FY2016 - FY2017 Annual Report

Middle Rio Grande
Endangered Species
Collaborative Program

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

Middle Rio Grande Endangered Species Collaborative Program
FY2016 - FY2017 Annual Report

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On Behalf of:

The Middle Rio Grande Endangered Species Collborative Program

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ACRONYMS & ABBREVIATIONS

ABCWUA	Albuquerque Bernalillo County Water Utility Authority
ACF	Aquatic Conservation Facility
AF	Acre-feet
AMAFCA	Albuquerque Metropolitan Arroyo Flood Control Authority
AMP	Adaptive Management Program
APA	Assessment Payers Association of the Middle Rio Grande Conservancy District
ARRC	Aquatic Resource and Recovery Center
BO	Biological Opinion
BEMP	Bosque Ecosystem Monitoring Program
BIA	Bureau of Indian Affiars
BLM	Bureau of Land Management
CC	Coordination Committee
cfs	Cubic feet per second
CoA	City of Albuquerque
CPUE	Catch per unit effort
DBMS	Database management system
EC	Executive Committee
eDNA	Environmental DNA
ESA	Endangered Species Act
FY	Fiscal Year
IDD	Isleta Diversion Dam
LiDAR	Light Detection and Radar
LLSMR	Los Lunas Silvery Minnow Refugium
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	Middle Rio Grande Endangered Species Collaborative Program

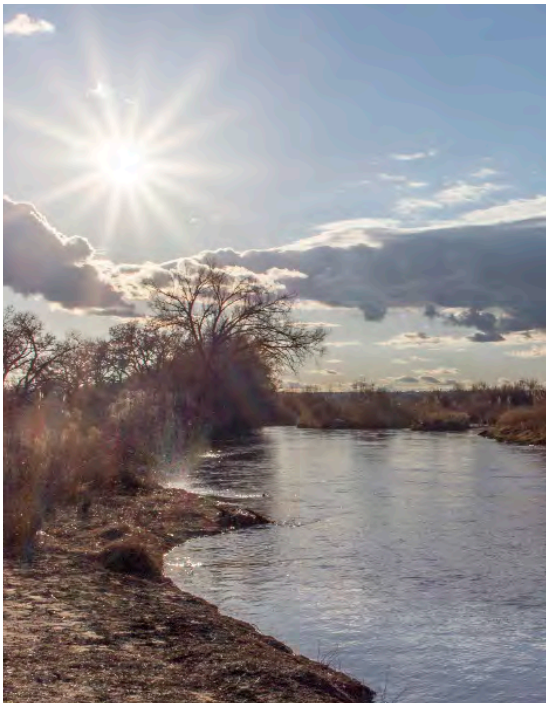
ACRONYMS & ABBREVIATIONS

mtDNA	Mitochondrial DNA
NMAGO	New Mexico Attorney General's Office
NMDA	New Mexico Department of Agriculture
NMFWCO	New Mexico Fish and Wildlife Conservation Office
NMED	New Mexico Environmental Department
NMDGF	New Mexico Department of Game and Fish
NMISC	New Mexico Interstate Stream Commission
NMMJM	New Mexico meadow jumping mouse (*Zapus hudsonius luteus*)
NMT	New Mexico Institute of Mining and Technology
PMT	Program Management Team
Program	Middle Rio Grande Endangered Species Collaborative Program
Reclamation	U.S. Bureau of Reclamation
RGSM	Rio Grande silvery minnow (*Hybognathus amarus*)
RIP	Recovery Implementation Plan
SADD	San Acacia Diversion Dam
SSCAFA	Southern Sandoval County Arroyo Flood Control Authority
ScW	Science Work Group
ScW/HR	Science/Habitat Restoration Work Group
SWFL	Southwestern willow flycatcher (*Empidonax traillii extimus*)
UNM	Unversity 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*)
2003 MRG BO	Biological and Conference Opinions of the Effects of Actions Associated with the Programmatic Biological Assessment of Bureau of Reclamation's Water and River Maintenace Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande, New Mexico
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

EXECUTIVE SUMMARY

The Middle Rio Grande Endangered Species Collaborative Program (Program or MRGESCP) is a diverse partnership bringing several federal, state, tribal, local, and university signatories together to address environmental concerns in the Middle Rio Grande (MRG) related to endangered species. The Program's collaborative efforts aim to protect and improve the status of endangered species and their habitats along the MRG, while also allowing existing and future regional water uses.

In fiscal years 2016 (FY16) and 2017 (FY17), the Program began to shift direction away from efforts to develop a MRG Recovery Implementation Plan (RIP) toward pursuing an Adaptive Management Program (AMP) and developing a new Long-Term Plan (LTP). Simultaneously, several signatories developed and implemented a new multi-party MRG Biological Opinion (BO). With these changes, and ongoing collaboration and support needed for other MRG BO's, and the Program's on-going activities geared toward species recovery, the U.S. Bureau of Reclamation (Reclamation), in coordination with the other Program signatories, contracted a third-party Program Management Team (PMT) to support the Program moving forward.



IMAGES: Scenic Views of the Rio Grande (Above and Front Page) ***CREDIT:*** Mike Marcus

In FY16 and FY17, the following signatories remained as participants under the 2008 Memorandum of Agreement (MOA):

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

Continuous collaboration around and coordinated support of habitat restoration projects, species management and monitoring, water management and operations, scientific studies, and Program a dministration has advanced the goals of contributing to the protection and recovery of federally listed species, while also protecting current and future water uses. This report describes the MRGESCP's goals and organization, summarizes Program expenditures, and highlights Program activities and accomplishments for FY16 and FY17.

IMAGE: MRGESCP Executive Committee Members ***CREDIT:*** WEST, Inc. Staff

1. INTRODUCTION

1.1 MRGESCP Background & Overview

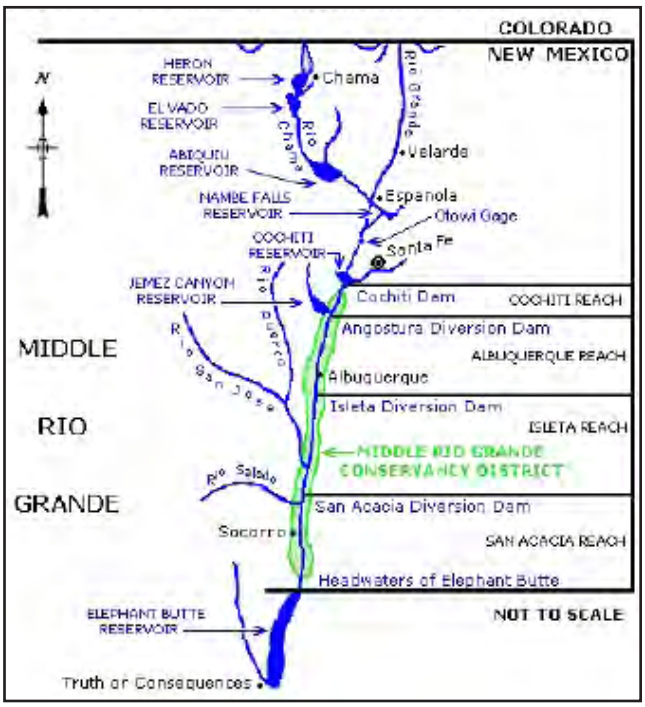
The MRGESCP was formed when conflict arose from the federally endangered listing of the Rio Grande silvery minnow (RGSM) in 1994, the southwestern willow flycatcher (SWFL) in 1995, and drought conditions in 1996 that exacerbated already stressed conditions in the MRG. When conflict resulted in litigation in 1999, stakeholders began to formulate workgroups to collaborate on species recovery and protection of the existing and future water uses in the MRG. Historically, these stakeholders included federal, state, and local agencies; environmental organizations; tribes and pueblos; agricultural interests; and business associations affected by and interested in resolving conflict and alleviating issues through collaboration.

The Endangered Species Act (ESA) Workgroup was formed in 2000 with the intent of developing the MRGESCP. The MRGESCP aimed to use the best available science to create economically viable and practical approaches to prevent species extinction, improve habitat, and promote the recovery of species. A Memorandum of Understanding (MOU) was signed in 2002 and affirmed the commitment of signatories to the Program.

Since 2002, signatories continue to provide a variety of support in collaborating on numerous projects and programs benefitting federally listed species within the MRG. The species of principle interest have been the endangered RGSM and SWFL since the Program's inception. However, after their federal status listings in 2014, the Program also began to concentrate efforts on the New Mexico meadow jumping mouse (NMMJM; endangered) and the yellow-billed cuckoo (YBCU; threatened).

