation** – Predation directly affects survival.

   The CEM recognizes anthropogenic disturbance, canopy closure, community type, intermediate structure, linear width of patch, parental feeding behavior, patch size, predator density, and tree density as habitat elements directly affecting predation rates.

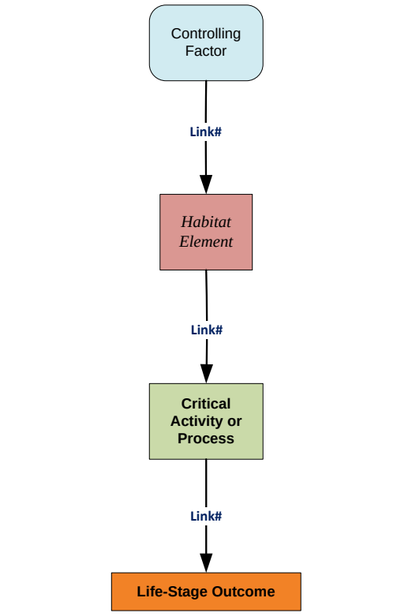
4. **Temperature Regulation** – The juvenile must maintain an optimum temperature to survive.

   The CEM recognizes canopy closure, humidity, intermediate structure, and temperature as habitat elements directly affecting temperature regulation. Disease as a critical biological activity and process can have influences on temperature regulation.

5. **Molt** – The juvenile must molt into basic plumage, and the process begins on the breeding grounds. Molt affects survival.

   The CEM does not recognize any habitat elements as directly affecting molt but many do indirectly through their impacts on foraging and eating.

Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) (YBCU)
Basic Conceptual Ecological Model for the Lower Colorado River



Link Magnitude

- High – thick line
- Medium – medium line
- Low – thin line
- Unknown – very thin line

Link Understanding

- High – black line
- Medium – blue line
- Low – red line

Link Predictability

- High – black text
- Medium – blue text
- Low – red text
- Unknown – grey text

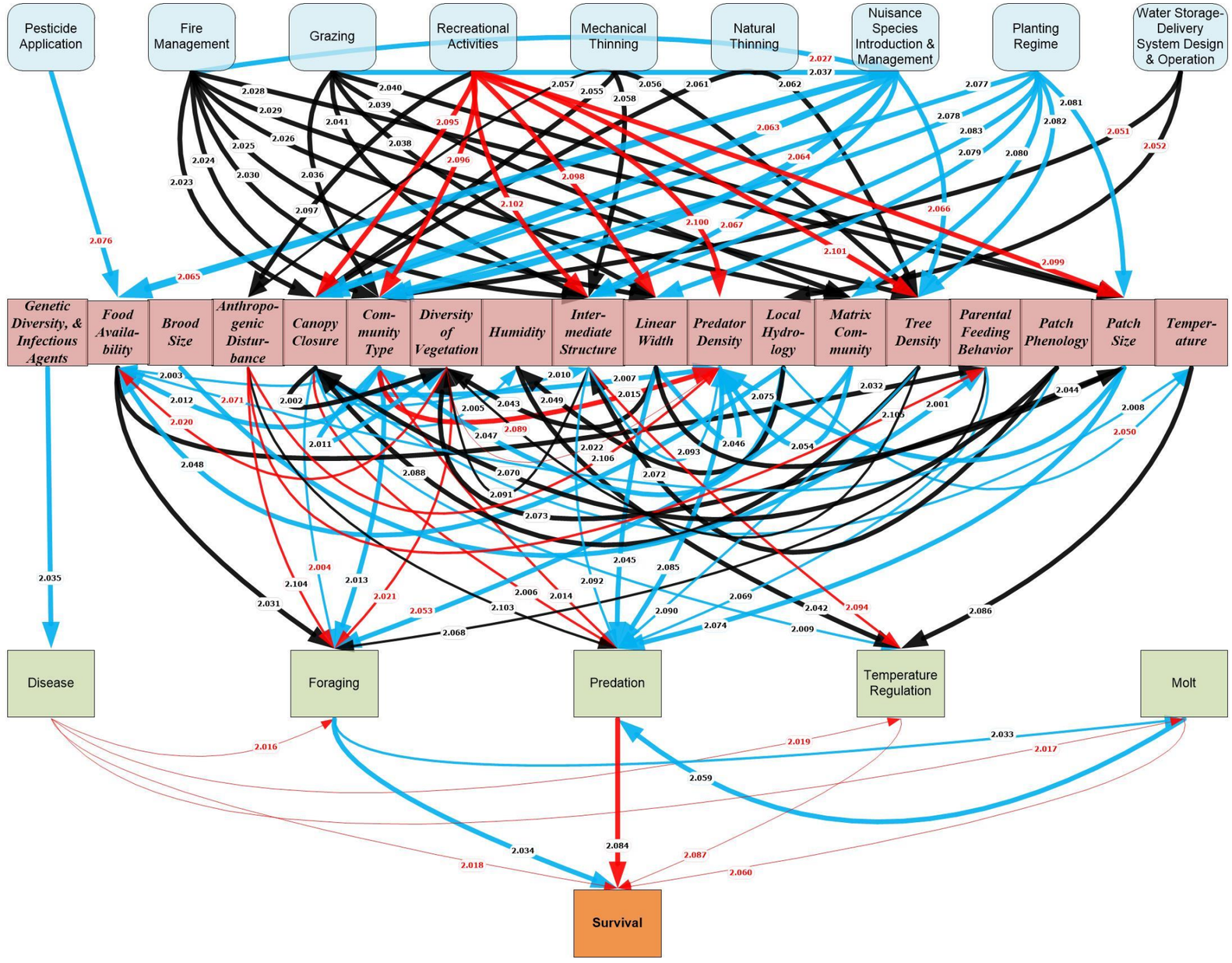
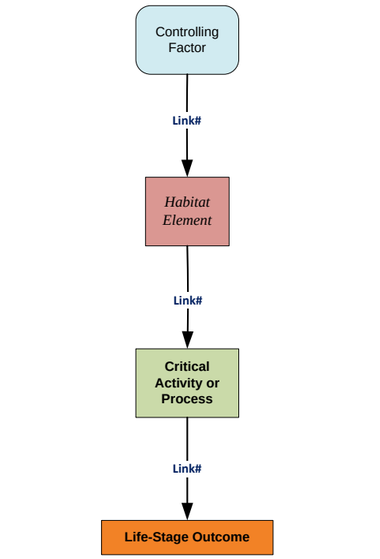


Figure 5.—YBCU life stage 2 – juvenile, basic CEM diagram showing the relevant controlling factors, habitat elements, and critical biological activities and processes at this life stage.

Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) (YBCU)
Basic Conceptual Ecological Model for the Lower Colorado River



Link Magnitude

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- Low – thin line
- Unknown – very thin line

Link Understanding

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Link Predictability

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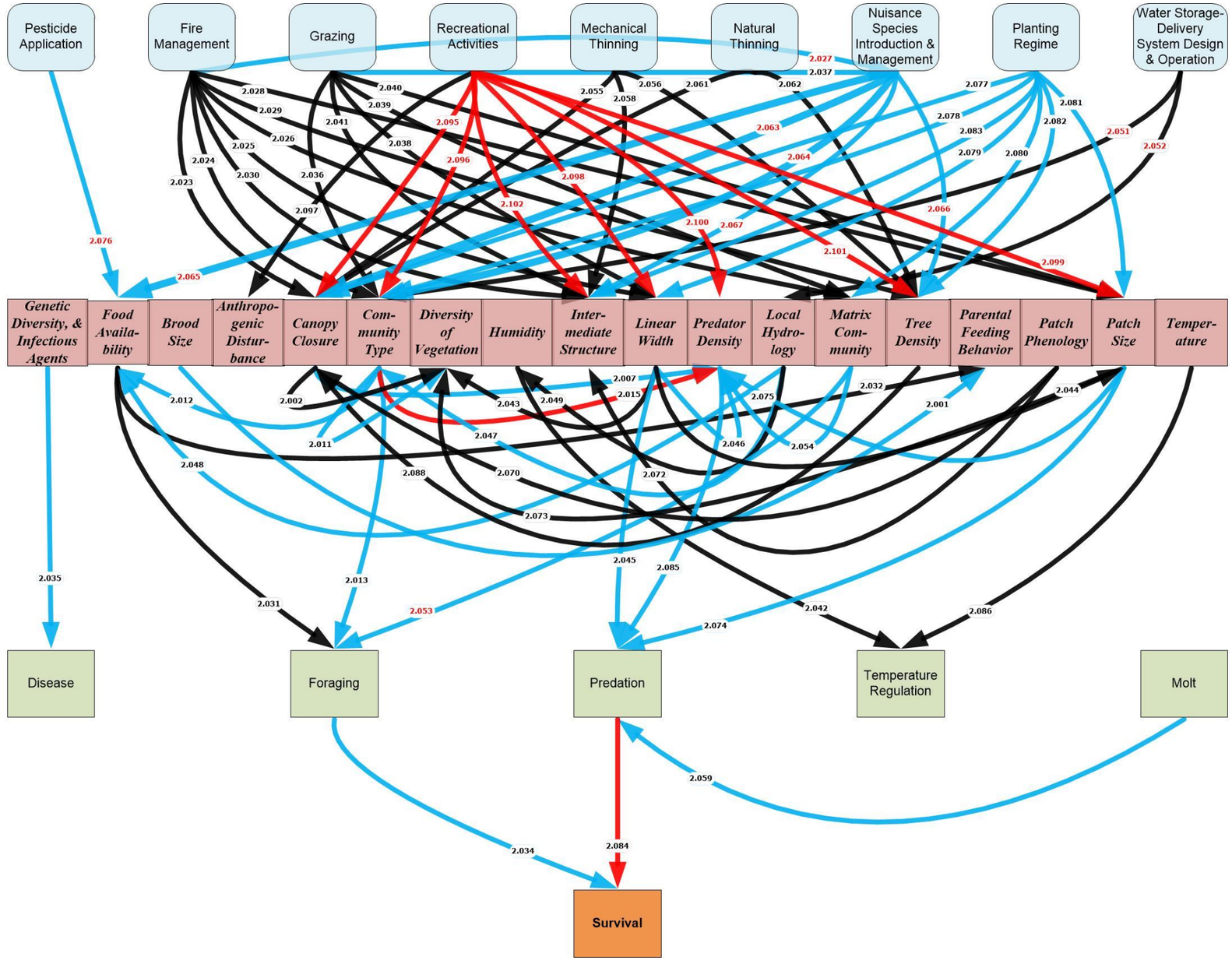


Figure 6.—YBCU life stage 2 – juvenile, high- and medium-magnitude relationships showing the relevant controlling factors, habitat elements, and critical biological activities and processes at this life stage.

YBCU LIFE STAGE 3 – BREEDING ADULT

The breeding adult stage begins when the bird returns to the breeding grounds after its first or subsequent winter and ends when it departs the breeding grounds during fall migration. Success during this life stage – successful transition to the next stage – involves organism survival and breeding. Individuals that do not successfully find a territory, floaters, are also included in this category even though they do not breed. The organisms actively interact with their environment.

The CEM (figures 7 and 8) recognizes seven (of eight) critical biological activities and processes for this life stage. Eating is not included as it is part of the nest life stage. The critical biological processes and activities are presented here, ordered as they appear on the following figures.

1. **Disease** – Although the literature does not emphasize disease as affecting population levels of YBCU, we still feel that disease bears mentioning. Diseases and parasites are prevalent in avian populations, so it is safe to assume they have an impact on YBCU (Morishita et al. 1999). Disease and parasite impacts along the LCR is recommended as an area of potential research.

   The CEM recognizes genetic diversity and infectious agents as a habitat element affecting disease.

2. **Foraging** – The breeding adult must forage to feed itself and its young. Both their survival and their young are dependent upon the foraging rate, which can be influenced by a number of factors.

   The CEM recognizes anthropogenic disturbance, brood size, canopy closure, community type, diversity of vegetation, food availability, the matrix community, and patch phenology as habitat elements directly affecting foraging. Disease is a critical biological activity and process that also directly affects foraging.

3. **Predation** – Adults must avoid predation to survive.

   The CEM recognizes anthropogenic disturbance, canopy cover, community type, linear width of patch, patch size, predator density, and tree density as habitat elements affecting predation. There are no critical biological activities and processes that directly affect predation.

4. **Nest Site Selection** – The breeding adult must choose where to place the nest, as nest placement will affect breeding success.

   The CEM recognizes anthropogenic disturbance, canopy closure, community type, diversity of vegetation, humidity, intermediate structure, linear width of patch, the matrix community, patch phenology, patch size, predator density, temperature, and tree density as habitat elements affecting nest site selection. There are no critical biological activities and processes that directly affect nest site selection.

5. **Nest Attendance** – The breeding adult must attend the nest to incubate eggs, brood young, and feed young.

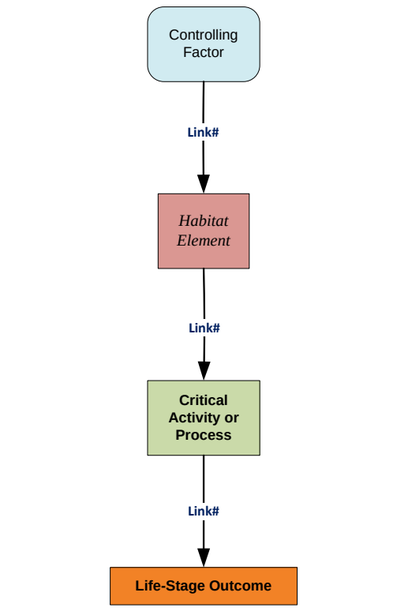
   The CEM recognizes anthropogenic disturbance, brood size, humidity, predator density, and temperature as habitat elements affecting nest attendance. Disease and foraging are the critical biological activities and processes that directly affect nest attendance.

6. **Temperature Regulation** – The adult must maintain an optimum temperature to survive.

   The CEM recognizes humidity and temperature as well as canopy closure and intermediate structure as primary habitat elements affecting temperature regulation. The critical biological activity and process of disease directly affects temperature regulation.

7. **Molt** – The adult must undergo a post-nuptual molt, and the process begins on the breeding grounds. This activity takes resources that must be directed from other biological processes. Molt requires food (through foraging) and is impacted by disease.

   The CEM does not recognize any habitat variables as directly affecting molt.



Link Magnitude

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- Unknown – very thin line

Link Understanding

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- Low – red line

Link Predictability

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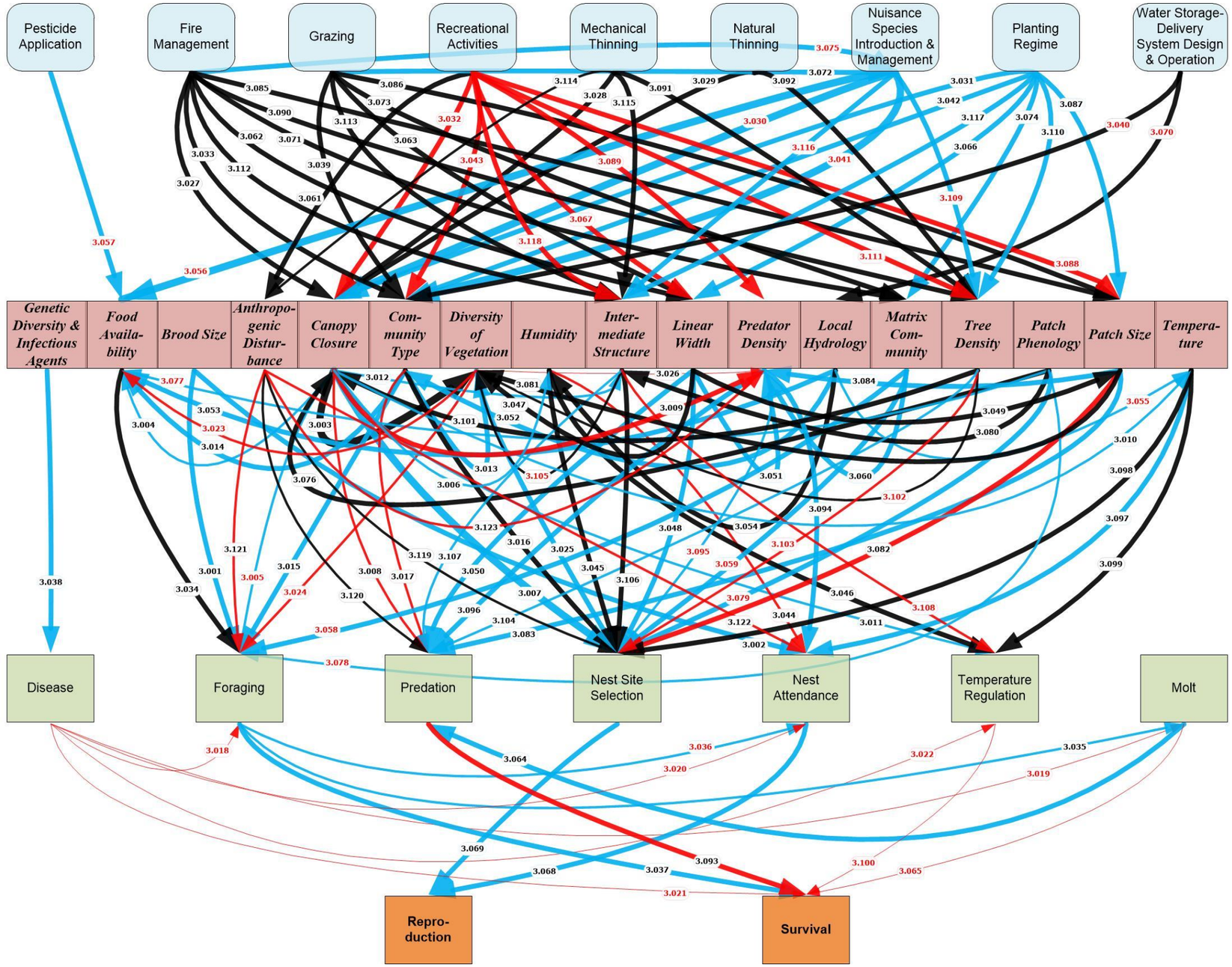


Figure 7.—YBCU life stage 3 – breeding adult, basic CEM diagram showing the relevant controlling factors, habitat elements, and critical biological activities and processes at this life stage.

Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) (YBCU)
Basic Conceptual Ecological Model for the Lower Colorado River

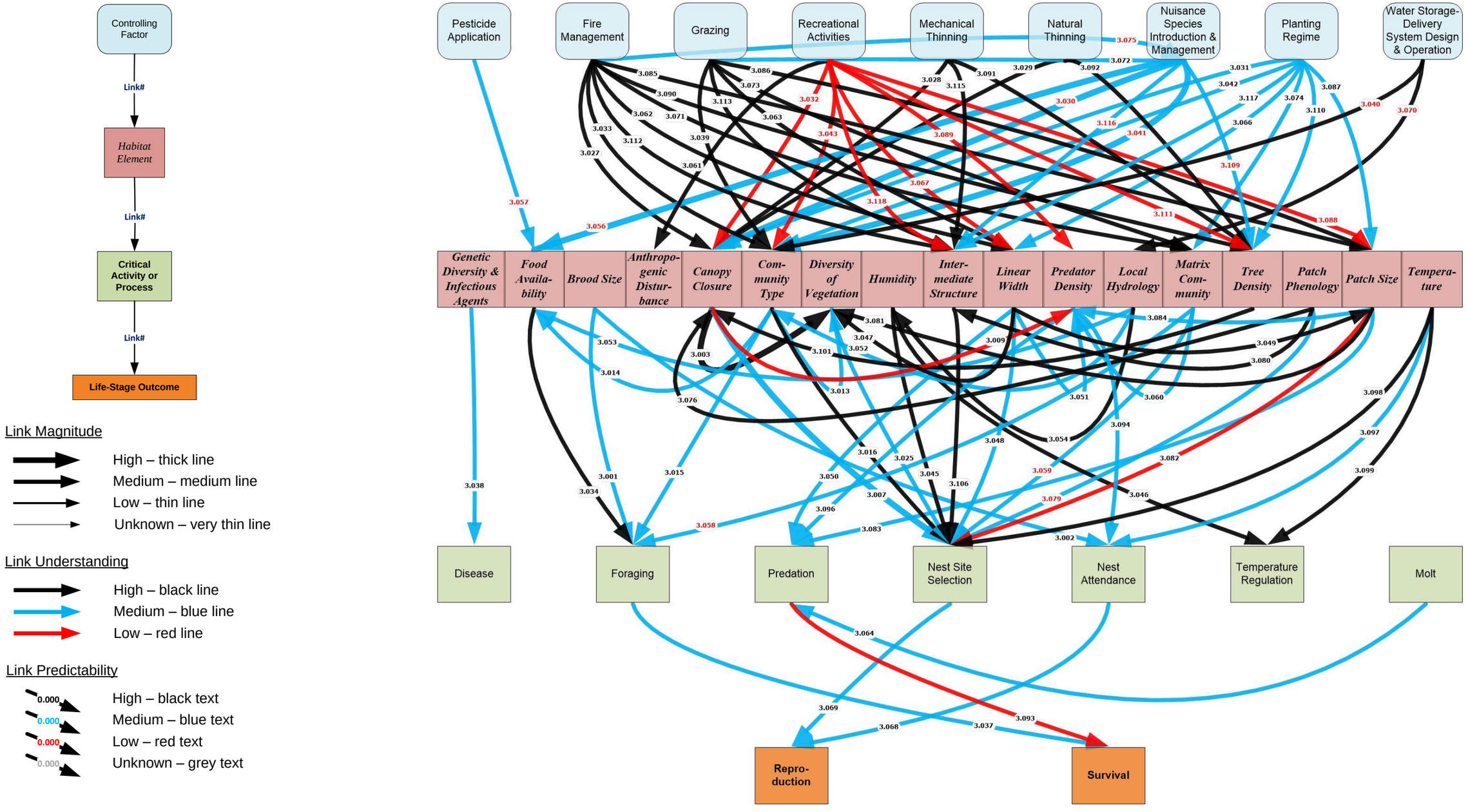


Figure 8.—YBCU life stage 3 – breeding adult, high- and medium-magnitude relationships showing the relevant controlling factors, habitat elements, and critical biological activities and processes at this life stage.

November 21, 2019

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

Draft Middle Rio Grande Endangered Species Collaborative Program Rio Grande Silvery Minnow Conceptual Ecological Model [draft]

Middle Rio Grande Endangered Species Collaborative Program Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Draft Conceptual Models V.1 [draft]

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Science and Habitat Restoration Work Group (ScW/HR)

November 21, 2019
9:00 AM – 12:00 PM

WEST Offices
8500 Menaul Blvd NE, 3rd Floor Conference Room

Meeting Agenda

9:00 – 9:10	**Welcome, Introductions, and Agenda Review** ➢ **Decision**: Approval of November 21, 2019 meeting agenda	*Program Support Team (PST)*
9:10 – 9:20	**Review of October 17, 2019 ScW/HR Meeting** • Review Action Items ➢ **Decision**: Approval of October 17, 2019 meeting minutes	*PST*
9:20 – 11:00	**Conceptual Ecological Model Discussion** • Review models developed in the October 17, 2019 meeting for RGSM, SWFL, and YBCU • Brainstorm and discuss model design options • Discuss uncertainties identified in the development of the models • Discuss next steps, including project development	*Group Discussion*
11:00-11:10	**Break**	*Group Discussion*
11:10 – 11:45	**ScW/HR 2020 Workplan** • Identify tasks to include in the 2020 work plan	*Group Discussion*
11:45-11:55	**RGSM Genetics SOW Update**	*PST*
11:55-12:00	**Additional Items and Next Meeting Date** ➢ **Action Item**: Determine agenda items for the next ScW/HR meeting ➢ **Action Item**: Set date(s) for future meeting(s)	*Group Discussion*
12:00	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Science and Habitat Restoration Work Group (ScW/HR)
Meeting Minutes

November 21, 2019
Location: Western Ecosystems Technology, Inc. (WEST)
8500 Menual Blvd NE, Albuquerque, NM 87112

Decisions:

- ✓ Approved November 21, 2019 meeting agenda
- ✓ Approved October 17, 2019 meeting minutes

Actions:

WHO	ACTION ITEM	BY WHEN
Program Support Team (PST)	Digitize progress made on conceptual ecological models (CEMs) for each species	December 9
PST	Populate the yellow-billed cuckoo (YBCU) spreadsheet to inform CEM development	December 9
PST and Terry McDill	Discuss criteria to designate variable weighting for CEMs for the avian species	December 9
Clint Smith and Lynette Giesen	Follow up with Vicky Ryan and Steven Ryan regarding avian CEMs	December 9
PST	Draft ScW/HR 2020 work plan based on tasks identified at the November 21 ScW/HR meeting	January 9
PST and ScW/HR Co-Chairs	Add time to discuss ongoing Rio Grande silvery minnow (RGSM) genetics work to January ScW/HR meeting agenda	January 9
All	Complete and present CEMs for RGSM, southwestern willow flycatcher (SWFL), and YBCU to the Adaptive Management Work Group (AMWG)	March 2020
All	Plan and participate in field trips	Throughout 2020

Next Meeting: December 9, 2019 from 9am – 12pm; every 2nd Thursday of the month thereafter through April 2020

Meeting Notes

Welcome, Introductions, and Agenda Review

- ✓ **Decision**: Approved November 21, 2019 meeting agenda

Review of October 17, 2019 ScW/HR Meeting Action Items and Minutes

- ✓ **Decision**: Approved October 17, 2019 meeting minutes

Conceptual Ecological Model Discussion

The ScW/HR split into groups and reviewed models developed for RGSM, SWFL, and YBCU during the October 17, 2019 meeting. Each group discussed model design options, identified uncertainties associated with each species, and discussed next steps, including project development.

ScW/HR 2020 Work Plan

The work group identified tasks for inclusion in the 2020 ScW/HR work plan, including:

- Refinement and finalization of CEMs for RGSM, SWFL, and YBCU by February 2020
- Presentation of finalized CEMs to the AMWG
- Prioritization of uncertainties identified in the CEM development process by March 2020 for the RGSM, SWFL, and YBCU
- Utilizing uncertainties identified in the CEM building process, the ScW/HR will submit scope of work (SOW) descriptions to the EC for review prior to April 2020
    - One signatory requested that after uncertainties are identified, the PST could pull together all of the SOW ideas related to those uncertainties for the group to consider
- Development of CEMs for Pecos sunflower (PESU) and New Mexico meadow jumping mouse (NMMJM) on or before July 2020.
    - It was suggested that experts may need to be brought in or contracted to complete these CEMs
- Submission of full SOWs to the EC for approval by August 2020
- Begin discussion of uncertainties to address in 2021 by September 2020
- Participate in the planning of the next Middle Rio Grande Endangered Species Collaborative Program (Program) Science Symposium
- Plan and participate in field trips for 2020
    - One group member suggested that field trips would provide learning opportunities for group members to experience what the river looks like in different conditions and at different times of the year.

Following the work plan discussion, the ScW/HR members identified a need to track new, ongoing, and completed projects to assist in understanding all that is happening in the Middle Rio Grande. The Program's annual report and Science Symposium were identified as excellent tools that assist in information dissemination.

RGSM Genetics SOW Update

An update was given on the status of the development of a single nucleotide polymorphism (SNP) panel for RGSM. Megan Osborne, University of New Mexico, will be presenting an update on this

work at the Program's Science Symposium in December, and will give an annual presentation to the ScW/HR in early 2020.

The group was asked if the genetics sub-group should meet to discuss next steps following the development of the SNP panel.

- The group decided to revisit this question in early 2020.

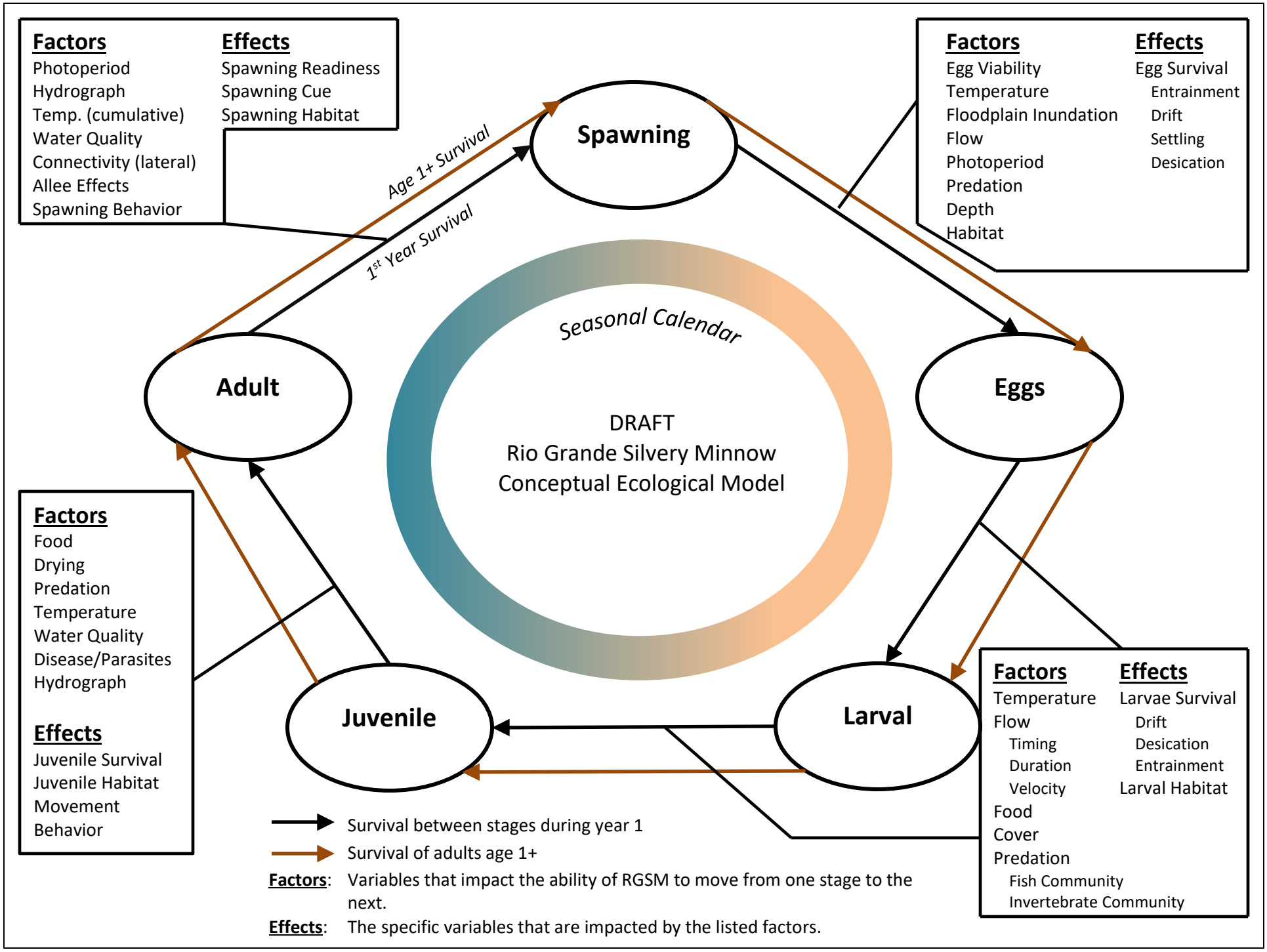
Additional Items and Next Meeting Date

Next meeting: December 9, 2019 from 9am – 12pm to discuss CEMs for RGSM, SWFL, and YBCU.

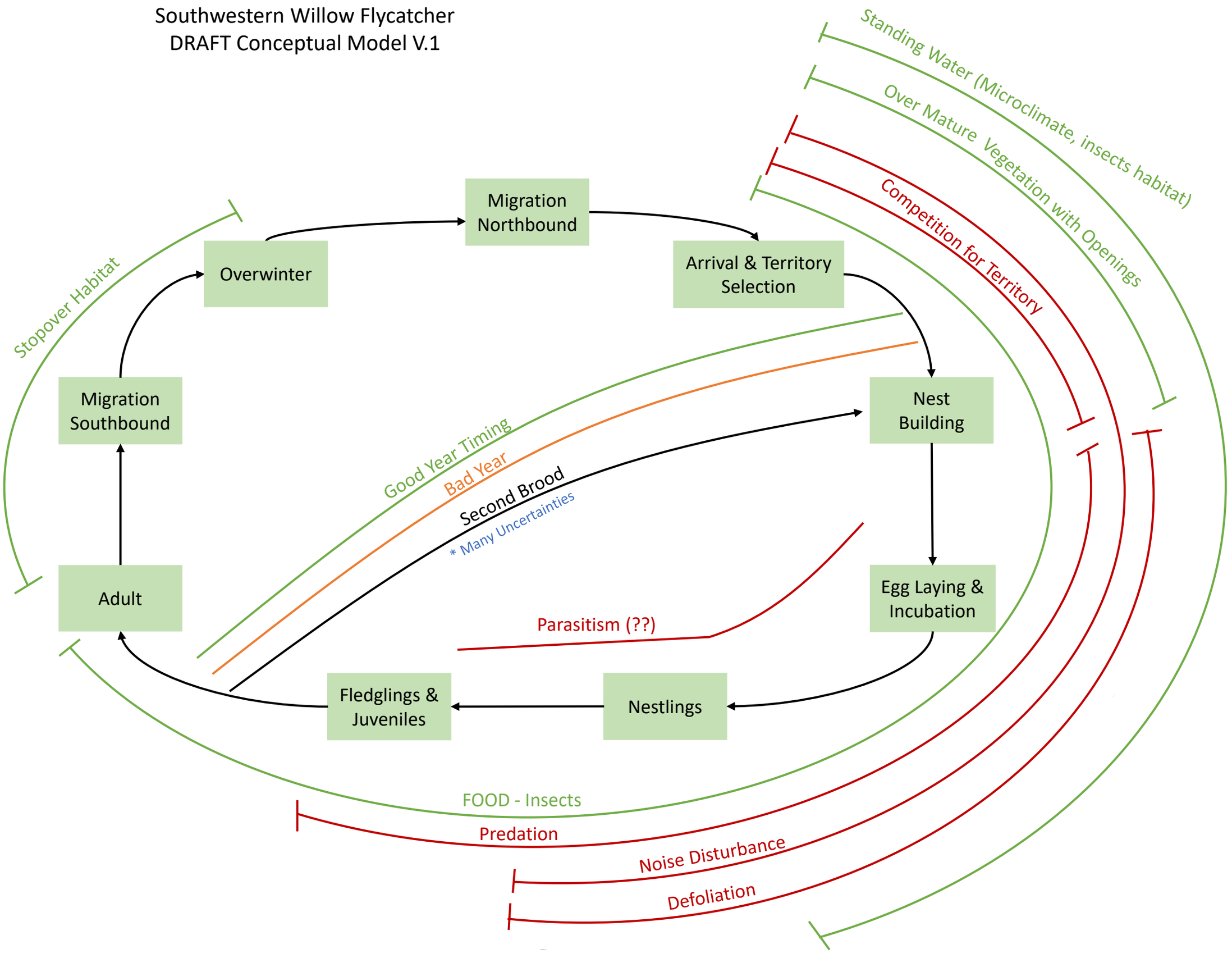
The first ScW/HR meeting of 2020 will be January 9th, with meetings taking place on the 2nd Thursday of the month in February, March, and April.