The Program area stretches from the headwaters of the Rio Chama watershed and the Rio Grande, including tributaries, from the New Mexico/Colorado border downstream to the elevation of the spillway crest of the 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: the Cochiti Reach, the Angostura Reach, the Isleta Reach, and the San Acacia Reach (Figure 1). Depending on their jurisdiction and authority, signatories may support activities within one or all four reaches, as well as north of the Cochiti Reach to the New Mexico/Colorado border.

Figure 1. Program Area Map



The MRGESP's purpose is multi-faceted:

1. To prevent extinction, improve habitat, support scientific analysis, and promote recovery of the listed species within the Program area in a manner that benefits the ecological integrity, where feasible, of the MRG riverine and riparian ecosystem.
2. To exercise creative and flexible options so that existing water uses continue and future water development proceeds in compliance with applicable federal and state laws.

1.2 MRGESCP Governance

Adopted in 2008, the Program's by-laws describe the governance structure, the decision-making processes, and the roles and responsibilities of the signatories. The Program's by-laws have been amended over the years, and continued to be updated through FY17 to accommodate Program development. Documents related to governance including by-laws, authorities, and charters, are maintained on the Program's database management system (DBMS; https://webapps.USGS.gov/MRGESCP).

IMAGES: Scenic Views of the Rio Grande (Left and Below) ***CREDIT:*** Reclamation

1.3 MRGESCP's Organization & Structure

The MRGESCP's organizational structure in FY16 consisted of the Executive Committee (EC), the Coordination Committee (CC), the signatory-led PMT, and technical work groups. In FY17, Reclamation contracted Western EcoSystems Technology, Inc. (WEST, Inc.) as a third-party PMT, but the Program's organizational structure largely remained the same. The following summarizes the roles and functions of the Program's committees, technical groups, and the PMT. More information including Program documents and the Annual Administrative Record can be found on the DBMS.

Executive Committee

FY16 Federal Co-Chair: Brent Esplin, Reclamation *FY16 Non-Federal Co-Chair: Rick Billings, ABCWUA*

FY17 Federal Co-Chair: Brent Esplin, Reclamation *FY17 Non-Federal Co-Chair: Janet Jarratt, APA*

The EC is the Program's governing body and consists of one primary and one alternate representative from each signatory organization. This committee provides policy direction, approves budget recommendations, and holds decision-making authority unless specifically delegated to other committees or work groups. Representatives work to set Program priorities, coordinate policy, and authorize Program activities.

Coordination Committee

FY16 Federal Co-Chair: Jim Wilber, Reclamation *FY16 Non-Federal Co-Chair: Rick Billings, ABCWUA*

FY17 Federal Co-Chair: Dave Campbell, USFWS *FY17 Non-Federal Co-Chair: Rick Billings, ABCWUA*

Each EC signatory representative appoints a CC member from their organization, and may appoint an alternate. The committee was established to provide Program support by identifying and working to resolve concerns related to Program activities; communicating directives, information, and recommendations between work groups and the EC; and ensuring EC representatives are informed on Program matters.

IMAGE: San Acacia Diversion Dam ***CREDIT:*** WEST, Inc. Staff

Program Management Team

FY16 Program Assistant: Alighieri Saenz, Reclamation

In FY16, the PMT consisted of program management and administrative staff employed or contracted by Reclamation, USFWS, USACE, and NMISC. The PMT provided management, administrative, and technical support to the EC, CC, and work groups.

FY17 Program Manager: Debbie Lee, WEST, Inc. *FY17 Science Coordinator: Dave Wegner, WEST, Inc.*

In FY17, Reclamation contracted WEST, Inc. as a third-party PMT to support the Program. The WEST, Inc. PMT provides program and science support to the EC, CC, and work groups. The PMT is staffed by a Program Manager who directs PMT activities and Program support staff, and a Science Coordinator and Deputy Science Coordinator who provide science support to the Program. The PMT is responsible for managing the technical and administrative aspects of Program activities.

WORK GROUPS

The EC establishes work groups as needed to provide assistance and expertise in addressing Program tasks. Work group members include Program signatory professionals, their contractors, and other parties with expertise related to the group's directive. Work groups provide focused assistance and expertise, technical review and project oversight, and coordination to address Program directives and activities. Work groups meet regularly and provide a forum for Program matters and technical planning efforts.

Science/Habitat Restoration Work Group

FY16 Science Work Group (ScW)

Federal Co-Chair: Dana Price, USACE *Non-Federal Co-Chair: Rick Billings, ABCWUA*

FY16 Habitat Restoration Work Group

Federal Co-Chair: Danielle Galloway, USACE *Non-Federal Co-Chair: Rick Billings, ABCWUA*

FY17 Science/Habitat Restoration Work Group (ScW/HR)

Federal Co-Chair: Danielle Galloway, USACE *Non-Federal Co-Chair: Rick Billings, ABCWUA*

In FY16, the ScW and the HR Work Group met separately; however, in 2017 mutual tasks, schedules, and interests merged the groups to become the ScW/HR. The ScW/HR provides technical support and expertise to the Program for science activities benefitting the federally listed MRG species. The group's key roles include planning and recommending research and monitoring priorities; providing technical review and project coordination; and providing a framework and venue for exchanging scientific information.

AD HOC GROUPS AND SUBGROUPS

Temporary ad hoc groups occasionally tier from Program work groups and committees to advance individual projects or tasks. Ad hoc groups report to the primary committee or work group, and typically consist of individuals with expertise or interest in the specialized assignment. These groups disband once pre-determined objectives have been completed.

2. FINANCIAL SUMMARY

The MRGESCP's signatories contribute funding and other resources to Program-related activities. Two federal partners, Reclamation and USACE, receive funding from Congressional Energy and Water Development Appropriations. Four municipal and state signatories: ABCWUA, CoA, MRGCD, and NMISC receive local and state money for MRG projects. All Program signatories contribute personnel time, technical expertise, and a variety of other resources toward supporting Program activities and efforts. Figures 2 and 3 show the percentage of combined funding allocations for each category in this report.

Figure 2. Percentage Allocated Costs for FY16 per Category

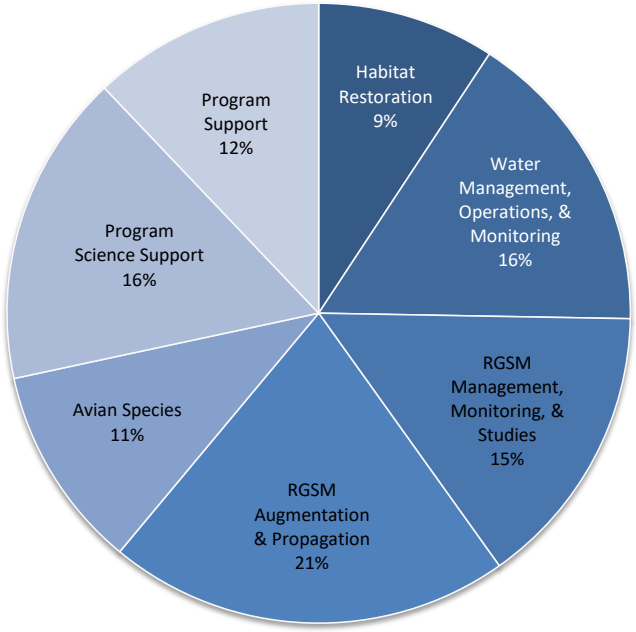
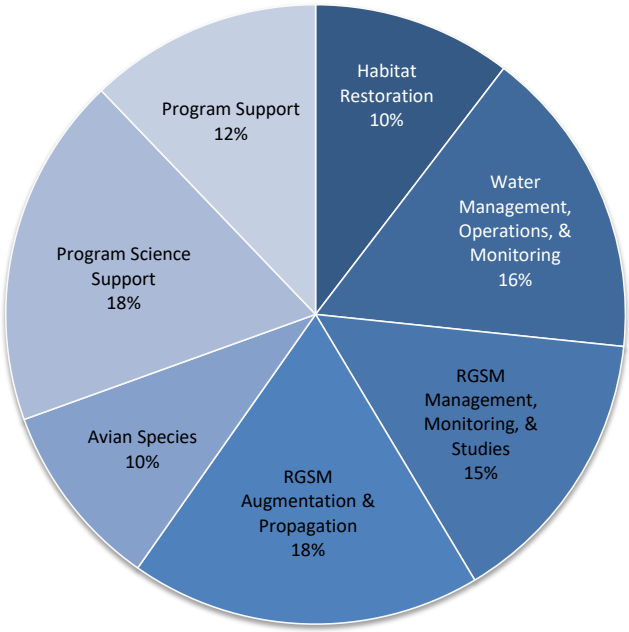


Figure 3. Percentage Allocated Costs for FY17 per Category



Non-Federal Cost Share

Reclamation's congressionally appropriated funding has a non-federal cost share requirement, and the non-federal signatories contribute financial and in-kind resources toward Program efforts. Two non-federal signatories, MRGCD and NMISC, are partners to the "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" (herein referred to as the 2016 MRG BO), and contribute funds toward implementation requirements. In addition to monetary contributions, other non-federal signatories provide in-kind resources such as personnel time, information, equipment, projects, and land access.

Three Pueblos actively participate in Program meetings and contribute to cost share with projects in their reaches of the MRG. The CoA Open Space division receives funding from the City's general obligation bonds toward habitat restoration and maintenance in the Albuquerque portion of the Angostura Reach. ABCWUA also works within this Reach to complete Program-related projects. BEMP produces research and science data with funding from a variety of sources, including MRGESCP partners. Other non-federal signatories commit time and expertise toward Program activities including attendance and participation at committee and work group meetings.

3. PROGRAM ACCOMPLISHMENTS

Throughout FY16 and FY17, the MRGESCP continued to promote the recovery of listed species. The Program collaborated to restore species habitat; acquire and manage supplemental water; perform water monitoring and studies related to listed species; conduct species monitoring, studies, augmentation, and propagation; support scientific analysis and adaptive management; and improve program management.

RGSM Releases

Over 126,000 RSGM were released into the MRG in 2016 and 2017

SWFL Monitoring

2017: First confirmation of SWFL nest and breeding pair at the Pueblo of Santa Ana

Water Activities

Acquired and released 14,490 AF of supplemental water during 2016, and 14,540 AF in 2017

RGSM Rescue/Salvage

More than 55,000 RGSM salvalged and relocated to wet reaches of the Rio Grande in 2016

Water Activities

Sustained early spring runoff of 3,000 cfs in 2016, and 4,000 cfs in 2017

IMAGE: ABCWUA's San Juan Chama Diversion Fish Passage
CREDIT: Reclamation

IMAGE: Texas Spiny Softshell in the Rio Grande
CREDIT: WEST, Inc. Staff

3.1 Habitat Restoration Projects

In FY16 and FY17, Program signatories worked to restore and improve habitat along the MRG. Activities included planning, designing, constructing, and monitoring of projects in various locations to benefit the listed species. Habitat restoration in the MRG involves physical manipulations of the Rio Grande channel and the adjacent bosque. Table 1 lists habitat restoration-related activities, project duration, and signatories that contributed to the projects.

Table 1: Habitat Restoration Activities List

Project Name	Begin	End	Contributing Signatories
Habitat Restoration			
Habitat Restoration in the Isleta and San Acacia Reaches	FY16	Ongoing	NMISC; MRGCD; Reclamation; USFWS
Habitat Restoration Fisheries Monitoring	FY16	Ongoing	NMISC; ABCWUA
Iselta Diversion Dam Preliminary Engineering Analysis Report	FY17	FY23	Pueblo of Isleta; MRGCD; Reclamation
Riverine Habitat Restoration and Endangered Species Monitoring	FY07	Ongoing	Pueblo of Sandia; Reclamation
Bar 3 Restoration Project Update	FY08	Ongoing	Pueblo of Santa Ana
Groundwater Levels and Response to River Discharge in the Albuquerque Area	FY15	FY17	USACE
Literature Review of Techniques for Creating Channel Bars for Instream RGSM Habitat	FY15	FY18	USACE
Los Lunas Habitat Restoration Project Monitoring	FY00	Ongoing	USACE; Reclamation; MRGCD
Tamarisk Leaf Beetle Monitoring	FY13	FY19	USACE

IMAGE: Constructed Floodplain ***CREDIT***: Mike Marcus

Habitat Restoration in the Isleta and San Acacia Reaches

This project focuses on characterizing hydrologic and geomorphic conditions in the lower Isleta Reach and upper San Acacia Reach, selecting potential restoration sites, modeling channel and overbank flows, and designing projects to improve RGSM, SWFL, and YBCU habitats in the MRG. In 2016 and 2017, NMISC collaborated with Sevilleta National Wildlife Refuge (NWR) and Reclamation to select, design, and construct habitat restoration projects. Cooperation between these agencies allowed these projects to be constructed using Reclamation and Sevilleta NWR field crews, which resulted in timely and cost-effective environmental compliance, design, and construction. One 16-acre overbank and backwater project has been constructed on the Sevilleta NWR and five off-channel projects, ranging from 1 to 10 acres, were constructed south of the San Acacia diversion dam (SADD). These projects provide habitat diversity and increase availability of the floodplain during spring runoff when several native fish species spawn.

Benefits to Species: Habitat restoration projects are intended to provide spawning and larval fish nursery habitats. In addition, SWFL and YBCU habitat is being created through regeneration of willow and cotton-wood trees in the restored areas.

Habitat Restoration Fisheries Monitoring

Constructed habitats in the Isleta Reach and the Albuquerque Reach were monitored during spring runoffs in 2016 and 2017 to evaluate the effectiveness of the projects, including monitoring of adult and larval fish. In 2016, main stem spring runoff and modified flow from temporary storage in El Vado reservoir created a sustained flow of up to 3,000 cubic feet per second (cfs) for over 30 days. In 2017, spring runoff exceeded 4,000 cfs for over 30 days. Sustained flows provided opportunities to work on floodplain habitats constructed over the past eight years, and the results of those projects are being analyzed.

Benefits to Species: These monitoring efforts will provide valuable information to address data gaps regarding RGSM spawning cues and preferred habitats, including expanding on limited information about larval fish, growth rates, and specific needs for food and timing of inundation.

IMAGES: Habitat Restoration Site Constuction (Middle and Left) ***CREDIT:*** Reclamation

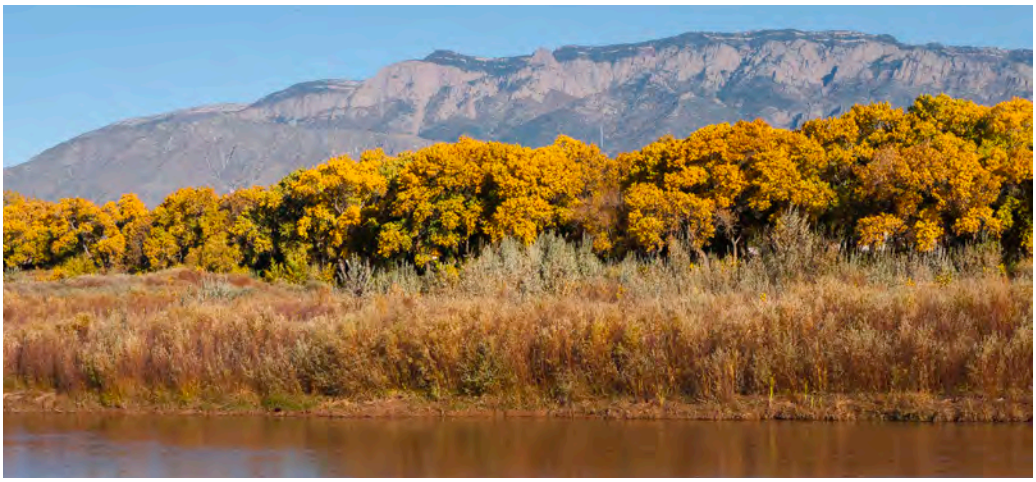


IMAGE: Bosque Views
CREDIT: Mike Marcus

Isleta Diversion Dam Preliminary Engineering Analysis Report

This project involves development of a Preliminary Engineering Analysis Report, which is anticipated to be complete in FY19, for modification of the Isleta Diversion Dam (IDD) and irrigation infrastructure related to sediment management, fish passage, and geomorphic analysis. This project also includes development of a Bosque and Riverine Restoration Plan for the Pueblo of Isleta.

Benefits to Species: 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 range, and a fish passage at IDD will provide connectivity between the Isleta and Angostura Reaches of the MRG. When constructed, planned riparian restoration will enhance current habitat and provide new habitat for terrestrial species.