Meeting Participants

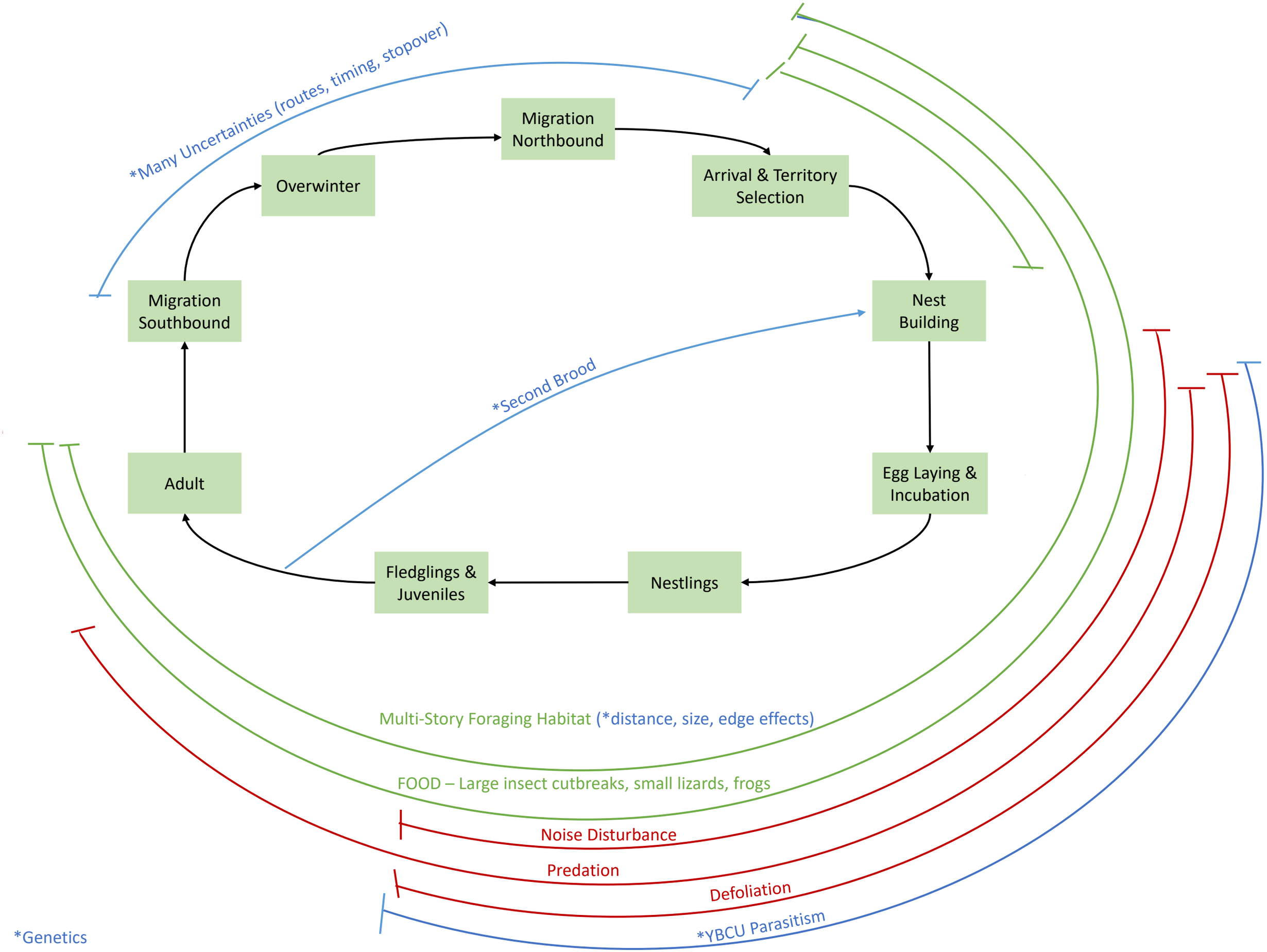
Participant	Organization
Amy Erickson	Audubon Society of New Mexico
Anne Marken	Middle Rio Grande Conservancy District
Ara Winter	Bosque Ecological Monitoring Program
Ashlee Rudolph	U.S. Bureau of Reclamation
Ashley Tanner	Program Support Team
Aubrey Harris	U.S. Army Coprs of Engineers
Clint Smith	U.S. Fish and Wildlife Service
Dana Price	U.S. Army Coprs of Engineers
Debbie Lee	Program Support Team
Grace Haggerty	NM Interstate Stream Commission
Kiara Takacs	Program Support Team
Lynette Giesen	U.S. Army Corps of Engineers
Meaghan Conway	NM Department of Game and Fish
Mick Porter	U.S. Army Corps of Engineers
Mike Marcus	Assessment Payers Association
Mo Hobbs	Albuquerque and Bernalillo County Water Utility Authority
Nathan Schroeder	Pueblo of Santa Ana
Ondrea Hummel	TetraTech
Trevor Birt	NM Interstate Stream Commission


Factors
Photoperiod
Hydrograph
Temp. (cumulative)
Water Quality
Connectivity (lateral)
Allee Effects
Spawning Behavior
Effects
Spawning Readiness
Spawning Cue
Spawning Habitat
Spawning
Age 1+ Survival
1st Year Survival
Factors
Egg Viability
Temperature
Floodplain Inundation
Flow
Photoperiod
Predation
Depth
Habitat
Effects
Egg Survival
Entrainment
Drift
Settling
Desication
Seasonal Calendar
DRAFT
Rio Grande Silvery Minnow
Conceptual Ecological Model
Adult
Eggs
Factors
Food
Drying
Predation
Temperature
Water Quality
Disease/Parasites
Hydrograph
Effects
Juvenile Survival
Juvenile Habitat
Movement
Behavior
Juvenile
Larval
Factors
Temperature
Flow
Timing
Duration
Velocity
Food
Cover
Predation
Fish Community
Invertebrate Community
Effects
Larvae Survival
Drift
Desication
Entrainment
Larval Habitat
Survival between stages during year 1
Survival of adults age 1+
Factors: Variables that impact the ability of RGSM to move from one stage to the next.
Effects: The specific variables that are impacted by the listed factors.

Southwestern Willow Flycatcher
DRAFT Conceptual Model V.1



Yellow-billed Cuckoo
DRAFT Conceptual Model V.1



January 9, 2020

Documents:

Meeting Agenda

Meeting Minutes

Read-Aheads and Presentations

- *Draft Science and Habitat Restoration Work Group 2020 Work Plan [draft]*
- *Goals for Conceptual Ecological Models*
- *Draft Middle Rio Grande Endangered Species Collaborative Program Rio Grande Silvery Minnow Conceptual Ecological Model [draft]*
- *Rio Grande Silvery Minnow Uncertainties Identified on 11/21/2019*
- *Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Life Cycle Model*
- *Draft Southwestern Willow Flycatcher Conceptual Ecological Model Life Stages [draft]*
- *Draft Transition Matrices for Rio Grande Silvery Minnow [draft]*
- *Draft Yellow-Billed Cuckoo Conceptual Ecological Model Life Stages [draft]*

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Science and Habitat Restoration Work Group (ScW/HR)
Meeting Agenda

January 9, 2020
9:00 AM – 12:00 PM

U.S. Fish and Wildlife Service
2105 Osuna Rd NE, Albuquerque, NM

Meeting Agenda

9:00 – 9:15	**Welcome, Introductions, and Agenda Review** ➢ **Decision**: Approval of January 9, 2020 meeting agenda ➢ Review meeting agenda	*Program Support Team (PST)*
9:15-9:30	**2020 Work Plan** • Review Draft 2020 Work Plan (Read-Ahead)	*ScW/HR Discussion*
9:30 – 10:20	**Conceptual Ecological Model Discussion** • Review progress made in model development for Rio Grande silvery minnow (RGSM), southwest willow flycatcher (SWFL), and yellow-billed cuckoo (YBCU) • Continue refining models	*Small Group Discussion*
10:20 – 10:30	**Break**	
10:30 – 11:00	**Identification of 1-3 Critical Uncertainties per Species**	*Small Group Discussion*
11:00 – 11:30	**Project/SOW Brainstorming** • Discuss projects/SOWs that could be developed based on the identified critical uncertainties	*Small Group Discussion*
11:30 – 11:50	**Presentation of Models** • RGSM • SWFL • YBCU	*ScW/HR Discussion*
11:50 – 12:00	**Announcements**	*All*
12:00	**Adjourn**	

Middle Rio Grande Endangered Species Collaborative Program

Est. 2000

Science and Habitat Restoration Work Group (ScW/HR)
Meeting Minutes

January 9, 2020 9:00 AM – 12:30 PM
Location: U.S. Fish & Wildlife Service
2105 Osuna Rd NE, Albuquerque, NM

Decision Log:

- ✓ Approval of January 9, 2020 meeting agenda.

Action Items and Next Steps:

WHO	WHAT	BY WHEN
PST	Edit one transition probability schematic and send to the RGSM small group to review the design	January 15
PST	Revise bird CEM life stage charts to include new variables identified at meeting	January 15
PST	Distribute list of critical uncertainties identified at previous CEM meetings for all three species	January 15
RGSM small group	Send Ashley Tanner (PST) top three critical uncertainties for RGSM	January 24
RGSM small group	Send any comments on transition probability schematic design to Ashley T.	January 24
ScW/HR members	Provide the PST any edits to the work group membership roster	January 30
PST	Revise 2020 ScW/HR Work Plan for review at the February Executive Committee meeting, including the following edits: • Tasks 1 and 2: Add a purpose statement for the development of conceptual ecological models and critical uncertainties • Task 2: Include a subtask to present to the AMWG on how uncertainties are prioritized and progress to date • Task 3: Include a subtask to incorporate feedback from the AMWG in the development of possible projects and scopes of work	February 3
ScW/HR members	Inform the PST of any potential field trip ideas, or offers to lead a field trip.	Ongoing

- ➢ **Next ScW/HR meeting**: January 28, 2020, 9:00 AM - 12:30 PM

Meeting Minutes

Welcome, Introduction, and Agenda Review

Ashley Tanner, Program Support Team (PST), opened the meeting and reviewed the meeting agenda.

- Decision: The January 9, 2020 ScW/HR meeting agenda was approved

2020 Work Plan

Ashley T. reminded ScW/HR members that at the December 18, 2019 meeting, the group had discussed tasks to include in the 2020 ScW/HR Work Plan. She presented the draft Work Plan, developed based on the December 18th conversation, and the group discussed the tasks as laid out. The group agreed to the following edits prior to presentation at the February 10, 2020 Executive Committee (EC) meeting:

- Fix the numbering on the Work Plan
- Tasks 1 and 2: include a purpose statement for the development of conceptual ecological models (CEMs)
- Task 2: include a subtask for the ScW/HR to get feedback from the Adaptive Management Work Group (AMWG) on the development of possible projects and scopes of work (SOWs)
- Task 3: include a subtask for the ScW/HR to incorporate feedback from the AMWG on how uncertainties are prioritized and the progress to date

- **Action Item:** PST revise the 2020 Work Plan with the edits listed above, and present to the EC at the February 10 meeting.
- **Action Item**: ScW/HR members provide the PST any edits to the membership roster.

The ScW/HR discussed options for future Science Symposia or alternatives. Ashley noted that in the feedback received, opinions were split about whether a Symposium should be held every year or every 2-3 years. One option was to have a Symposium biennially with another event on the off-years. These could include field events, a session at another conference, or smaller targeted workshops. During the conversation, the following suggestions were raised:

- Focus on different topics in different years (e.g., birds one year, fish another year). A few participants voiced support for this, with some others noting that one of the strengths of the 2019 Symposium was seeing work outside of an individual's focal area.
- Field trips would fill the gaps in off years. Field trips could include multiple sites and could cover more than one topic area.
    - One participant cautioned about having large field trips far away from Albuquerque, as it might limit the ability of people to attend.
    - One participant requested that any field events happen in the spring and fall.

- **Action Item**: Convene the Symposium small planning group to discuss alternatives and options.

The ScW/HR also discussed potential field trip options in more detail. Ashley informed the group that having field trips requires ScW/HR members to take a more active role in suggesting locations, and even leading them. The following suggestions were made:

- Southwestern willow flycatcher (SWFL) habitat

- **Action Item**: ScW/HR members provide the PST with field trip suggestions, and/or offers to lead a field trip.

Conceptual Ecological Models (CEMS)
The ScW/HR broke into two groups: one to discuss the Rio Grande silvery minnow (RGSM) CEM, and a second to discuss the SWFL and yellow-billed cuckoo (YBCU) CEMs. Following the small group discussions, each presented to the full ScW/HR.

Birds
The birds group added two additional variables to the CEMs for both species: fire and an increase of large herbivores. Members agreed to develop a glossary of terms to explain the different variables that appear in the base model.

They identified the following key uncertainties for each species:

- SWFL:
  - What is the overall use of habitat restoration (HR) sites? Specifically, how to attract SWFL to HR sites? What is the plant species diversity that attracts SWFL?
  - How does soil health and composition impact the success of HR sites?
  - What is the edge effect for SWFL territories? What kinds of edges are better (i.e., edge-adjacent habitat composition)?
- YBCU:
  - What degree of habitat fragmentation impacts colonization and occupancy?
  - What is the optimal plant species composition for insect populations that are food sources for YBUC?
  - What habitat characteristics appeal to both SWFL and YBCU (including edge effects)?

The birds group also brainstormed the following potential project ideas based on the above uncertainties:

- A soil moisture holding capacity study
- A study looking at insect host plants and the relationship with YBCU foraging habitat
- An analysis of overbank flow and its relationship with territory selection in the successive year
- An evaluation of aerial imagery and occupied habitat in order to determine (1) overlap in habitat characteristics for the two species, and (2) edge effects

- **Action Item**: PST will revise the SWFL and YBCU CEMs to include the new variables.

Fish
The fish group completed the transition probability schematics for the RGSM CEM.

- **Action Item**: PST will complete one transition probability schematic for review by the fish group
- **Action Item**: The fish group will send the PST their top three critical uncertainties before January 28
- **Action Item**: The PST will distribute the list of uncertainties identified over the course of the CEM development

Announcements

- Ashley T. has moved to Texas but is still working with the Program. Please call her cell phone or email to get in touch with her.

➢ **Next meeting**: January 28, 2020, 9:00 AM – 12:30 PM, location TBD

Meeting Participants

Alison Hutson, N.M. Interstate Stream Commission
Amy Erickson, Audubon New Mexico
Andy Dean, U.S. Fish and Wildlife Service
Anne Marken, Middle Rio Grande Conservancy District
Ashley Tanner, Program Support Team
Brian Hobbs, U.S. Bureau of Reclamation
Dana Price, U.S. Army Corps of Engineers
Danielle Galloway, U.S. Army Corps of Engineers
Dave Campbell, U.S. Fish and Wildlife Service
Debbie Lee, Program Support Team
Eric Gonzales, U.S. Bureau of Reclamation
Kate Mendoza, Albuquerque-Bernalillo County Water Utility Authority
Mick Porter, U.S. Army Corps of Engineers
Mike Marcus, Assessment Payers Association
Mo Hobbs, Albuquerque-Bernalillo County Water Utility Authority
Nathan Schroeder, Pueblo of Santa Ana
Ondrea Hummel, Tetra Tech
Steve Ryan, U.S. Army Corps of Engineers
Thomas Archdeacon, U.S. Fish and Wildlife Service
Vicky Ryan, U.S. Fish and Wildlife Service

Science and Habitat Restoration Work Group
2020 Work Plan

PURPOSE:
Complete the Middle Rio Grande Endangered Species Collaborative Program (Program) Science and Habitat Restoration Work Group (ScW/HR) 2020 Work Plan as approved at the [DATE] ScW/HR meeting.

TASKS AND MANAGEMENT/SCIENCE IMPLICATIONS:
The following tasks are not listed in any specific order. The numbering is intended for conversational reference.

1) **Develop Conceptual Ecological Models for the New Mexico Meadow Jumping Mouse (NMMJM), Pecos Sunflower (PESU), Rio Grande Silvery Minnow (RGSM), Southwest Willow Flycatcher (SWFL), and Yellow-billed Cuckoo (YBCU).**

In the fall of 2019, the Adaptive Management Work Group (AMWG) tasked the ScW/HR with developing conceptual ecological models for the five species encompassed within the Program. Utilizing subject matter experts, the ScW/HR will develop conceptual ecological models for the RGSM, SWFL, and YBCU by February 2020. Development of models for the NMMJM and PESU will begin by July 2020. All models will be presented to the AMWG.

2) **Identify and Prioritize Uncertainties Developed during the Conceptual Ecological Model Building Process**

The ScW/HR will identify uncertainties during the conceptual ecological model building process, prioritize those uncertainties, and identify overlap in uncertainties between species. These uncertainties will drive project/scope of work (SOW) development each year. The ScW/HR will identify, asses, and prioritize uncertainties for the RGSM, SWFL, and YBCU starting in March 2020.

3) **Develop Fiscal Year (FY) 2021 Project/SOW Descriptions and Full SOWs for Executive Committee (EC) Consideration**

The ScW/HR will utilize uncertainties identified in the conceptual ecological model building process to develop project/SOW descriptions for EC review by April 2020. Approved project/SOW descriptions will be developed into full SOWs for EC consideration by August 2020.

4) **Determine Priorities for 2021**

The ScW/HR will discuss and identify which uncertainties will be a focus of project/SOW development for 2021 starting in September 2020. Project/SOW development for 2021 will begin immediately after this task is complete.

5) **Consult as Needed with the AMWG**

The ScW/HR will continue to consult with the AMWG as needed to assist with Program planning and adaptive management (AM) moving forward.

6) Continue Data Inventory and Consolidation Efforts

The Program signatories have collected a large amount of data, including, but not limited to, endangered species population numbers, hydrology, water quality, and habitat restoration.

There is a need to inventory these data, and to consolidate datasets where possible. This will inform the Program's science and AM activities, and minimize duplicate efforts. Data inventory and consolidation will be a targeted and objective-driven effort, concentrating on specific datasets of interest to better meet the needs of the end data users. The ScW/HR will work with the U.S. Geological Survey (USGS) and those working to develop the Program Portal (formerly the Program's database management system [DBMS]) to ensure that all data consolidation efforts result in a dataset that can be uploaded onto the Program Portal.

7) Continue Participation in Program Portal Maintenance and Updates

The USGS developed and launched a new Program Portal in December 2019 to replace the Program's prior database management system (DBMS). This Program Portal will need to be responsive to the needs of the Program, including its scientists and technical experts. The ScW/HR will provide input to the USGS as needed. Overall, a Program Portal will help the Program organize, store, share, and ultimately better utilize data collected and reports written by its multiple stakeholders. These services may inspire scientific studies, provide data for scientific research, and allow managers to interact with resources needed to inform decisions.