Riverine Habitat Restoration and Endangered Species Monitoring

The Pueblo of Sandia completed riverine habitat restoration and endangered species monitoring during 2016 and 2017. The habitat restoration project is intended to increase riverine habitat complexity to support various life stages of RGSM as well as SWFL habitat. The phased project included habitat improvement work in the Sandia Subreach of the MRG.

Phase I planning efforts resulted in focused recommendations for improving habitat including the use of passive restoration, island and bar enhancement, bank lowering, and embayments. Phase II, completed in 2016, involved bank-lowering of a previously constructed flow-through channel so the channel entrance and exit function more like floodplains. Other flow channels were widened in targeted locations to create habitat for RGSM where they are documented to be using the channels. Channel widening also had the objective of expanding wetland vegetation and allowing overbank flooding. This phase also included shrub planting and seeding. Phase III, completed in 2017, involved bank-lowering and creation of another inlet, as well as shrub planting and seeding.

In addition to habitat restoration projects, the Pueblo of Sandia uses established protocols to document presence/absence of endangered species in the Sandia Subreach.

Benefits to Species: Year-round RGSM augmentation and salvage efforts have placed thousands of RGSM in areas directly upstream and within Pueblo of Sandia boundaries. Improvements to surface water hydrology and overbank flooding should have the additional benefit of supporting the creation and enhancement of suitable SWFL habitat. Increased habitat diversity will provide better egg retention and larval rearing so that the RGSM's documented use of the Sandia Subreach may be increased.

Bar 3 Habitat Restoration Project Update

In 2011, the MRGESCP funded Santa Ana Pueblo's Bar 3 Modification and Habitat Restoration Project. This project aimed to develop RGSM wetted habitat by installing woody debris piles and creating low velocity channels to inundate at lower cfs than previous bar elevations. Additionally, several varieties of willows and other vegetation were planted to increase vegetation cover and structure necessary for SWFL habitat. Channel construction and vegetation plantings were completed in 2014, and additional plantings occurred at the end of 2015. The photos at left show the project site in 2012, 2014, and 2017. The Pueblo conducts monitoring of the fish community every spring, summer, and fall, including in locations above and below the Bar 3 project site.

In 2017, the Santa Ana Pueblo received funding through the New Mexico Environment Department (NMED) Surface Water Quality Bureau's River Stewardship Program for further habitat restoration efforts that will mimic the success of the Bar 3 project. Planning efforts began in FY17 for the Pueblo's upcoming Bar 1 Restoration Project. This project will restore 27 acres of river bar by removing exotic trees and shrubs, creating low flow channels through high and dry areas, and planting native trees and shrubs. Additionally, the Pueblo will begin planning efforts on a Southeast Bar Restoration Project. Planning efforts will include analysis of the project site, data collection, project design, reporting, and environmental compliance.

IMAGES:

Top: 2012 Aerial Image of Project Area
Middle: 2014 Aerial Image of Project Area
Bottom: 2017 Aerial Image of Project Area
CREDIT: Google Earth

Groundwater Levels and Response to River Discharge in the Albuquerque Area

Data from this USACE monitoring project provide information regarding how long 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 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 useful for a number of reasons, including the following:

1) Evaluating differences in soil moisture availability on vegetation growth attributes in the constructed willow restoration features.
2) Informing future designs for SWFL restoration projects.
3) Evaluating differences in primary biological productivity between restoration features with and without a direct river connection.

Benefits to Species: This study will aid in the understanding of impacts to species' environments, support operational strategy decision-making, and contribute to maintaining healthy and suitable species habitat.

IMAGE: Groundwater Monitoring Site
CREDIT: Danielle Galloway, USACE

Literature Review of Techniques for Creating Channel Bars for Instream RGSM Habitat

Sand bars and similar geomorphic features are important for river ecosystems because they provide nesting and foraging habitat for birds and important shallow water habitat for numerous aquatic species. However, most rivers that are managed to prevent flooding lack sufficient sediment to maintain channel bars, which causes these features to erode and disappear. In channels that are being eroded and that lack floodplain connectivity, instream habitat is even more important. This project intends to identify effective techniques for creating these features.

Benefits to Species: The techniques, guidance, and models described in this literature review will provide planning support for USACE and other agencies to develop in-channel habitat restoration projects that better utilize river flows, structural modifications, and available sediment to create quality habitats for endangered avian and aquatic species.

IMAGES: Channel Bars (Left and Above) ***CREDIT:*** Michael Porter, USACE

Los Lunas Habitat Restoration Project Monitoring

Following a fire in April 2000, the Los Lunas Restoration Site was selected as the first restoration area under the "Biological and Conference Opinions on the Effects of Actions Associated with the Programmatic Biological Assessment of Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande, New Mexico" (herein referred to as the 2003 MRG BO). Reclamation and USACE have acted as joint lead federal agencies on this 40-acre project, and MRGCD is the primary non-federal cooperator. This was the first habitat restoration project funded by the MRGESCP.

The primary objective of the project is to improve habitat conditions for RGSM and SWFL. The project included removing non-native vegetation to promote native willow and cottonwood establishment and growth; excavating high-flow channels and terrace lowering to provide RGSM nursery habitat; and excavating a groundwater pond/wetland for other wildlife. This ongoing activity will monitor the availability and effectiveness of restored habitat, including physical elements related to habitat characteristics (hydrology, geomorphology, and vegetation) and the presence of RGSM and SWFL.

Benefits to Species: Habitat restoration may successfully create sustainable habitat features for RGSM and SWFL. Consistent monitoring will ensure that constructed projects are functioning as designed and assist in determining the effectiveness and life spans of various restoration techniques and treatments. This will also help with the design of future restoration projects, which can be refined based on monitoring results.

IMAGE: Los Lunas Habitat Restoration Site
CREDIT: Michael Porter, USACE

IMAGE: Tamarisk Leaf Beetle ***CREDIT:*** USDA

Tamarisk Leaf Beetle Monitoring

Tamarisk leaf beetle (*Diorhabda carinulata*) monitoring results revealed the spread of the beetle resulting in defoliation of tamarisk into the Rio Grande watershed. The spread of tamarisk leaf beetle from the north and potential spread of other species of tamarisk leaf beetle (e.g., *Diorhabda elongata*) from Texas will ultimately affect riparian forests in central and southern New Mexico. *Diorhabda carinulata* has already spread further south, and the spread of the Texas beetle species is expected to continue range expansion into New Mexico watersheds. These areas are suitable habitat for the endangered SWFL and important to many other riparian birds, reptiles, and amphibians.

The survey methods for tamarisk leaf beetle are based on those established by the Tamarisk Coalition. Field data sheets are compiled and entered into a database, the spatial data for the beetle numbers present in each sampling location are used to create a GIS map, and findings identify what beetle species are present in New Mexico. This work is used to coordinate and compile tamarisk leaf beetle monitoring datasets with the Tamarisk Coalition.

Benefits to Species: Suitable habitat for SWFL and other riparian birds, reptiles, and amphibians exists in the MRG. The spread of the tamarisk leaf beetle will ultimately impact riparian forests in central and southern New Mexico. This project provides valuable information to managers for habitat restoration and other projects in riparian forests along the MRG.

3.2 Water Management, Operations & Monitoring Projects

In FY16 and FY17, Program signatories worked to acquire and manage water, collaborated on water releases and species activity, and conducted hydrologic studies in the MRG. Table 2 gives an overview of water management, operations, and monitoring activities, project duration, and signatories that contributed to the projects.

Table 2. Water Management, Operations, and Monitoring Activities List

Project Name	Begin	End	Contributing Signatories
Habitat Restoration			
Minnow Action Team	FY12	Ongoing	All Signatories
Supplemental Water Program	FY01	Ongoing	Reclamation
Continuous Water Temperature Monitoring of the MRG Basin	FY13	Ongoing	USACE
Rio Grande Nature Center High Flow Channel Gage Monitoring	FY10	Ongoing	USACE
Water Quality Monitoring of Aquatic Refugia in the MRG	FY17	Ongoing	USACE

Minnow Action Team

The Minnow Action Team (MAT) began in 2012 as an ad hoc work group to coordinate activities related to MRG water and species activities for a particular year. Due to reports of low RGSM numbers in the MRG resulting from the prolonged drought in 2012, the MAT was formed to determine if management actions could be proposed to the EC.

The MAT assists resource management entities with annual coordination, evaluation, and recommendations on water operations and species management to meet BO and recovery goals for the RGSM. It does this by assimilating hydrologic, biological, and ecological information on an annual basis; and providing recommendations that could be used to reduce endangered species threats, and to enhance spawning, recruitment, and survival conditions for RGSM.