The ScW/HR will assist the PST in developing future content for the Program Portal; ensuring relevant reports, papers, and other documents are included in the document library; and supporting the development of other digital resources.

7) Participate in the Planning of the Science Symposium

The Program's Science Symposium aims to improve science communication, inform SOW development, and assist in long-term planning. The ScW/HR will assist as needed in the planning process.

8) Plan and Participate in Program Field Trips

Field trips will provide members of the ScW/HR with experience-based learning opportunities, such as field visits to restoration sites, float trips down the river, lab tours, hatchery tours, and more. These trips will provide members with the opportunity to learn more about the breadth of work underway in the Middle Rio Grande.

TASKS SCHEDULE:

Task	By Date
Complete CEMs for the RGSM, SWFL, and YBCU for presentation to the AMWG at the following meeting	February 2020
Assess and prioritizing critical uncertainties for the RGSM, SWFL, and YBCU	March 2020
Submit project/SOWs descriptions to the EC for review	End of March 2020
Begin developing conceptual ecological models for the NMMJM and PESU	July 2020
Submit finalized projects/SOWs to the EC for approval to move forward	August 2020
Discuss 2021 priorities and projects/SOW	September 2020
Plan field trip(s)	Duration of 2020
Consult with the AMWG to inform development of the Program's AM plan	As needed

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MEMBER ROSTER:

First Name	Last Name	Affiliation
Thomas	Archdeacon	U.S. Fish & Wildlife Service
Jonathan	AuBuchon	U.S. Army Corps of Engineers
Jennifer	Bachus	U.S. Bureau of Reclamation
Trevor	Birt	N.M. Interstate Stream Commission
Holly	Casman	City of Albuquerque, ABQ BioPark
Meaghan	Conway	New Mexico Department of Game and Fish
Katherine	Cordova	Bosque Ecosystem Monitoring Program
Clayton	Derby	Western Ecosystems Technology, Inc.
Julie	Dickey	Western Ecosystems Technology, Inc.
Kim	Eichhorst	Bosque Ecosystem Monitoring Program
Amy	Erickson	Audubon New Mexico
Kim	Fike	Bosque Ecosystem Monitoring Program
Danielle	Galloway	U.S. Army Corps of Engineers
Lynette	Giesen	U.S. Army Corps of Engineers
Eric	Gonzales	U.S. Bureau of Reclamation
Grace	Haggerty	New Mexico Interstate Stream Commission
Aubrey	Harris	U.S. Army Corps of Engineers
Chuck	Hayes	New Mexico Department of Game and Fish
Brian	Hobbs	U.S. Bureau of Reclamation
Monika (Mo)	Hobbs	Albuquerque Bernalillo County Water Utility Authority
Alison	Hutson	New Mexico Interstate Stream Commission
Kathy	Lang	City of Albuquerque
Debbie	Lee	Western Ecosystems Technology, Inc.
CW	Lujan	
Joel	Lusk	U.S. Bureau of Reclamation
Shannon	Mann	Pueblo of Sandia
Mike	Marcus	Assessment Payers Association of the MRGCD
Anne	Marken	Middle Rio Grande Conservancy District
Terry	McDill	N.M. Interstate Stream Commission
Yvette	McKenna	U.S. Bureau of Reclamation

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Kate	Mendoza	Albuquerque Bernalillo County Water Utility Authority
Yasmeen	Najmi	Middle Rio Grande Conservancy District
Megan	Osborne	University of New Mexico
Robert	Padilla	U.S. Bureau of Reclamation
Kirk	Patten	NM Department of Game & Fish
Page	Pegram	NM Interstate Stream Commission
Matthew	Peterson	City of Albuquerque Open Space
Michael (Mick)	Porter	U.S. Army Corps of Engineers
Dana	Price	U.S. Army Corps of Engineers
Justin	Reale	U.S. Army Corps of Engineers, CESPA-DE
Ashlee	Rudolph	U.S. Bureau of Reclamation
Stephen	Ryan	U.S. Army Corps of Engineers
Vicky	Ryan	U.S. Fish & Wildlife Service
Jeff	Sanchez	U.S. Fish & Wildlife Service
Nathan	Schroeder	Pueblo of Santa Ana, DNR
Summer	Schulz	U.S. Army Corps of Engineers
Michael (Scial)	Scialdone	Pueblo of Sandia
Lauren	Sherson	U.S. Geological Survey
Clint	Smith	U.S. Fish & Wildlife Service
Dale	Strickland	Western Ecosystems Technology, Inc.
Kiara	Tackas	Western Ecosystems Technology, Inc.
Ashley	Tanner	Western Ecosystems Technology, Inc.
Douglas	Tave	Los Lunas Silvery Minnow Refugium
Cody	Walker	Pueblo of Isleta - Natural Resources Department, Water Resources Div.
Lori	Walton	U.S. Bureau of Reclamation
Kim	Ward	City of Albuquerque
Wade	Wilson	U.S Fish & Wildlife Service, Southwestern Native Aquatic Resources and Recovery Center
Ara	Winter	Bosque Ecosystem Monitoring Program
Leann	Woodruff	U.S. Bureau of Reclamation

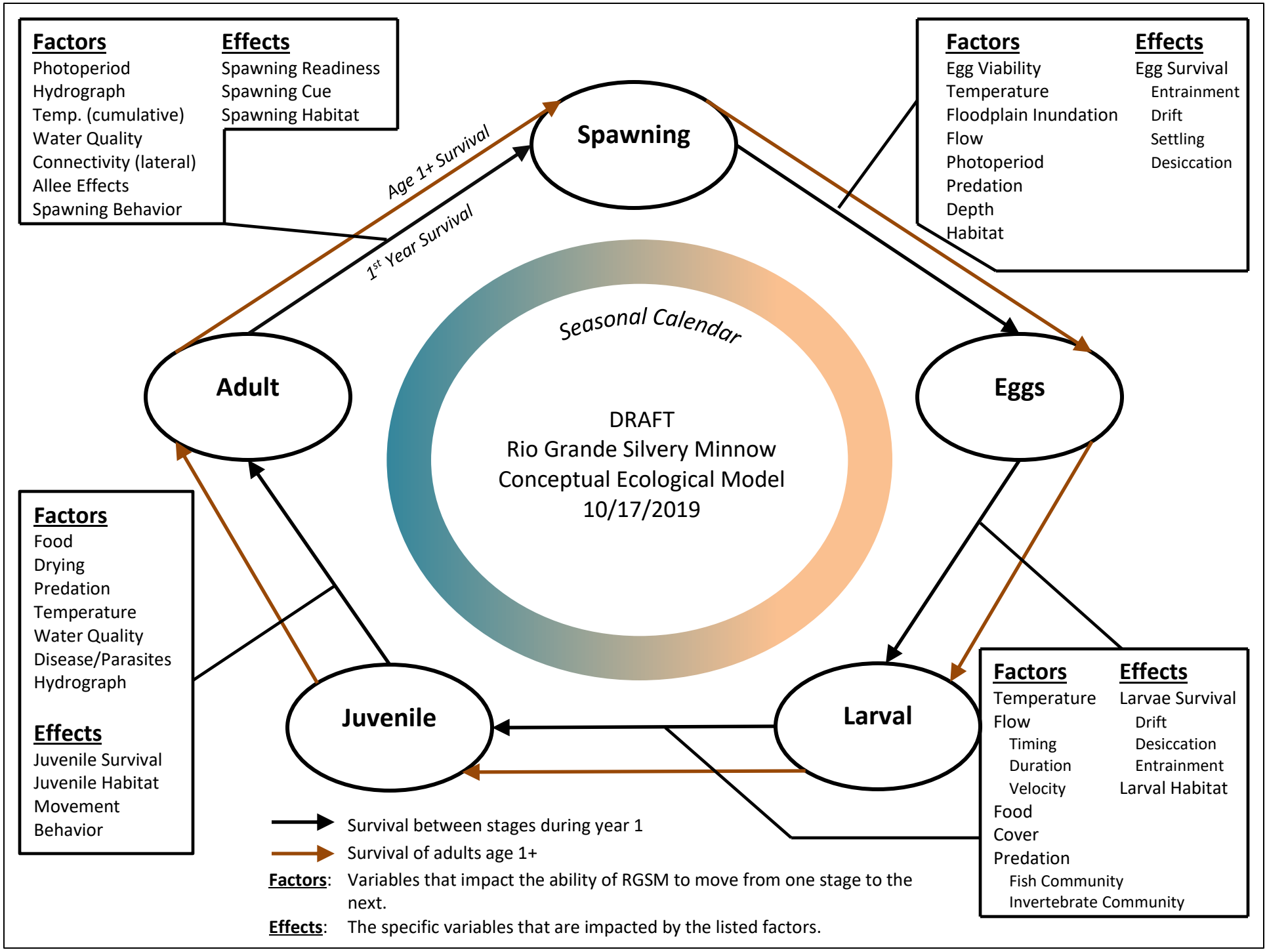
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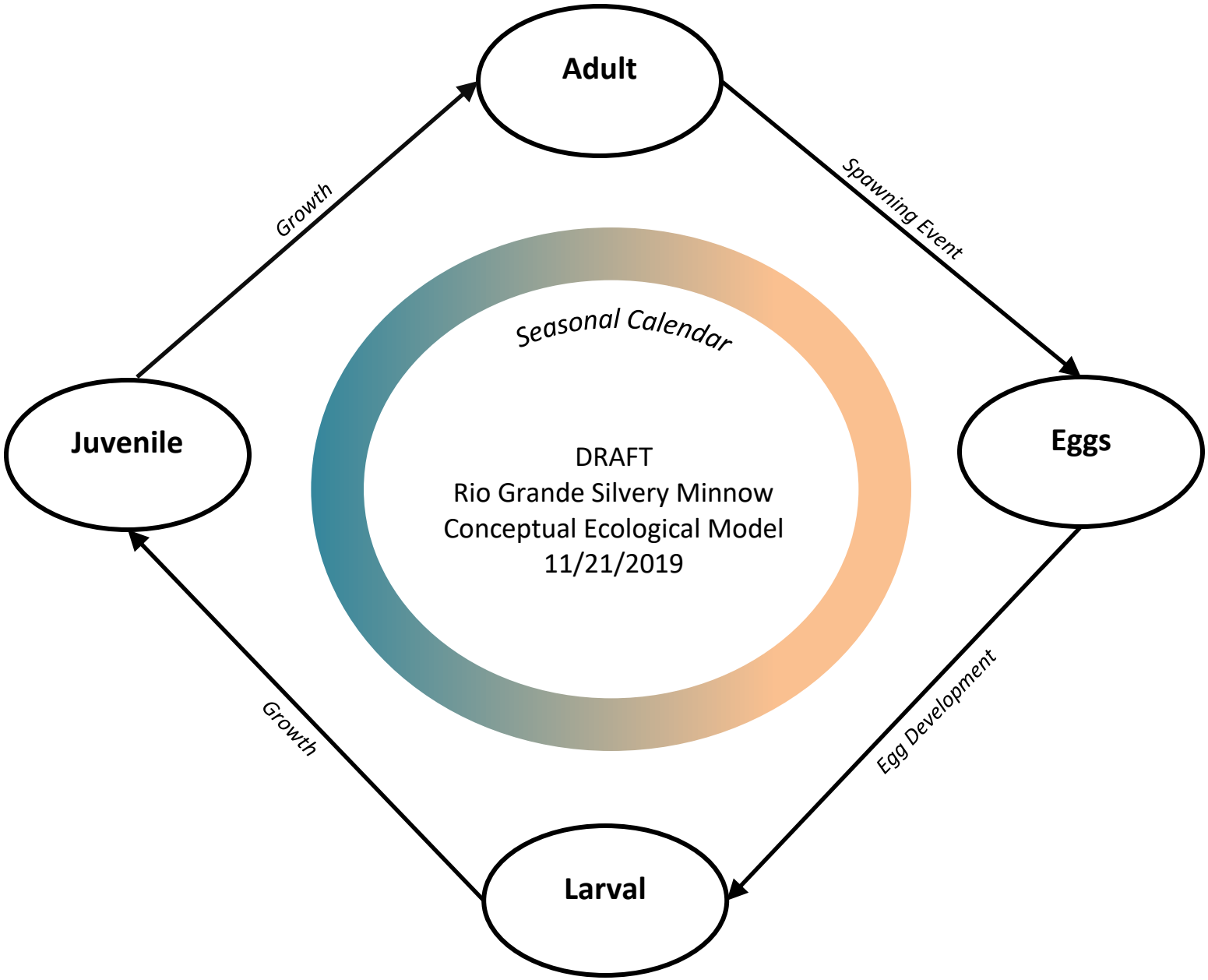
Brooke	Wyman	Pueblo of Sandia

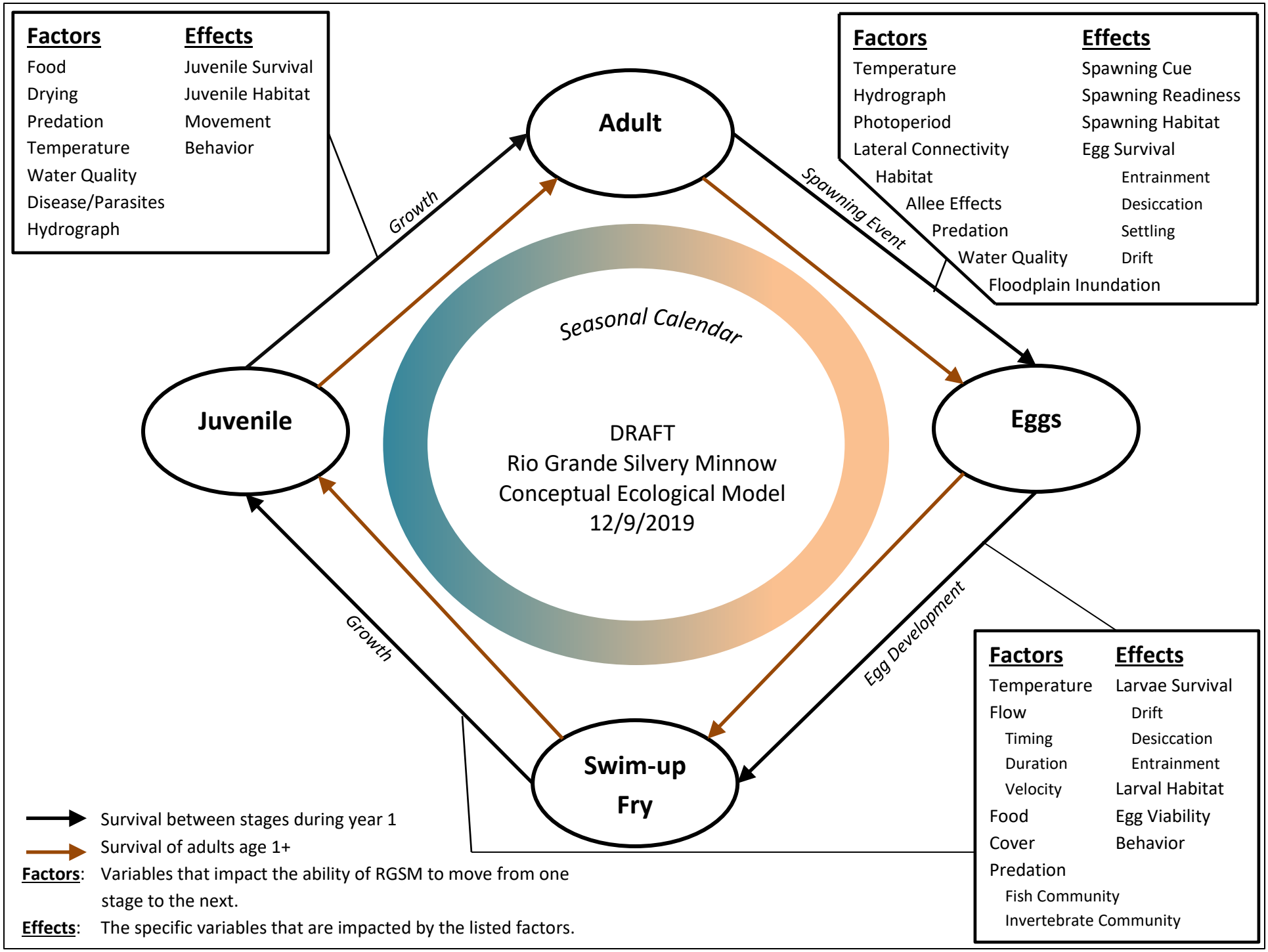
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Conceptual Ecological Models will be used to:

1. Identify and reduce uncertainties
2. Identify management actions that impact the system and species
3. Help create projects/scopes of work that reduce uncertainties
4. Reduce complexity
5. Identify 'need to know' uncertainties versus 'nice to know' uncertainties
6. Generate and evaluate goals


Factors
Photoperiod
Hydrograph
Temp. (cumulative)
Water Quality
Connectivity (lateral)
Allee Effects
Spawning Behavior
Effects
Spawning Readiness
Spawning Cue
Spawning Habitat
Spawning
Age 1+ Survival
1st Year Survival
Factors
Egg Viability
Temperature
Floodplain Inundation
Flow
Photoperiod
Predation
Depth
Habitat
Effects
Egg Survival
Entrainment
Drift
Settling
Desiccation
Seasonal Calendar
DRAFT
Rio Grande Silvery Minnow
Conceptual Ecological Model
10/17/2019
Adult
Eggs
Factors
Food
Drying
Predation
Temperature
Water Quality
Disease/Parasites
Hydrograph
Effects
Juvenile Survival
Juvenile Habitat
Movement
Behavior
Juvenile
Larval
Factors
Temperature
Flow
Timing
Duration
Velocity
Food
Cover
Predation
Fish Community
Invertebrate Community
Effects
Larvae Survival
Drift
Desiccation
Entrainment
Larval Habitat
Survival between stages during year 1
Survival of adults age 1+
Factors: Variables that impact the ability of RGSM to move from one stage to the next.
Effects: The specific variables that are impacted by the listed factors.


Adult
Growth
Spawning Event
Seasonal Calendar
Juvenile
DRAFT
Rio Grande Silvery Minnow
Conceptual Ecological Model
11/21/2019
Eggs
Growth
Egg Development
Larval


Factors
Food
Drying
Predation
Temperature
Water Quality
Disease/Parasites
Hydrograph
Effects
Juvenile Survival
Juvenile Habitat
Movement
Behavior
Adult
Growth
Spawning Event
Factors
Temperature
Hydrograph
Photoperiod
Lateral Connectivity
Habitat
Allee Effects
Predation
Water Quality
Floodplain Inundation
Effects
Spawning Cue
Spawning Readiness
Spawning Habitat
Egg Survival
Entrainment
Desiccation
Settling
Drift
Seasonal Calendar
DRAFT
Rio Grande Silvery Minnow
Conceptual Ecological Model
12/9/2019
Juvenile
Eggs
Growth
Egg Development
Swim-up
Fry
Factors
Temperature
Flow
Timing
Duration
Velocity
Food
Cover
Predation
Fish Community
Invertebrate Community
Effects
Larvae Survival
Drift
Desiccation
Entrainment
Larval Habitat
Egg Viability
Behavior
Survival between stages during year 1
Survival of adults age 1+
Factors: Variables that impact the ability of RGSM to move from one stage to the next.
Effects: The specific variables that are impacted by the listed factors.

RGSM Uncertainties Identified on 11/21/2019

No/minimal management implications

Questionable management implications

1. How often are temperature tolerances exceeded in the main channel and for how long?
2. Do RGSM establish territories/what is their home range size?
3. How does channel flow/shear stress affect RGSM food availability?

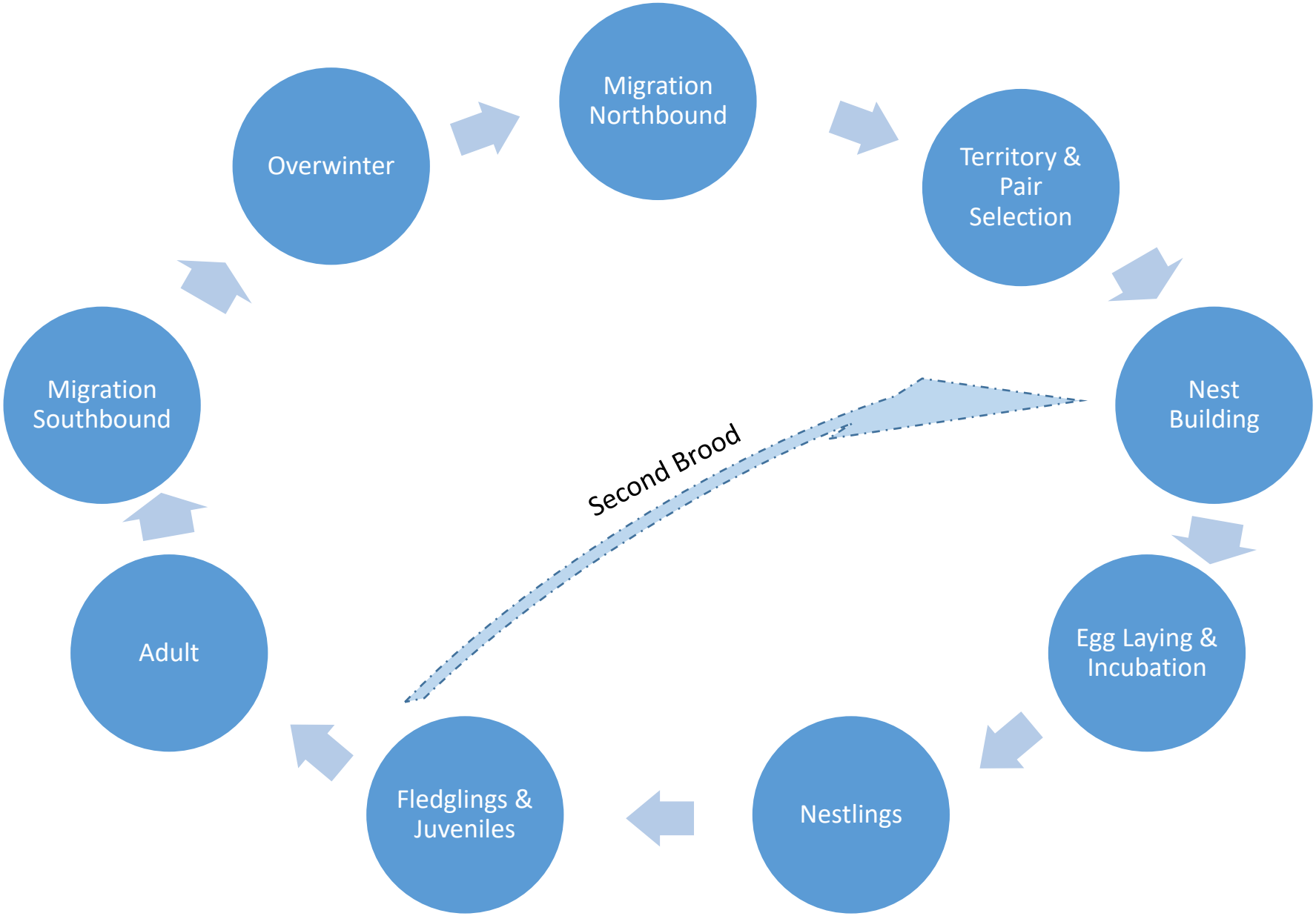
Has direct management implications

4. What are the stressors and their relative importance on RGSM survival leading up to and including drying?
5. How does RGSM habitat quality and quantity change at different flows?

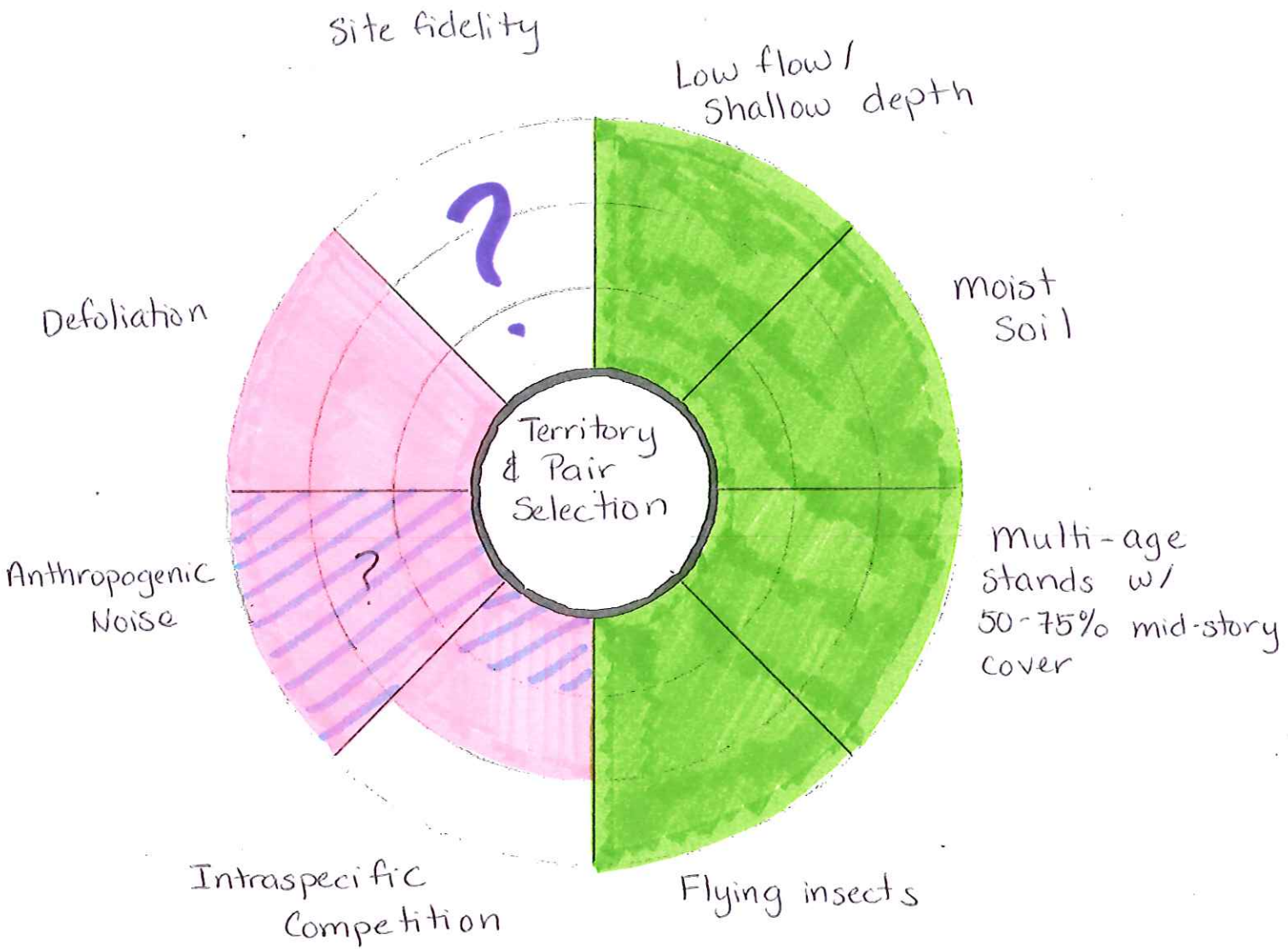
Uncategorized

6. Are RGSM food limited?
7. When and how does water quality affect RGSM survival?
8. Is competition a factor in RGSM survival/persistence?
9. Are disease and parasites affecting RGSM survival?

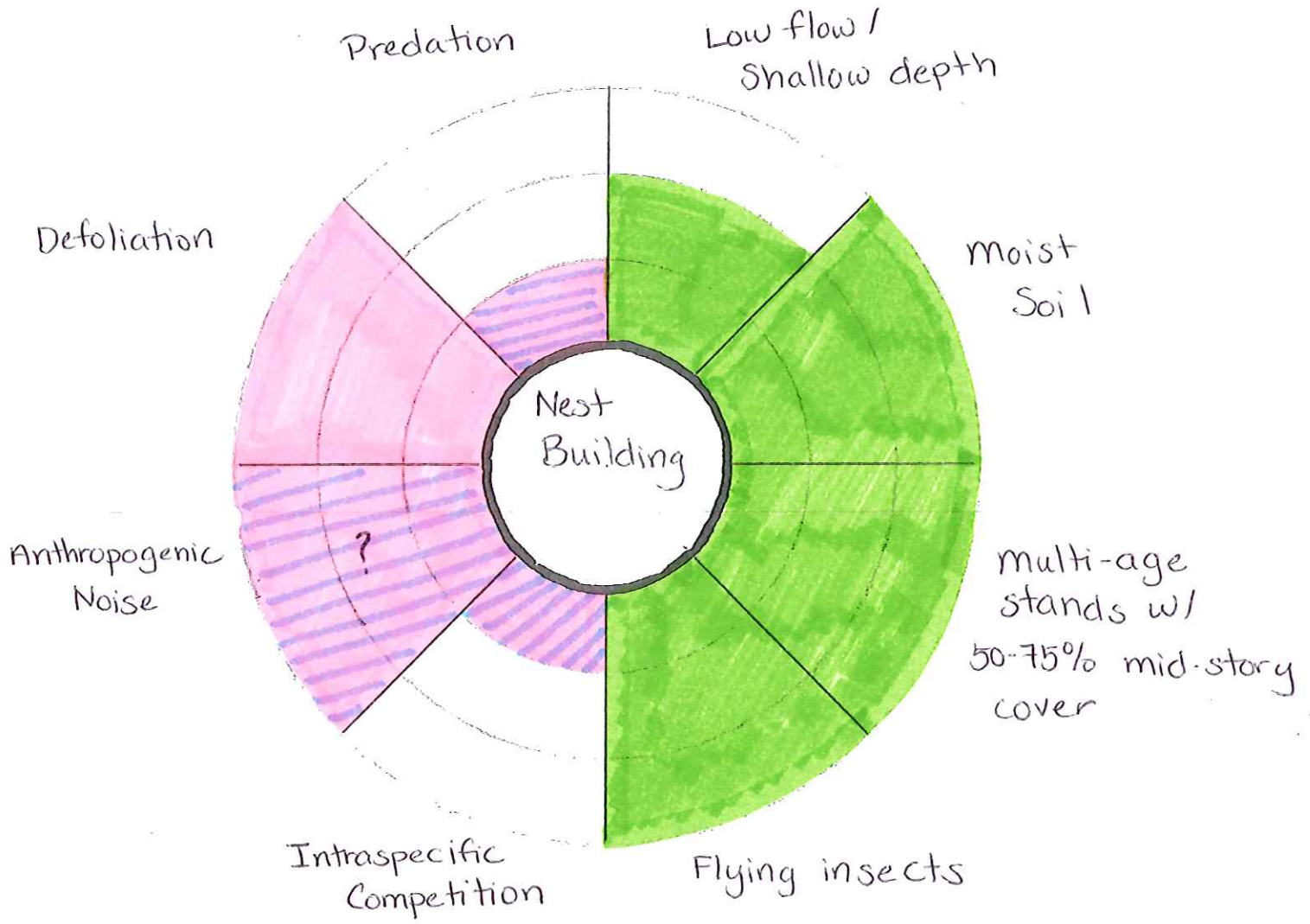
SWFL & YBCU Life Cycle Model
Developed by SwC/HR at October 2019 meeting



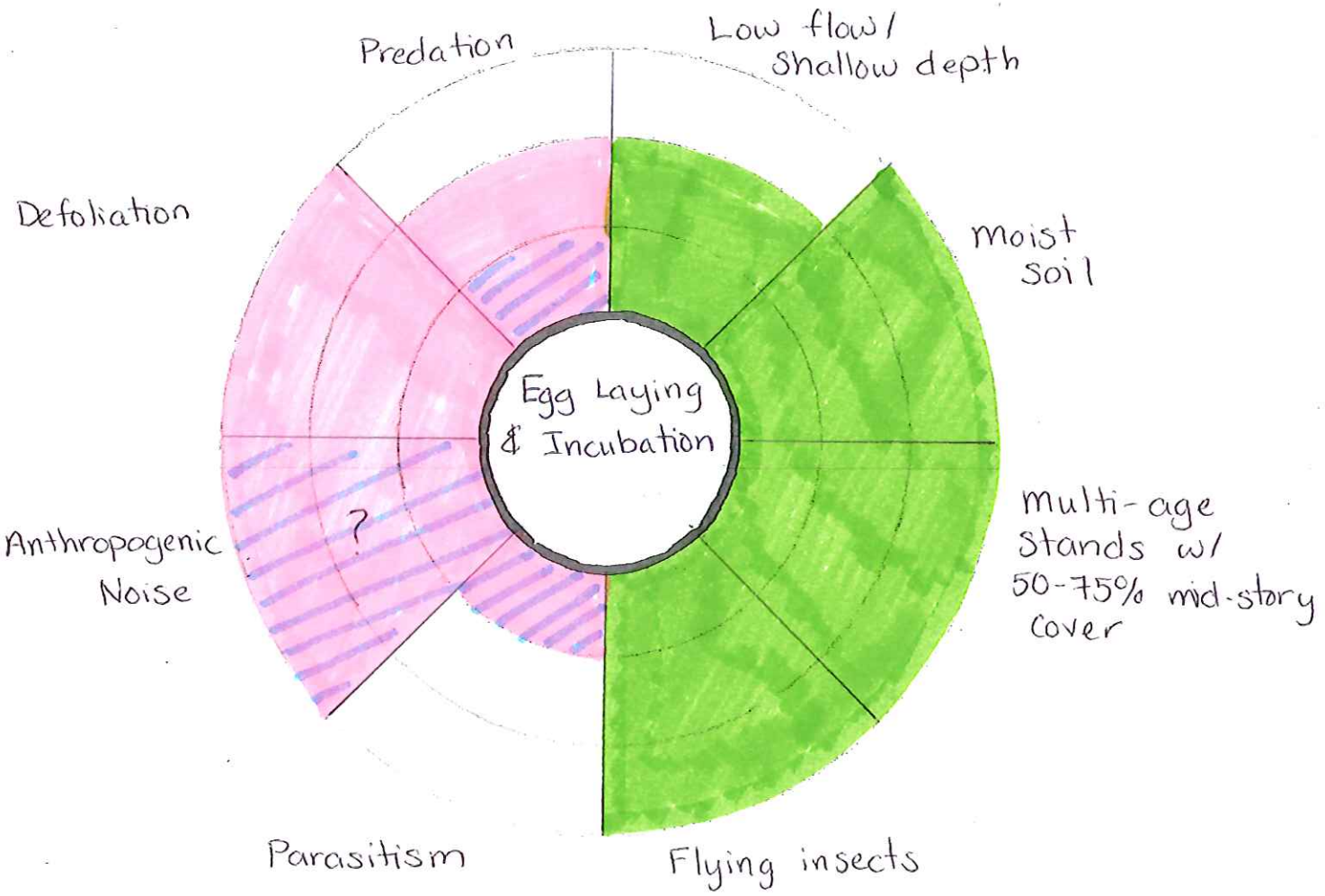
SWFL


Site fidelity
Low flow / Shallow depth
Defoliation
moist soil
Territory & Pair Selection
Anthropogenic Noise
Multi-age stands w/ 50-75% mid-story cover
Intraspecific Competition
Flying insects
?
?