In 2016, the MAT performed its annual assessment of hydrologic conditions in the context of addressing species' needs. The MAT informed the EC of the technical recommendations to the management agencies on potential operational and monitoring actions that could be considered for the upcoming irrigation season. These recommendations included the following:

- Seek to maintain the 2003 MRG BO flow targets for dry year (Article VII) conditions
- Support efforts to collect RGSM eggs for captive propagation facilities
- Seek to create/enhance the spring runoff hydrograph for RGSM spawning and recruitment
- Seek to create and maintain perennially wet refugia in the Isleta and San Acacia reaches

In 2017, the runoff forecast was improved over the previous four years, and Article VII of the Rio Grande Compact was lifted for a portion of the spring runoff. The MAT's recommendations included the following:

- Maintain regular operating conditions with no modifications for spawning or recruitment operations
- Entities conducting RGSM monitoring efforts should monitor for the occurrence of eggs, larvae, and adults in both the main channel and inundated overbank areas, and should evaluate the need to improve connections between the floodplain and channel for receding flows

After meeting again in 2017 to discuss results of the spring runoff and what would be anticipated for summer flows and drying, the MAT provided the following additional recommendations:

- Use up to 18,000 acre-feet (AF) of supplemental water strategically to reduce drying in the San Acacia and Isleta reaches
- Seek to maintain continuous flows in the Albuquerque portion of the Angostura Reach
- As they are able, agency staff and contractors should quantify habitat extent, gains, and losses in the main channel during the summer months

Supplemental Water Program

In accordance with commitments in Reclamation's 2016 MRG BO, water acquisition funding in 2016 and 2017 allowed releases of supplemental water to benefit RGSM and SWFL. Funds totaling $1,123,875 in 2016 and $1,119,900 in 2017 secured leases of San Juan-Chama Project water from willing lessors to release supplemental water into the Rio Grande. Table 3 summarizes the water leases in both fiscal years.

Table 3. Water Acquisition and Funding for the San Juan-Chama Project Supplemental Water

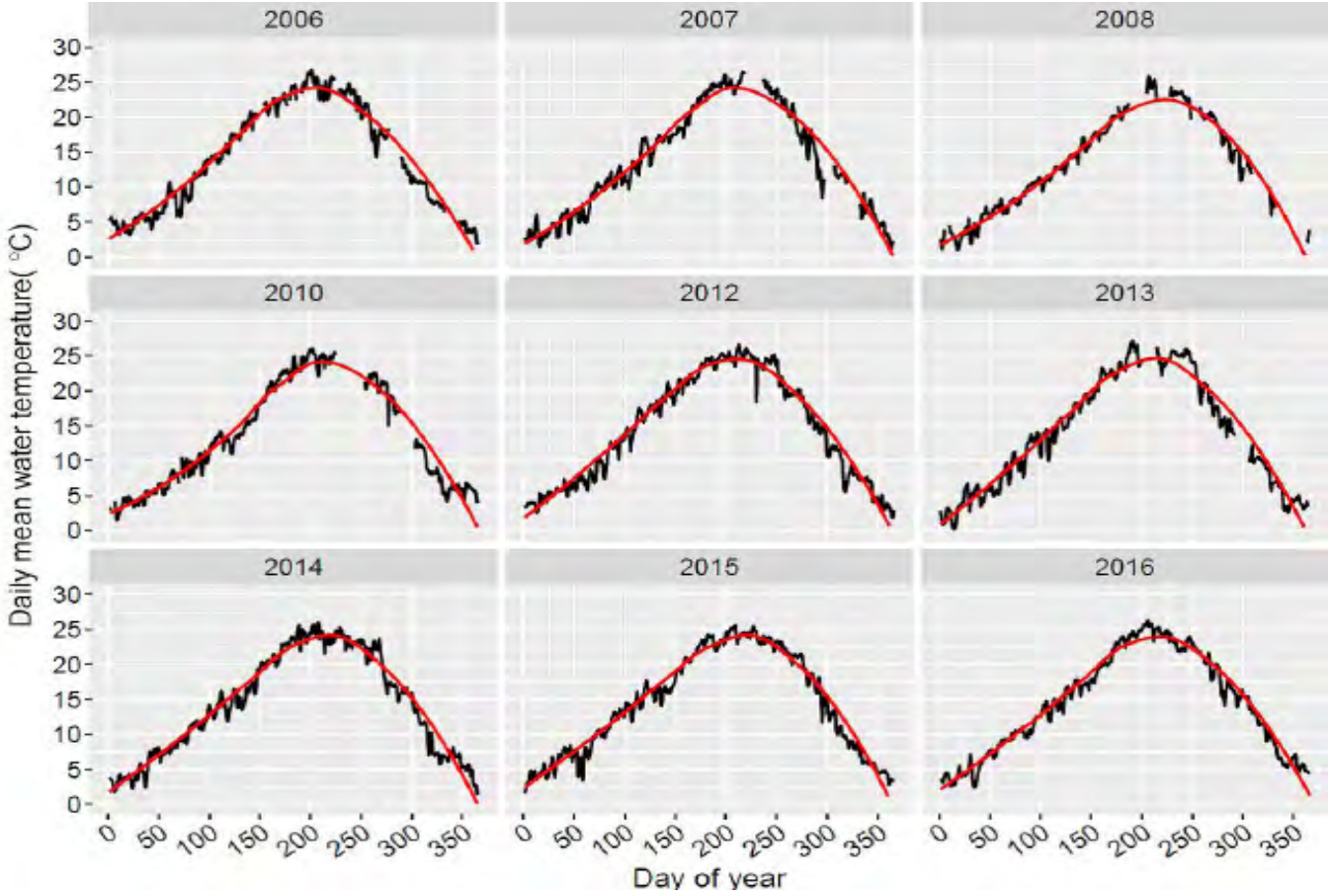
San Juan-Chama Contractor	2016 Leased Acre-Feet	2016 Funding	2017 Leased Acre-Feet	2017 Funding
City of Belen	450	$22,050	450	$21,600
City of Española	900	$44,100	930	$44,640
City of Santa Fe	50	$2,450	50	$2,400
County of Los Alamos	1,200	$58,800	1,200	$57,600
Couty of Santa Fe	375	$18,375	375	$18,000
El Prado W&S District	40	$1,960	40	$1,920
Jicarilla Apache Nation	5,900	$590,000	5,900	$590,00
OhKay Owingeh	2,000	$98,000	2,000	$96,000
Taos Pueblo	2,215	$221,500	2,215	$221,500
Town of Bernalillo	300	$14,700	300	$14,400
Town of Red River	60	$2,940	60	$2,880
Town of Taos (original + settlement allocations)	700	$34,300	700	$33,600
Village of Los Lunas	300	$14,700	320	$15,360
Total	**14,490**	**$1,123,875**	**14,540**	**$1,119,900**

Continuous Water Temperature Monitoring of the MRG Basin

The thermal regime of rivers is a key factor that determines the overall health of aquatic ecosystems as it influences the habitat suitability, distribution, and growth rates for most aquatic organisms. Temperature directly affects the level of dissolved oxygen in water, which is crucial for the health of aquatic organisms and for overall ecosystem health. Water temperature in the MRG fluctuates naturally (i.e., daily, seasonally and annually) and as of result of human activities that alter the flow of the river, such as dam releases and water diversions. RGSM evolved in a highly variable ecosystem, and is likely more tolerant of elevated temperatures and low dissolved oxygen concentrations for short periods. Despite this tolerance, degraded water quality can significantly affect the ability of RGSM to carry out biological processes, or even survive.

Project data are available in real-time via USGS (https://waterdata.usgs.gov/nm/nwis/current/?type=quality) and Reclamation (https://www.usbr.gov/uc/albuq/water/ETtoolbox/rg/riog/schematic/ SCHEMATICwaterquality.html).

Figure 4. Daily mean (black line) and locally weighted scatter plot smoothed (LOESS; red line) water temperature (°C) for the Rio Grande at Alameda Bridge. Data was collected by the USGS, USACE, and UNM at the Alameda Bridge.



Benefits to Species: By collecting and analyzing water temperature data at fixed stations year-round and periodically during periods important to the life history of the RGSM (i.e., snowmelt pulse, flow reduction, flow alteration), scientists and engineers can assess seasonal and inter-annual variability, determine what environmental factors (e.g., discharge and air temperature) influence water temperature, and how water temperature influences RGSM (e.g., hatch periodicity, growth rates, survival, and population trends).