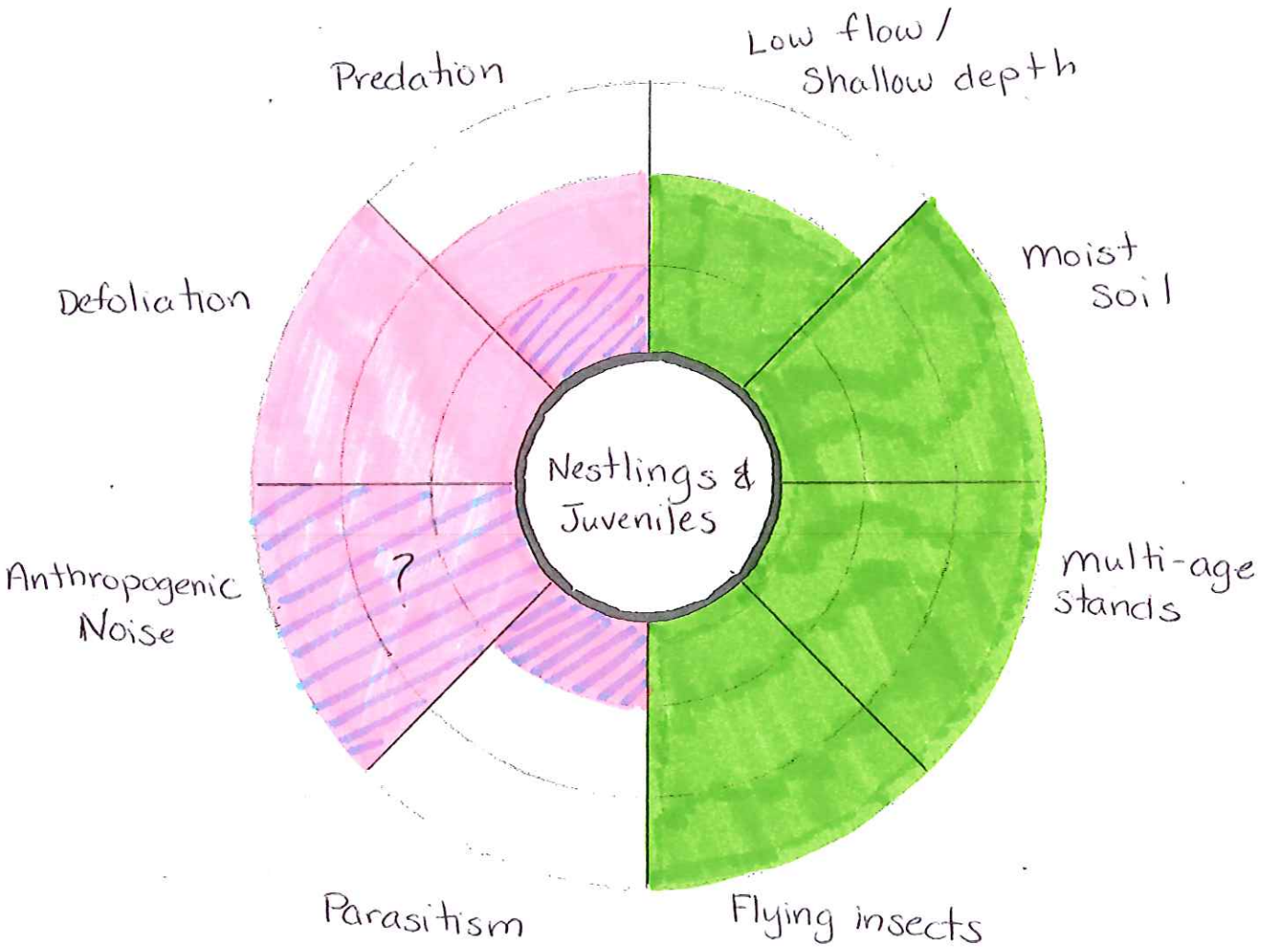
SWFL


Predation
Low flow / Shallow depth
Defoliation
moist Soil
Nest Building
Anthropogenic Noise
?
multi-age stands w/ 50-75% mid-story cover
Intraspecific Competition
Flying insects

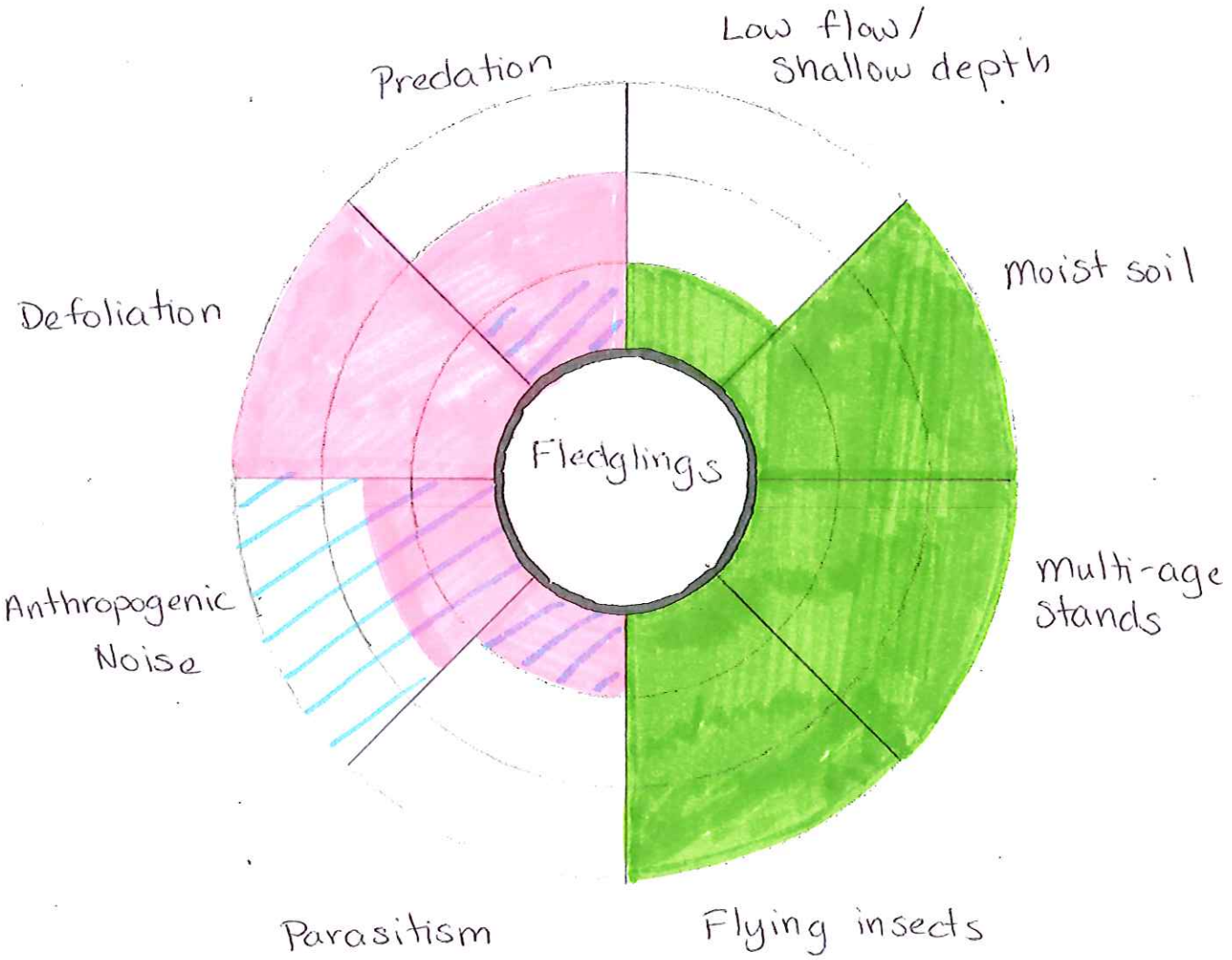
SWFL


Predation
Low flow/
Shallow depth
Defoliation
moist
soil
Egg Laying
& Incubation
Multi-age
Stands w/
50-75% mid-story
cover
Anthropogenic
Noise
?
Parasitism
Flying insects

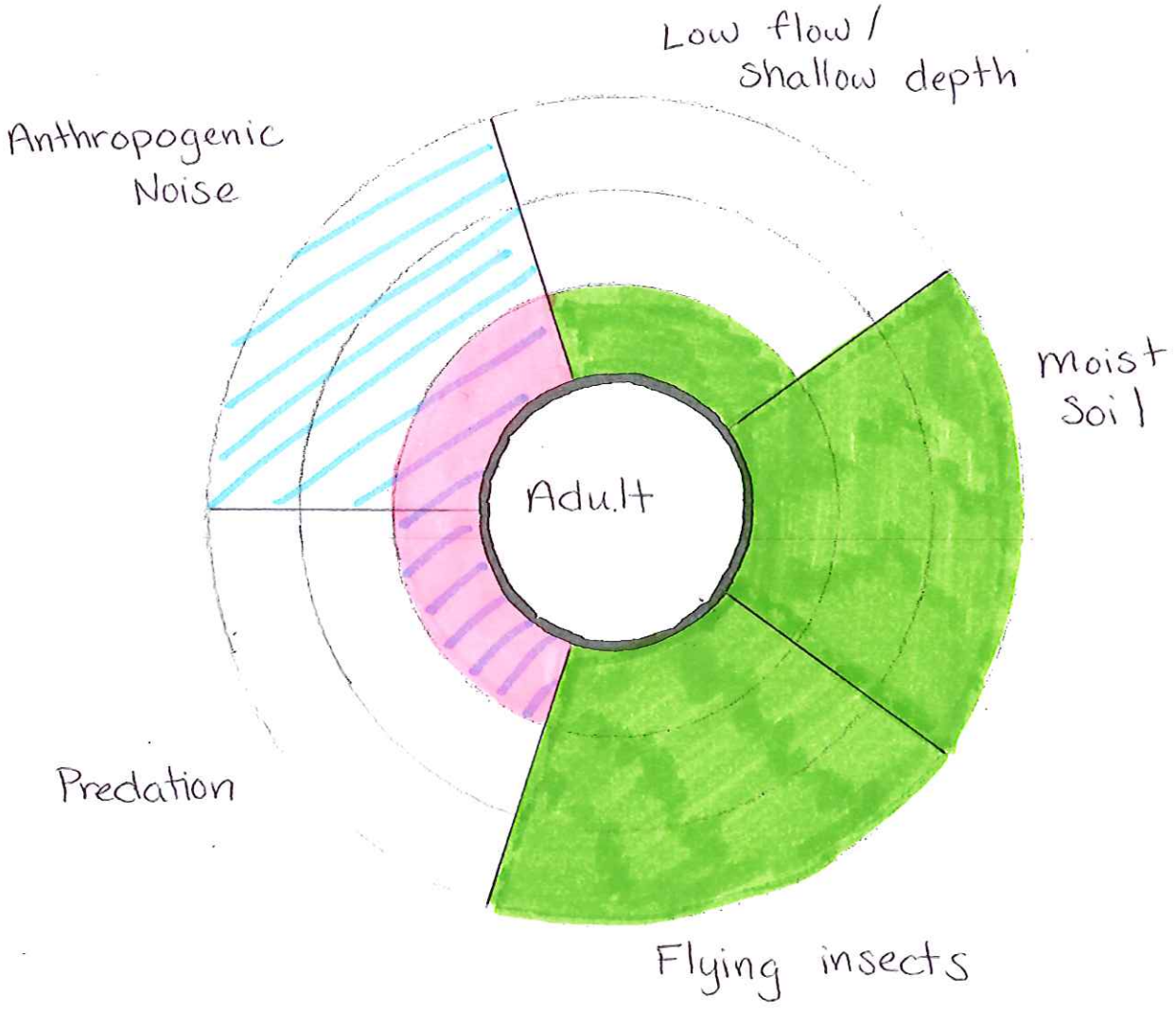
SWFL


Predation
Low flow / Shallow depth
Defoliation
moist soil
Nestlings & Juveniles
?
Anthropogenic Noise
multi-age stands
Parasitism
Flying insects

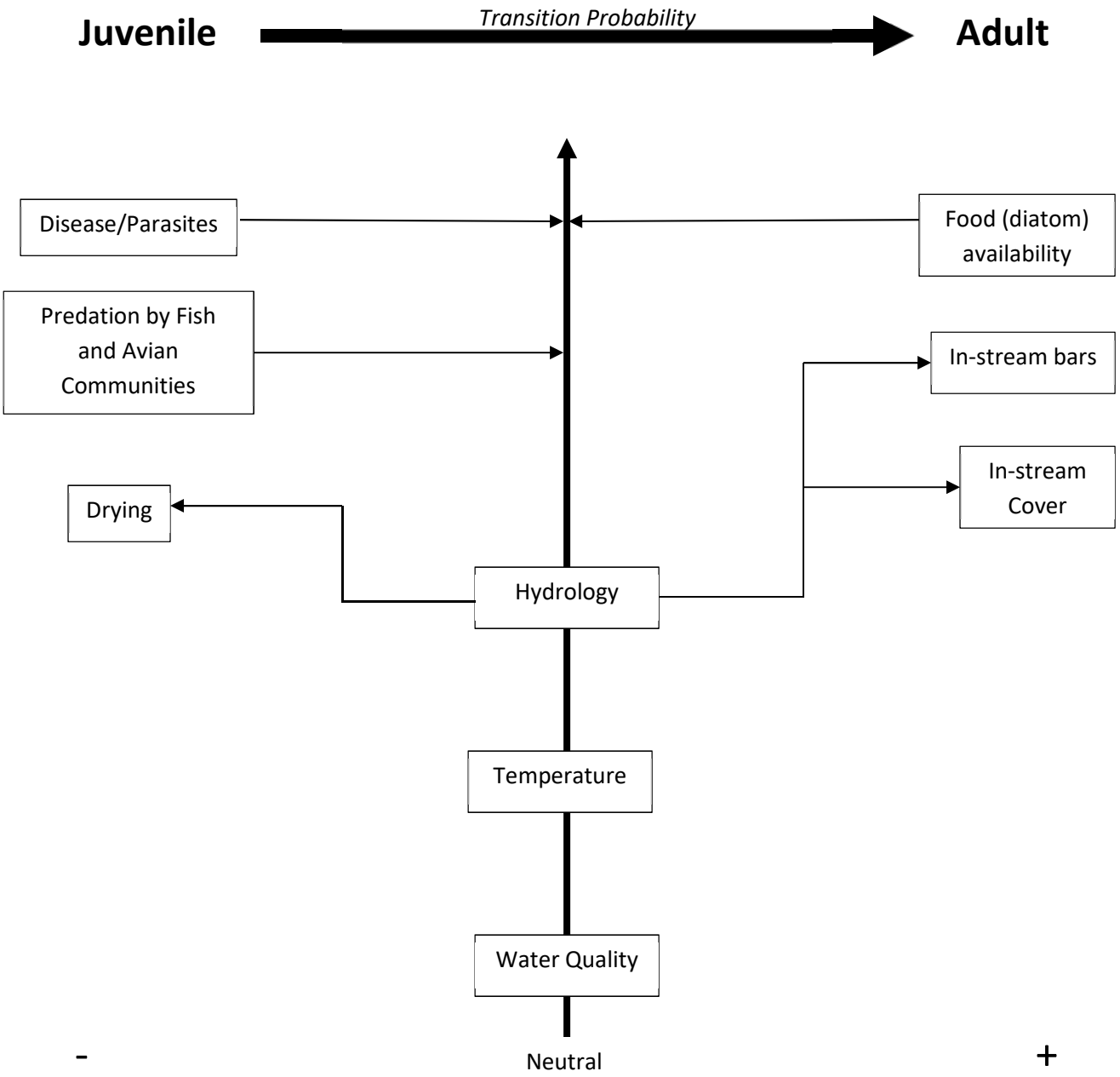
SWFL

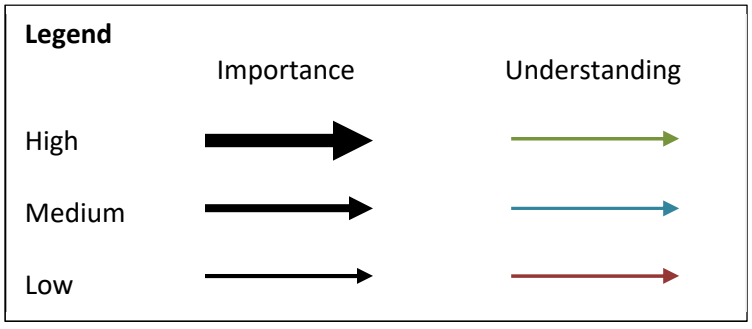

Predation
Low flow/
Shallow depth
Defoliation
Moist soil
Fledglings
Anthropogenic
Noise
Multi-age
Stands
Parasitism
Flying insects

SWFL

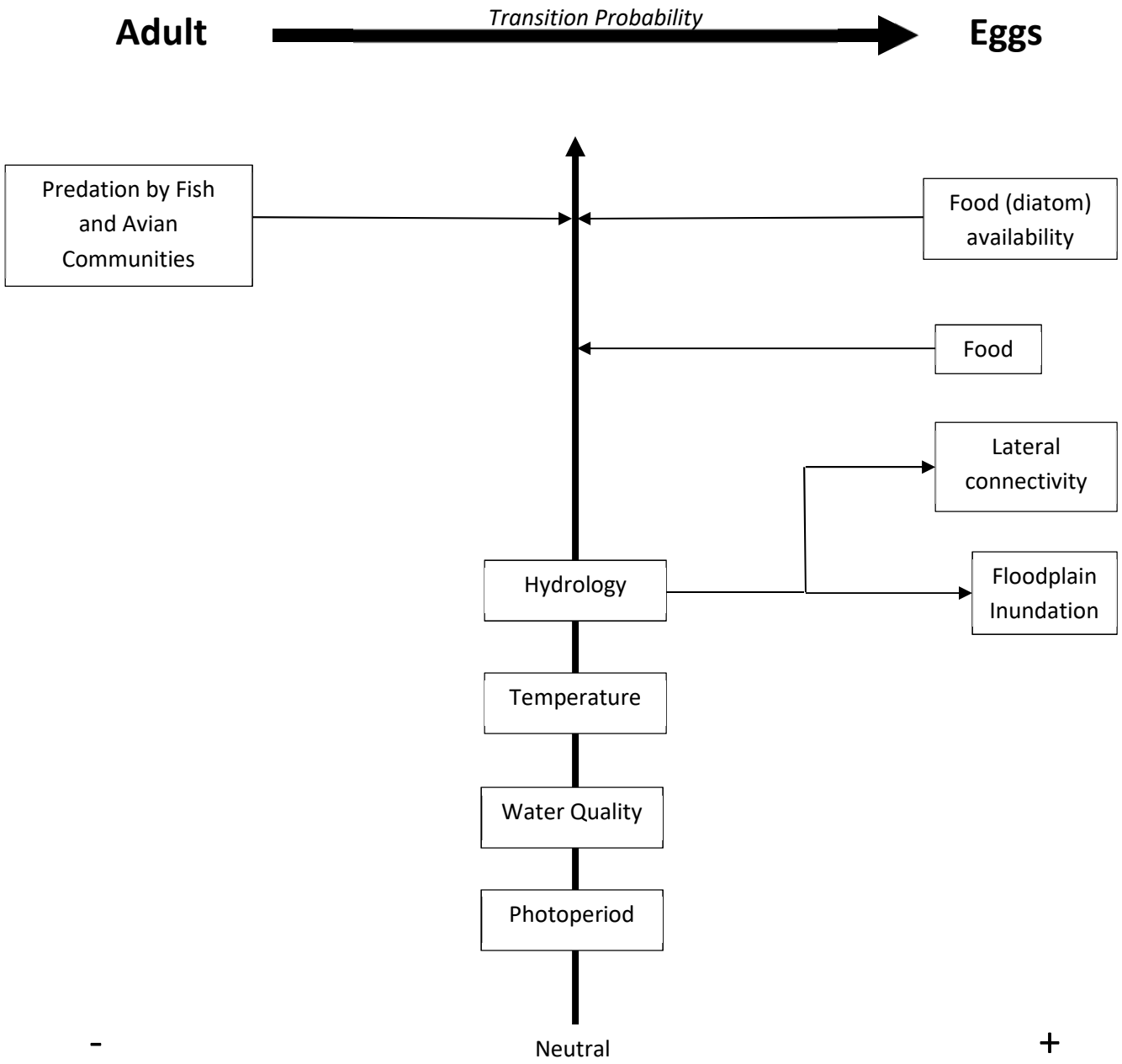

Low flow / Shallow depth
Anthropogenic Noise
moist soil
Adult
Predation
Flying insects

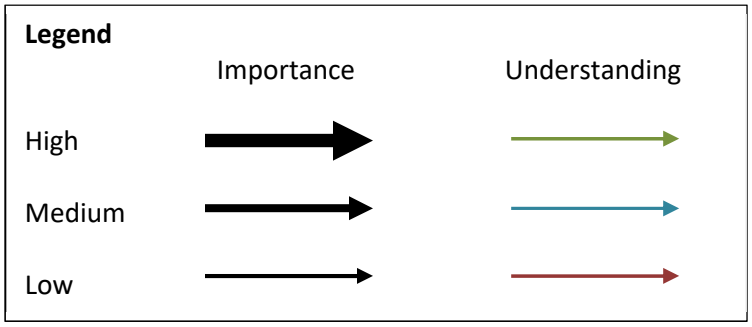
Fish Responses: Juvenile Survival, Juvenile Habitat, Movement, Behavior, Population Size



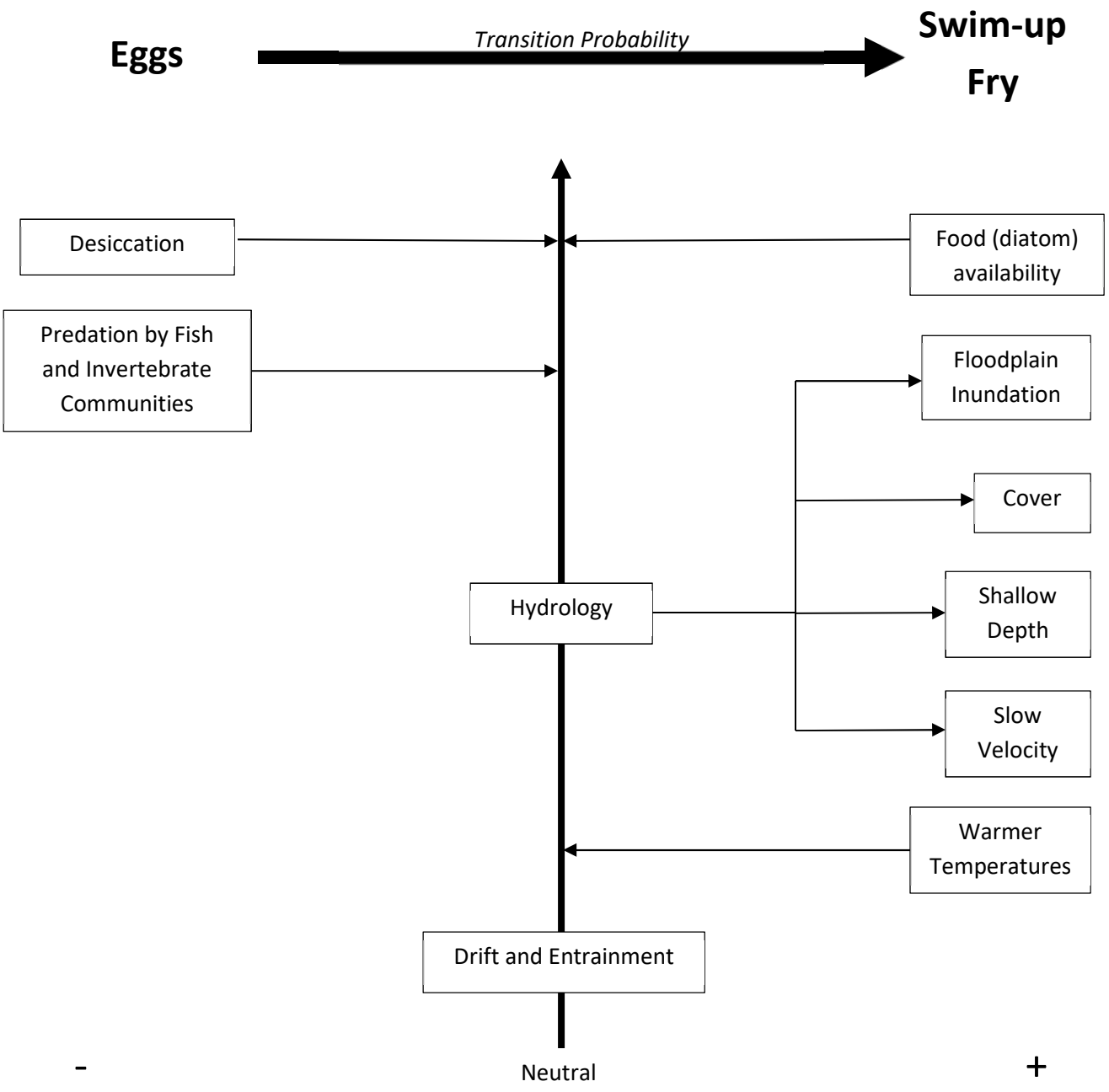


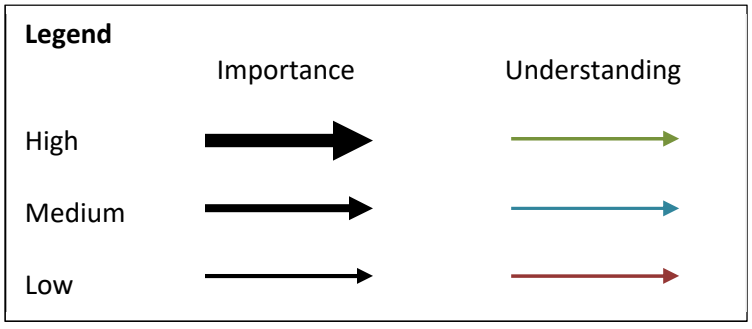
Fish Responses: Population Size, Behavior, Spawning, Genetics