Rio Grande Nature Center High Flow Channel Gage Monitoring

The objective of this monitoring study is to collect data on stream flow through the channel during spring runoff. This information helps biologists understand whether and for how long flow conditions in this channel are suitable for RGSM spawning and recruitment. The amount and duration of flows also affect growth of native shrub species that provide essential SWFL habitat.

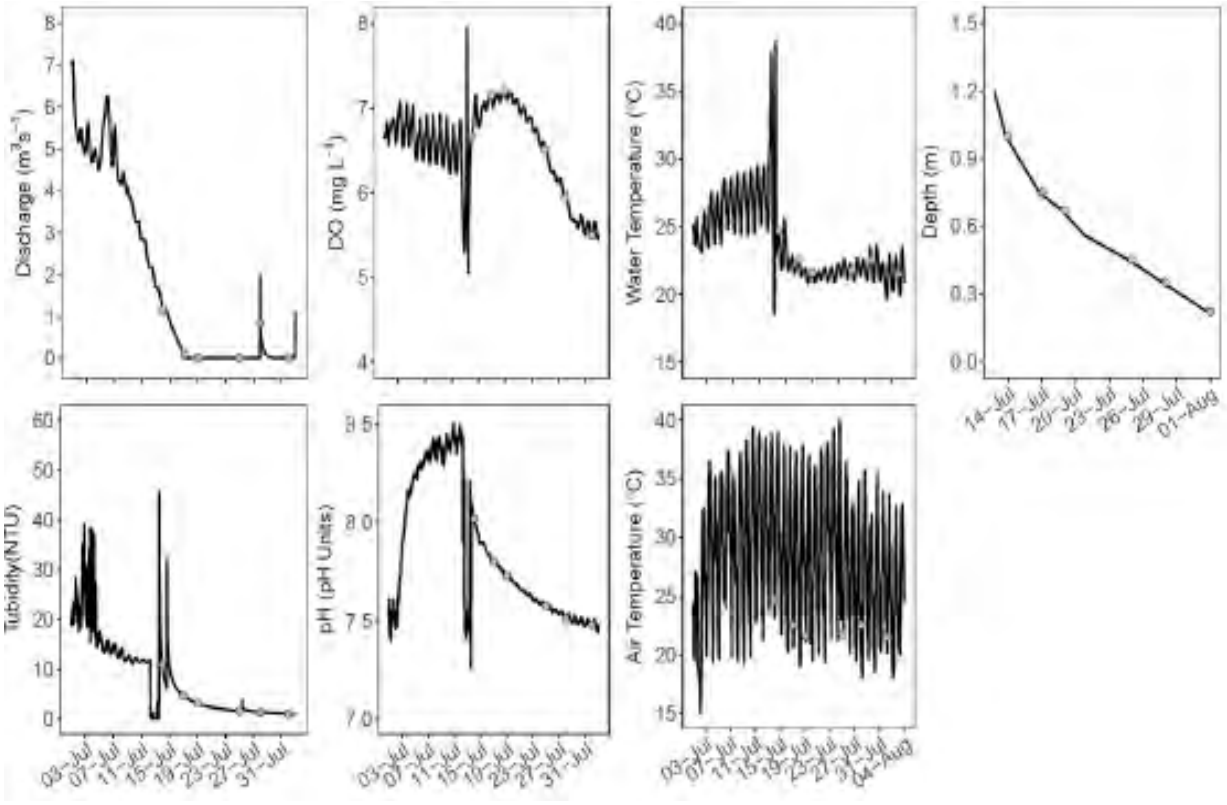
Benefits to Species: This project benefits RGSM and SWFL in the Albuquerque Reach by reestablishing hydrological connection between the river and channel.

IMAGE: High Flow Channel Gage Monitoring
CREDIT: Michael Porter, USACE

Water Quality Monitoring of Aquatic Refugia in the MRG

River intermittency, or 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 southwestern U.S. On the MRG, significant river intermittency is now considered the norm, and will become more frequent and widespread given water scarcity predictions.

Figure 5. Estimate discharge (m 3 s-1) of the Rio Grande near San Antonio, NM (USGS gage No. 08355490), and dissolved oxygen (DO, mg L-1), water temperature (°C), pH, and turbidity (NTU) measured at 15-minute increments from an isolated pool near the south boundary of Bosque del Apache NWR during the summer of 2016. The isolated pool was approximately 24 river-km downstream of the USGS gage. Pool depth was measured periodically during discrete water quality sampling events (grey dots). Hourly air temperature data was obtained from the meteorological station at the Socorro municipal airport.



Aquatic wildlife experience habitat loss as drying occurs along stretches of the MRG. Remaining aquatic habitat, such as irrigation outfalls and isolated pools may provide temporary refuge for aquatic wildlife 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 within aquatic refugia including pH, nutrient content, temperature, and oxygen have been identified as potentially inhibiting the use of these spaces by endangered species such as the RGSM.

Continuous and discrete measurements of water quality within aquatic refugia will provide insight into factors that may influence fish survival, and more specifically, survival of the endangered RGSM. Moreover, the evaluation of these aquatic refugia will lead to a greater understanding of stream fish ecology and future challenges facing the MRG. The results of this work may then be used to inform management decisions.

Benefits to Species: Quantifying and evaluating the water quality and biogeochemistry, in combination with overlapping physical habitat and fish community assessments of MRG aquatic refugia help water managers determine how to manage water or other factors to support refugia for RGSM and the greater MRG fish community.

IMAGE: Water Quaility Monitoring in an Isolated Pool at Bosque del Apache NWR
CREDIT: Justin Reale, USACE

3.3 Rio Grande Silvery Minnow

In FY16 and FY17, MRGESCP signatories contributed funding and other resources toward protection and recovery of RGSM. Table 4 lists RGSM-related projects, project duration, and signatories that contributed to the projects. Activity areas in this section are divided into the following two categories:

1) Species Management, Monitoring, and Studies
2) Population Propagation and Augmentation

Table 4. Rio Grande Silvery Minnow Activities List

Project Name	Begin	End	Contributing Signatories
Species Management, Monitoring, and Studies			
Drain Outfall Monitoring	FY14	FY16	MRGCD
Fish Community Surveys	Ongoing		Pueblo of Santa Ana; USGWS
Assessment and Monitoring of RGSM Genetics	FY03	Ongoing	Reclamation; UNM
RGSM Genetics Peer Review & Population Monitoring Workshop	**FY15**	**FY16**	**Reclamation**
RGSM Population Monitoring	FY02	Ongoing	Reclamation
RGSM Spawning Monitoring/Egg Monitoring in Canals	FY99; FY01	Ongoing	Reclamation
Evaluation of RGSM Population Model Alternatives	FY15	FY18	USACE
Evaluation of using eDNA for Detecting Larval RGSM on the Rio Grande Floodplain	FY17	FY17	USACE
Investigation of RGSM Mesohabitat Preferences	FY15	FY18	USACE
RGSM Monitoring in Habitat Restoration Areas	FY14	FY17	USACE
Population Augmentation and Propagation			
Operations and Maintenace of the LLSMR	FY07	Ongoing	NMISC; Reclamation
CoA Rearing/Breeding Operations and Maintenance	FY01	Ongoing	Reclamation; ABCWUA; CoA
RGSM Propagation, Augmentation, and Rescue/ Salvage	FY01	Ongoing	Reclamation; USFWS

SPECIES MANAGEMENT, MONITORING, & STUDIES

Drain Outfall Monitoring

MRGCD and SWCA staff conducted sampling of the fish populations in three outfall locations in the Isleta Reach of the MRG. Small volumes of water were consistently discharged out of the wasteways during periods of river drying. Sampling was conducted during irrigation season at approximately three week intervals. The intention of the sampling was to determine if RGSM use the MRGCD drain outfalls as refugia when the adjacent river channel is dry.