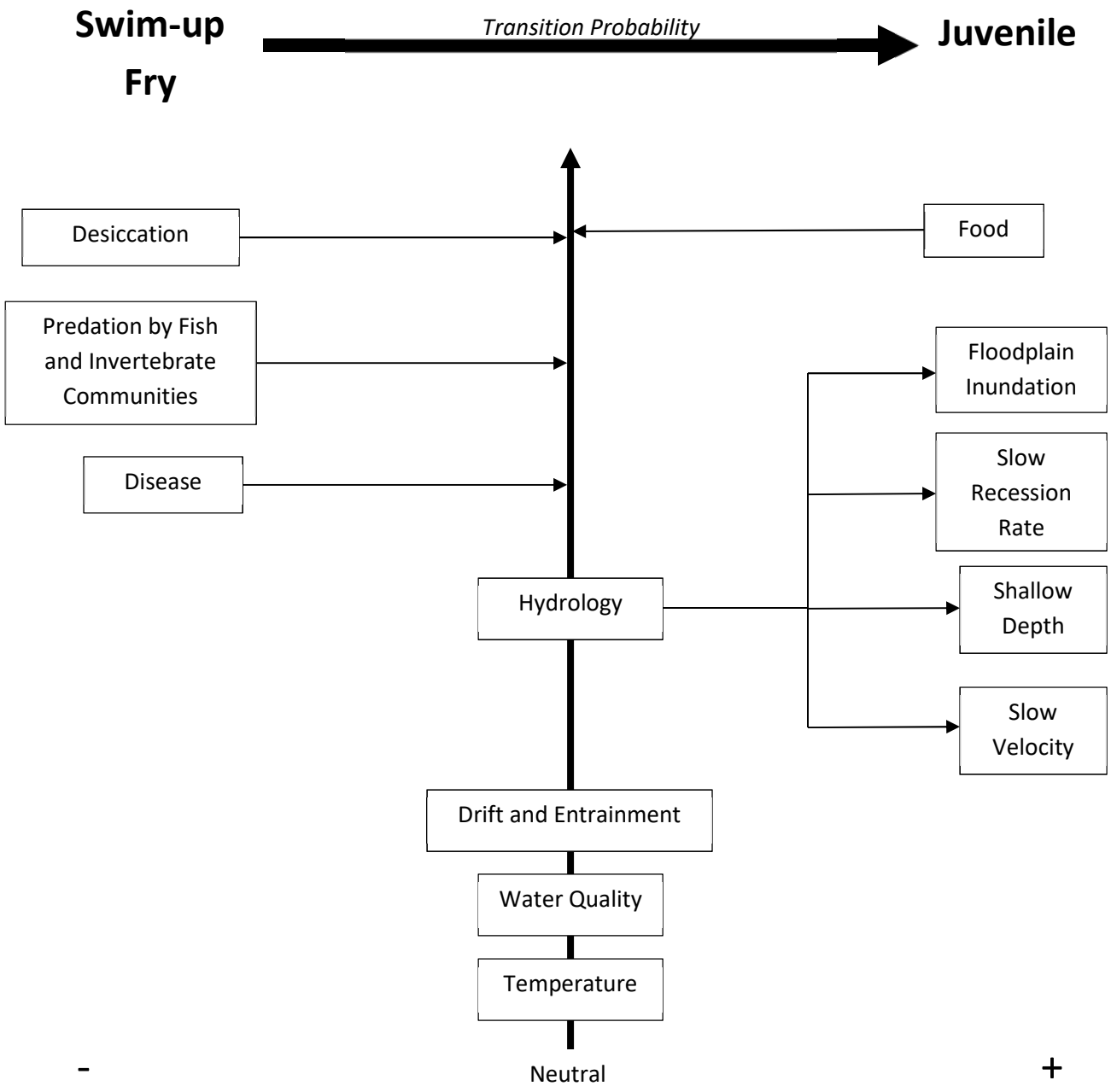


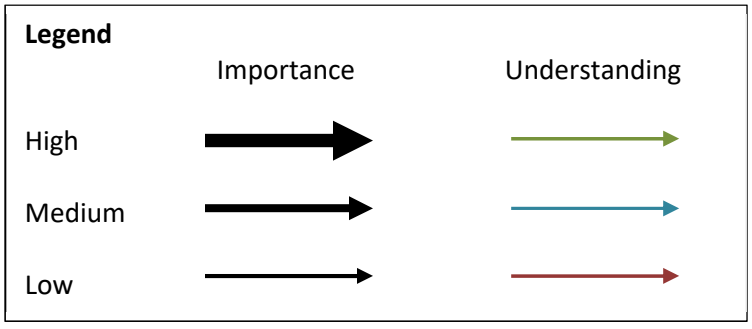
Fish Responses: Egg viability, Behavior



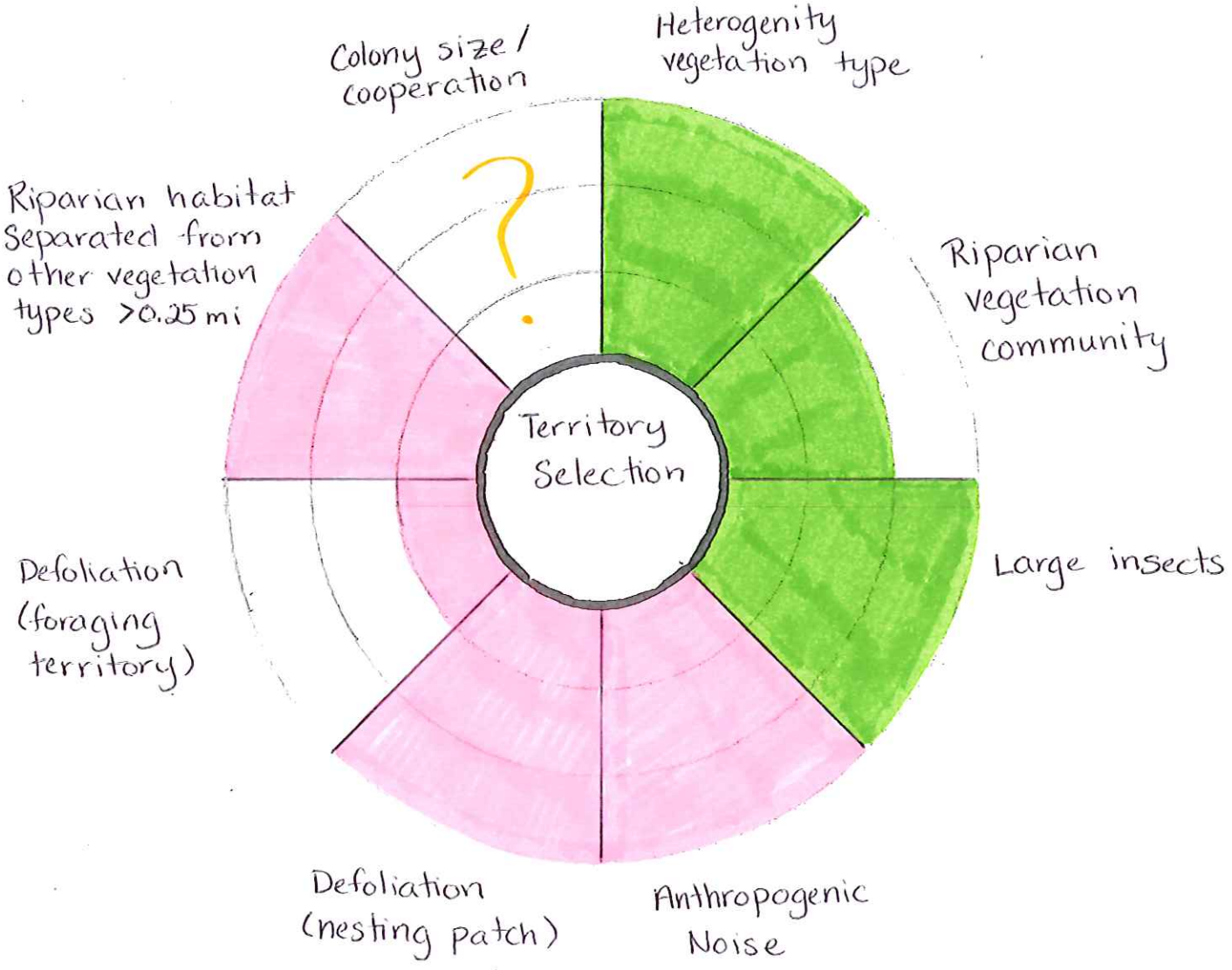


Fish Responses: Behavior, Viability

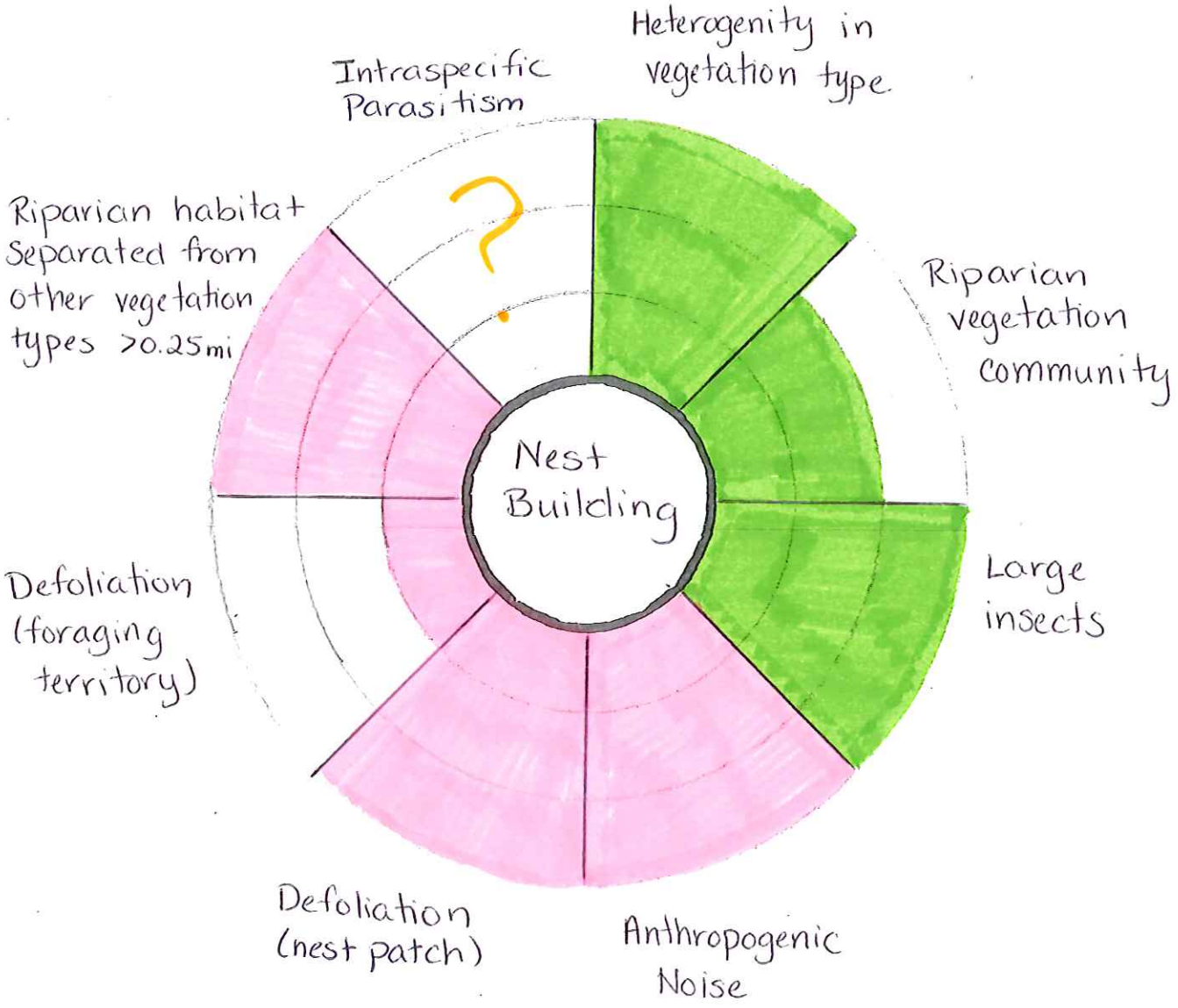




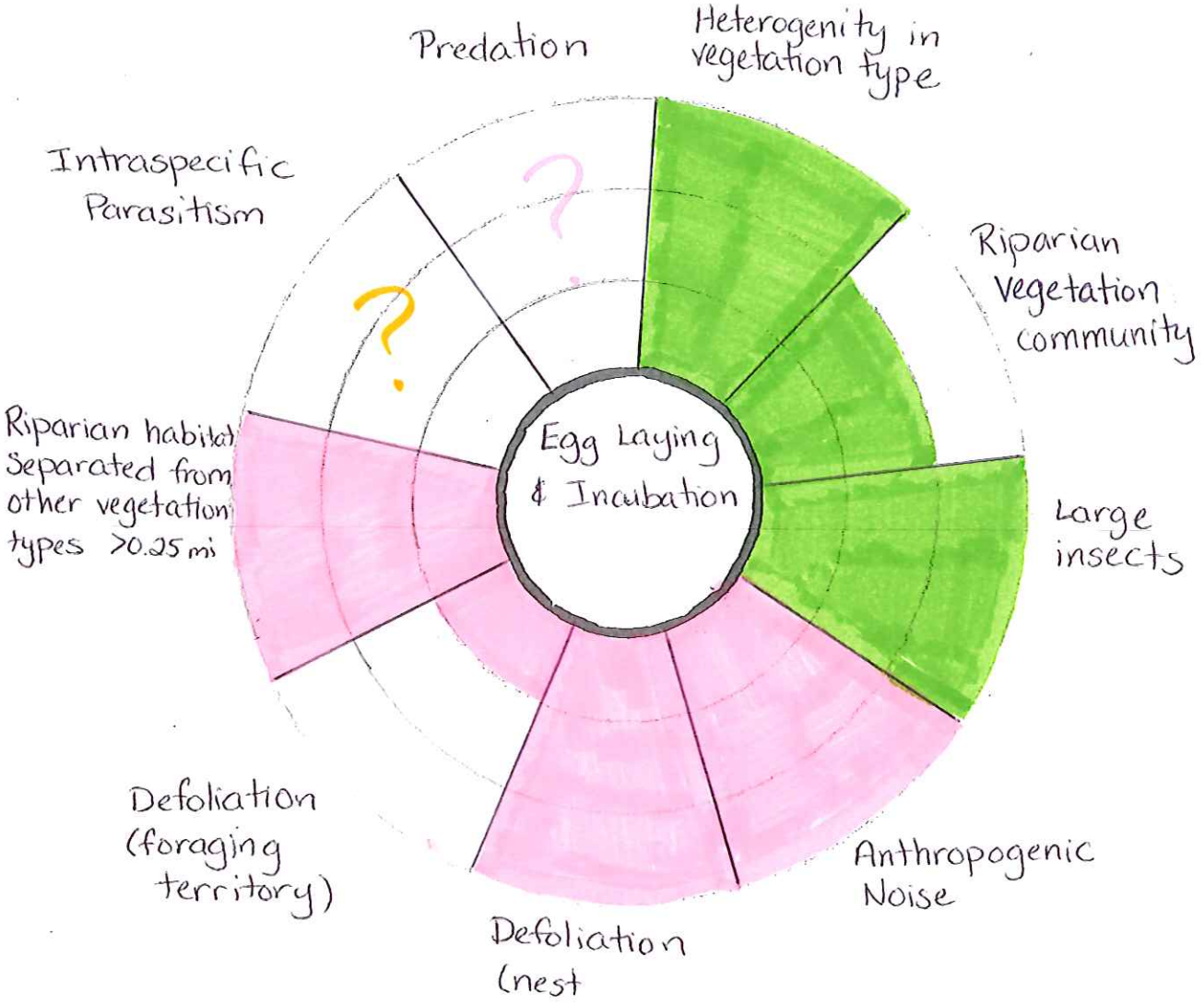
YBCU


Colony size / cooperation
Heterogenity vegetation type
Riparian habitat Separated from other vegetation types >0.25 mi
?
Riparian vegetation community
Territory Selection
Defoliation (foraging territory)
Large insects
Defoliation (nesting patch)
Anthropogenic Noise

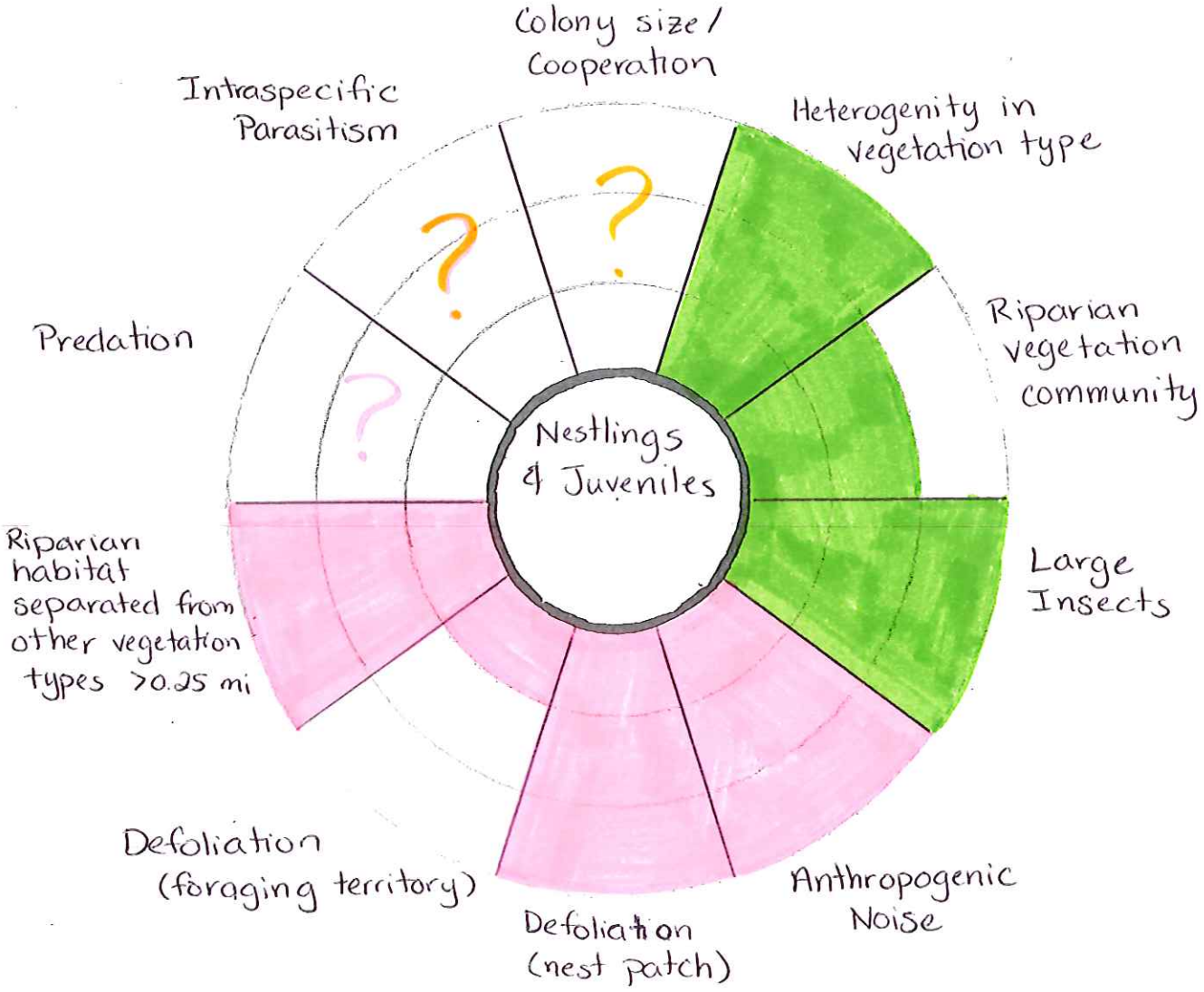
YBCU


Heterogenity in vegetation type
Intraspecific Parasitism
?
Riparian habitat Separated from other vegetation types >0.25mi
Riparian vegetation community
Nest Building
Large insects
Defoliation (foraging territory)
Defoliation (nest patch)
Anthropogenic Noise

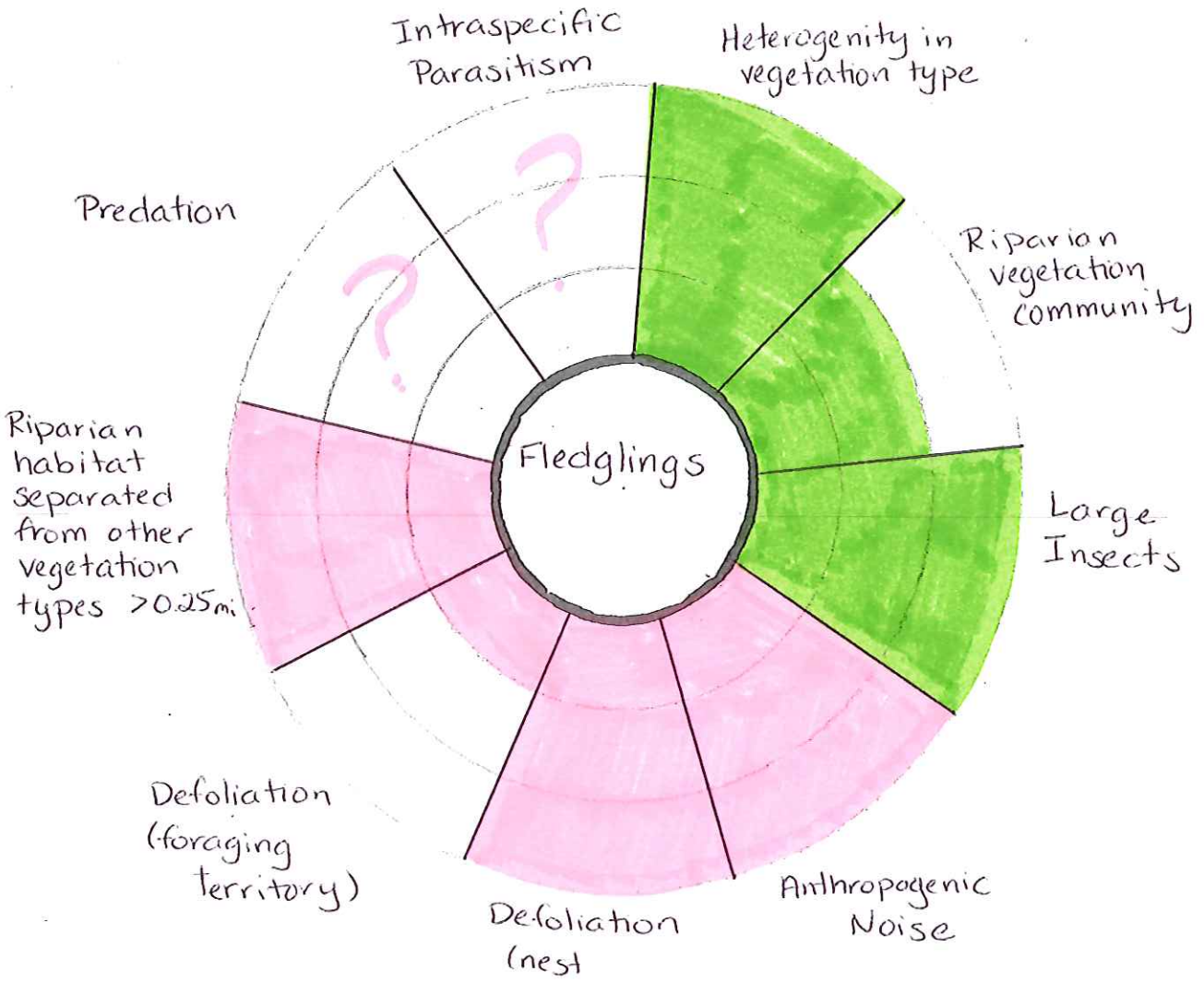
YBCU


Predation
Heterogenity in vegetation type
Intraspecific Parasitism
Riparian Vegetation community
Riparian habitat Separated from other vegetation types >0.25 mi
Egg Laying & Incubation
Large insects
Defoliation (foraging territory)
Anthropogenic Noise
Defoliation (nest

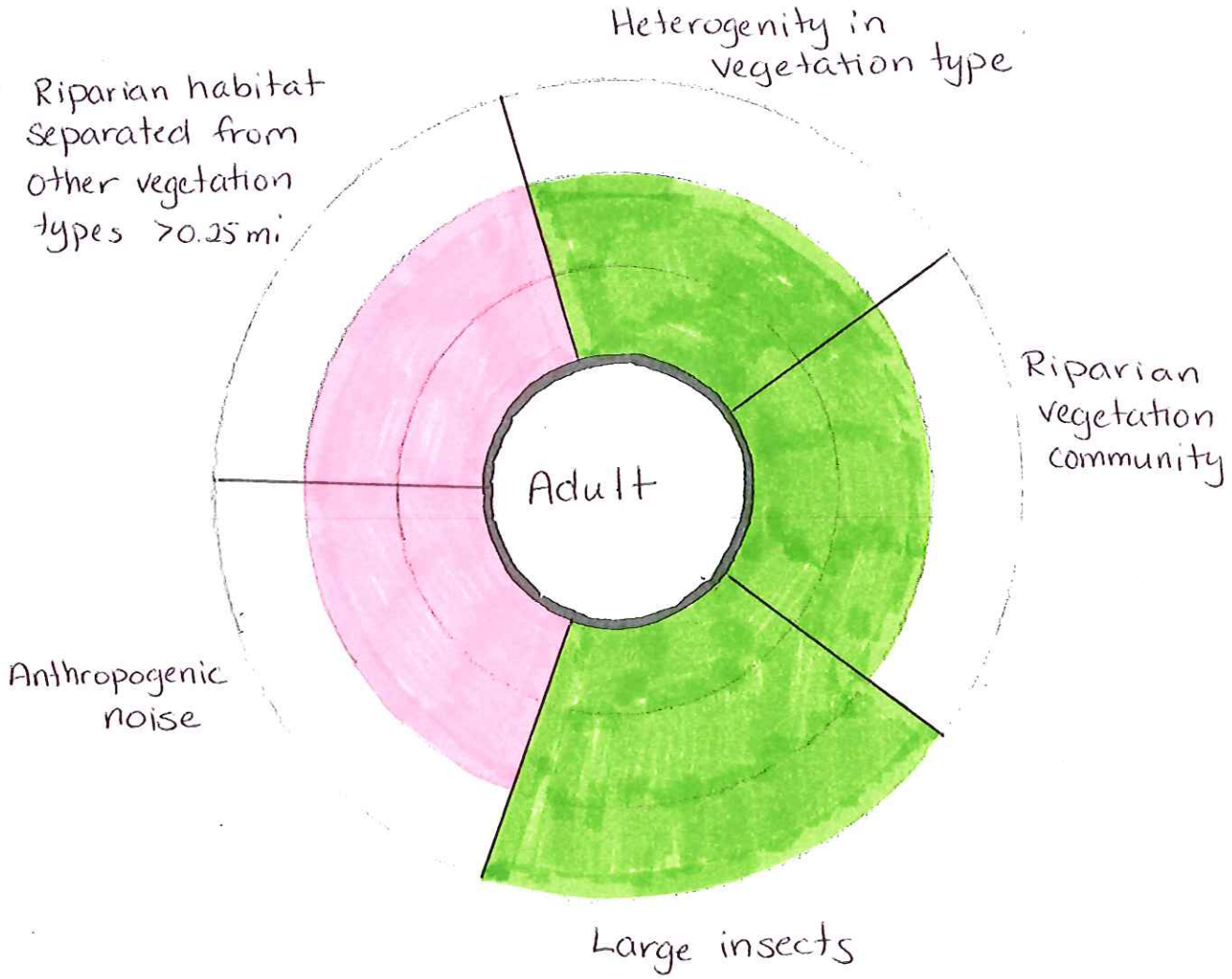
YBCU


Colony size / Cooperation
Intraspecific Parasitism
Heterogenity in vegetation type
Predation
Riparian vegetation community
Nestlings & Juveniles
Riparian habitat separated from other vegetation types >0.25 mi
Large Insects
Defoliation (foraging territory)
Anthropogenic Noise
Defoliation (nest patch)
?
?
?

YBCU


Intraspecific Parasitism
Heterogenity in vegetation type
Predation
Riparian Vegetation Community
Riparian habitat separated from other vegetation types >0.25mi
Fledglings
Large Insects
Defoliation (foraging territory)
Defoliation (nest
Anthropogenic Noise

YBCU


Heterogenity in vegetation type
Riparian habitat separated from other vegetation types >0.25 mi
Riparian vegetation community
Adult
Anthropogenic noise
Large insects