Benefits to Species: RGSM may use MRGCD drain outfalls as habitat when the river channel is dry. Monitoring of RGSM populations in the drain can determine the effectiveness of this water management strategy. This information can be used to inform future management decisions and help determine the most economical use of water when supplies are limited, as well as aid in the formation and refinement of future studies and monitoring projects

IMAGES: Drain Outfall Monitoring Areas ***CREDIT:*** MRGCD Staff

Fish Community Surveys

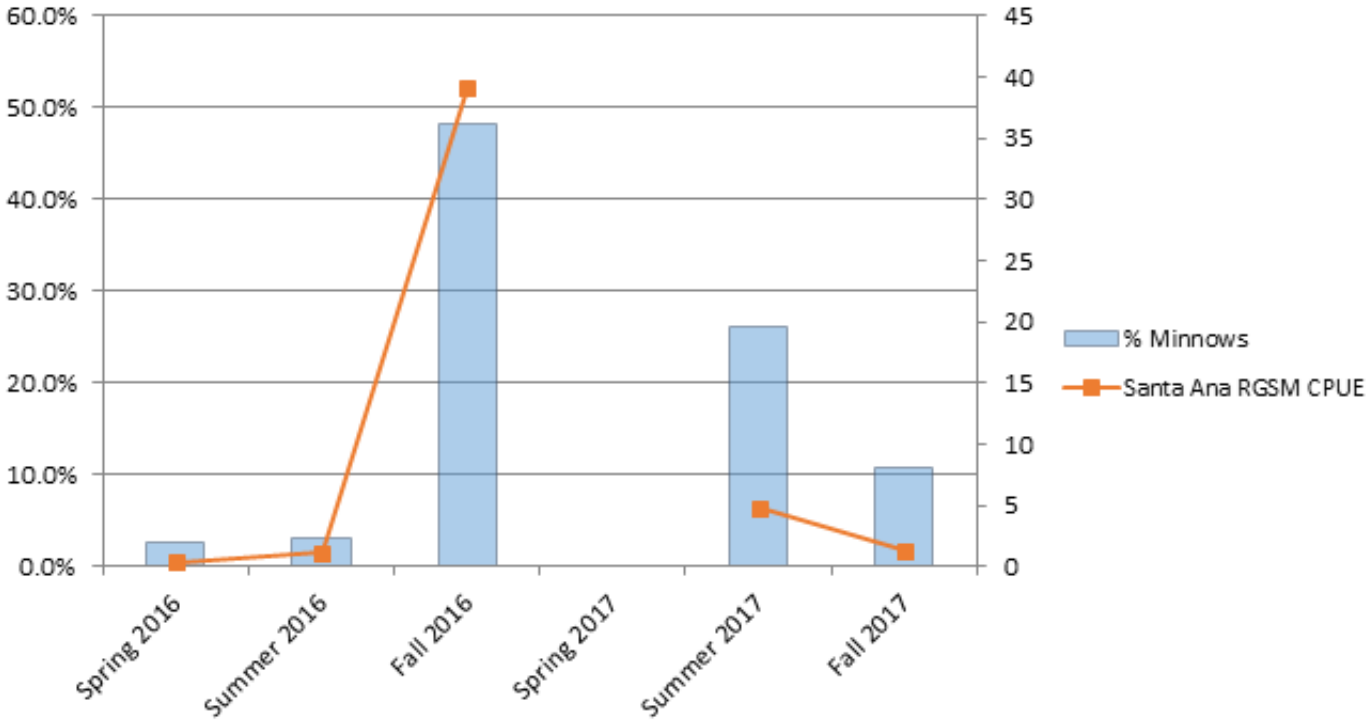
The Pueblo of Santa Ana completed fall 2016, and summer and fall 2017 fish community surveys in conjunction with USFWS staff. Due to high flows in spring 2017, data collection only happened during one day. The Pueblo monitored nine sites in the Santa Ana stretch of the Rio Grande during the fall and summer events. The Rio Jemez was dry during both events, and no data was collected for the six sites in that area.

There were a total of 135 seine hauls at nine sites during each event.

The fall 2016 event fell on the same week that USFWS stocked 20,880 minnows into Santa Ana's reach of the Rio Grande. Subsequently, the Pueblo collected data on the stocking recapture and provided the data to USFWS. During the summer 2017 monitoring event, the Pueblo invited BEMP and WEST, Inc. staff to assist in monitoring efforts and learn to identify fish.

Benefits to Species: Surveying fish communities provides management-relevant information on RGSM, including population trends in response to habitat restoration projects.

Figure 6: 2016 and 2017 Surveying Data



Graph shows percentage of minnows caught compared to the entire species list numbers, and catch per unit effort (CPUE) as minnows/100m²

Assessment and Monitoring of RGSM Genetics

Genetic monitoring of the MRG population of RGSM has been conducted from 1999 through 2012, and resumed from 2014 through 2017. Since 2002 when the augmentation program began, this has included monitoring stocks bred or reared in captivity and released to the MRG. In 2017, the project also began genotyping of all USFWS Southwestern Native Aquatic Resource and Recovery Center (ARRC) and the CoA Aquatic Conservation Facility (ACF) broodstocks used to produce fish for release in the fall.

The work under these contracts examines changes in levels of genetic variability in the wild population, impacts to viability, and impacts of captive propagation and augmentation on wild stocks. The RGSM genetics database is used to develop, parameterize, and verify models directed at predicting genetic effects of captive propagation on wild stocks of RGSM (under various scenarios) to inform captive propagation and augmentation strategies aimed at species recovery.

Monitoring in 2016 was based on genotyping 420 river-spawned RGSM collected in the three occupied reaches of the MRG, as well as wild-caught hatchery released fish, and progeny of captive stocks from USFWS Southwestern Native ARRC, the Los Lunas Silvery Minnow Refugium (LLSMR), and the CoA ACF. 2017 monitoring was based on genotyping 469 river-spawned RGSM collected in the three occupied reaches of the MRG, and progeny of captive stocks from Southwestern Native ARRC, Uvalde National Fish Hatchery, and the CoA ACF.

In 2016 and 2017, microsatellite diversity statistics (a measure of genetic variability within a population) were essentially unchanged from 2015 and 2016 values and exceeded minimum benchmark levels of diversity. In 2016, this stability is likely the result of the augmentation of the wild population with hatchery produced fish acting to buffer the population against loss of diversity. In 2017, the stability is also partly attributed to strong recruitment in fall 2016. The average number of alleles has remained relatively stable between 2006 and 2016, but in 2017 a decline in allelic diversity was observed, with this metric approaching the benchmark. Mitochondrial gene diversity and haplotype richness increased in 2016 and 2017 over most previous estimates, but remained within the range seen in previous years.

Variance genetic effective size using the temporal comparison from 2015 to 2016 was greater (NeV=514-744) than for the previous comparison from 2012 to 2015 (NeV=193-328), and estimates from 2016 to 2017 were greater (NeV=1028-2325) than the comparison from 2015 to 2016. Higher NeV for 2017 suggests more stable allele frequencies between years and is consistent with higher densities in the wild.

In 2017, UNM began genotyping of all broodstock used to produce fish for release in the fall of 2017 from USFWS Southwestern Native ARRC and the CoA ACF. Gene diversity measured from microsatellites fell within the range seen in the samples collected from the Rio Grande over the course of the study. Haplotype diversity (calculated from mitochondrial DNA [mtDNA]) was lower in the broodstock from the CoA ACF compared to

Benefits to Species: This project provides long-term, annual genetic information on wild and captive-reared stocks of RGSM. It is critical to characterize the genetic diversity of the wild population of RGSM, both spatially and temporally, so that broodstock may be selected to mirror the pattern of wild variation in hatchery-propagated individuals. Having knowledge about the genetic diversity of captive-spawned RGSM ensures that artificial selection in hatcheries or variance in reproductive success among brooding individuals have not significantly altered (i.e., reduced) gene frequencies of individuals released into the wild population.

RGSM Genetics Peer Review and Population Monitoring Workshop

In December 2015, Reclamation sponsored two peer review panels related to RGSM. The first was a peer review to assess the Program's Genetics Project. Interviews were completed in 2016, resulting in a report released in August 2016 titled: *Expert Peer Review of the Middle Rio Grande Endangered Species Collaborative Program's Rio Grande Silvery Minnow Genetics Project.*

The second panel workshop was the Population Monitoring Workshop. Expert panelists discussed current CPUE methodologies, RGSM sampling design, and the final reports. *Summary of Findings by the External Expert*

Panelists: RGSM Population Monitoring Workshop was submitted in April 2016. Descriptions of the peer review and the workshop are available in the reports and in the FY2015 Annual Report.

Benefits to Species: The peer reviews provide an independent evaluation of current efforts to aid in action toward conservation of the species. The workshop provides information to inform adaptive management and further improving conditions for the endangered RGSM.

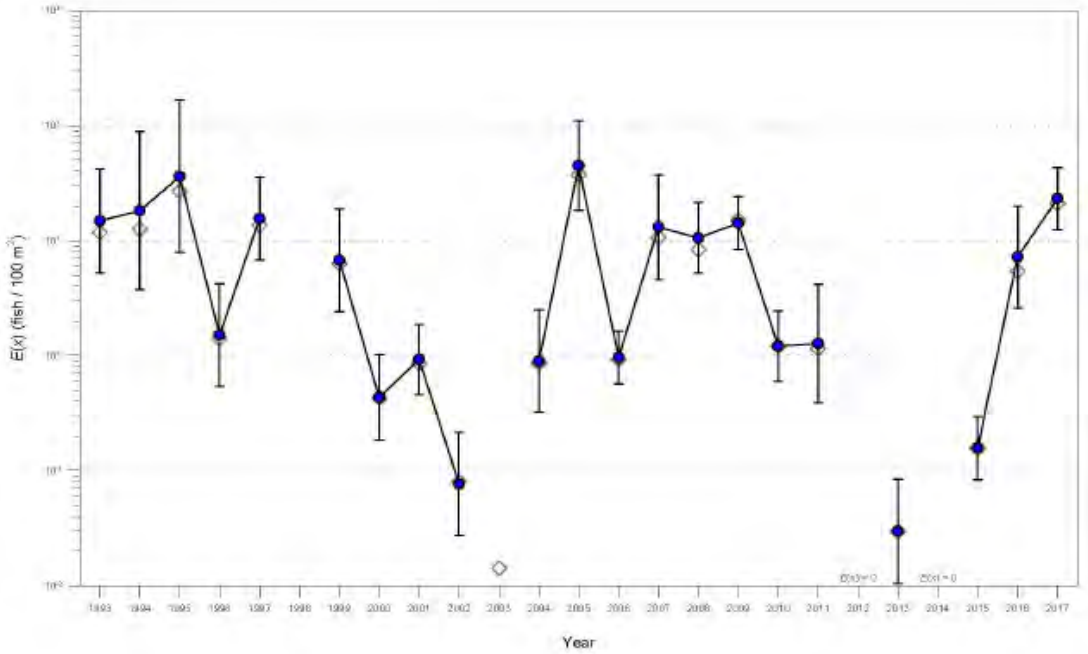
RGSM Population Monitoring

The Program and Reclamation have funded systematic population monitoring of RGSM and the associated MRG fish community since 2002. Monitoring initially began in 1993 at multiple sites from Algodones to Elephant Butte Reservoir. This long-term sampling program documents RGSM population trends.

Monitoring occurs nine months of the year at 20 locations in the MRG. In 2017, peer review recommendations were added to the sampling design and a total of 30 sites were used during the key months of April and October, and two months were made optional tasks (December and February). Catch per unit effort (CPUE), or the number of RGSM individuals per unit area sampled, is used to measure the status of the species. A consistent monitoring protocol yields a nearly seamless long-term ecological data set to accomplish the following:

- Determine long-term (multi-year) and short-term (seasonal) trends in fish populations of the MRG using statistical approaches that discern spatiotemporal differences in the abundance of native and non-native fish, with a focus on RGSM
- Evaluate 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 RGSM
- Compare changes in RGSM absolute and rank abundance to that of other native and non-native fish species
- Determine site-specific sampling variation
- Examine spatial correlation of RGSM population dynamics over time

Figure 7. RGSM Estimates of Density using October Sampling-Site Density Data (1993–2017)



Solid circles indicate modeled estimates and bars represent 95% confidence intervals. Dotted horizontal lines represent orders of magnitude. Source: ASIR, LLC.

The estimated densities (E(x)) of RGSM in October were notably lower from 2010 to 2014 as compared to the 2007 to 2009 period. Estimated densities improved in October 2015 (E(x) = 0.16), and again in 2016 (E(x) = 7.20). Catch rates dramatically increased in October 2017 (21.56). Over 2,800 RGSM were detected at sampling sites during standard monitoring surveys in October 2017 as compared to 584 in October 2016.

Benefits to Species: Monitoring provides the foundation for assessing long-term changes in the MRG fish community, including RGSM. Specifically, these data have been used to document temporal and spatial trends in native and non-native fish populations, and to assess the influence of environmental variability (i.e., timing, magnitude, and duration of discharge) on species abundance and community structure. Monitoring fish communities at selected study sites provides information on RGSM and associated fish fauna, including population trends in response to water management practices.

RGSM Spawning Monitoring/Egg Monitoring in Canals

Spawning activity of RGSM was monitored at sites in the Isleta and San Acacia reaches daily starting in 1999, and has continued annually since 2001 (with the exception of 2005). The sampling survey results were used to estimate the number of in-river RGSM eggs produced during major spawning events and over the duration of the principal spawning season (April - June). These results are also used to analyze egg passage rates, make correlations with water quality data, identify detailed spatial spawning patterns, and makes comparisons with prior years' data.

Reclamation has funded canal monitoring annually from 2003 to 2016 to document RGSM entrainment in main canals associated with diversion dams during the RGSM spawning period (May 1 - May 31). To minimize take as a result of diversions, catch rates in irrigation canals were used to determine the extent of the transport of eggs into the irrigation system at both IDD and SADD. Daily reports from this project inform resource management and river management decisions during the spring runoff. Canal monitoring was not conducted in 2017.

Monitoring from April 22 - June 10, 2016 detected a total of 496 eggs. The estimated number of eggs transported downstream was 166,147 at the Isleta Reach site, 144,374 at the San Acacia site, and 127,267 at San Marcial site. In 2017, monitoring occurred from May 2 - June 21 and detected a total of 450 eggs. The estimated number of eggs transported downstream was 149,818 at the lower Albuquerque site, 1,286,669 at the Sevilleta site, and 689,472 at San Marcial.

Benefits to Species: Long-term monitoring of the reproductive efforts of RGSM is necessary for recovery efforts and to facilitate effective management decisions. Research personnel use selected samples of wild eggs to conduct ongoing studies of population viability and genetics. Catch rates of drifting eggs during the spring peak flows are used to determine the magnitude and timing of the spring spawn for RGSM. Each yearly effort is also designed, in part, to provide insight into the success of recent stocking efforts. The future conservation status of RGSM appears to be dependent on ensuring adequate flow conditions during the spawning and early recruitment stages.

Evaluation of RGSM Population Model Alternatives

This project includes testing the potential for using a simulation model to evaluate the impact of environmental factors on the Rio Grande that have measurable effects on RGSM populations. This work involves

modifications to a simulation model using publicly available software to test linking RGSM population parameters to space and time parameters, including habitat availability and quality, and timing of environmental flows for RGSM spawning and recruitment. The initial model, anticipated in the spring or summer 2018, compares river drying with a continuous flow to demonstrate the effect of drying on the population trajectories. Subsequent versions will evaluate possible management actions for population effects.

Benefits to Species: This information is useful for management decisions regarding river flow, water deliveries, aquatic and riparian habitat restoration, endangered species protection, and the public use of sensitive areas. These decisions will result in appropriate river flow levels that support improved environmental conditions and ecosystems for species that rely on riparian and aquatic habitats.

Evaluation of using eDNA for Detecting Larval RGSM on the Rio Grande Floodplain

This project involved conducting a literature review of RGSM DNA data archives and environmental DNA (eDNA) fish studies to determine effective field sampling protocols to assess the presence/absence of larval fish. The literature review supports planning for monitoring habitat restoration projects focused on RGSM floodplain habitat.

Benefits to Species: The eDNA methods would increase efficiency of monitoring RGSM populations, which would generate more detailed data. The optimized eDNA method for noninvasively monitoring larval fish could then be used for other species in the future.

Investigation of RGSM Mesohabitat Preferences

This project studied mesohabitat types and fish behavior under various levels of water velocity and depth at 15 sites on the MRG. The USGS mapped the spatial extents and physical characteristics of fish habitat, evaluating them at moderate and low stream flows. This information enables better understanding of RGSM mesohabitat preferences and modeling of fish movement.

Benefits to Species: It is important to understand RGSM mesohabitat use to develop effective river management tools. This information is useful for understanding the availability of habitats used by RGSM, which is necessary for maintaining viable fish populations.

IMAGE: Evaluation of RGSM Mesohabitat ***CREDIT:*** Michael Porter, USACE

RGSM Monitoring in Habitat Restoration Areas

Bosque habitat restoration projects have been constructed to benefit both aquatic and terrestrial species in the MRG. Specifically, the endangered RGSM may use inundated riparian habitat for spawning and recruitment. Evaluating the effectiveness of habitat restoration projects requires monitoring for RGSM during spring runoff and post runoff.

Benefits to Species: Habitat restoration is needed to reduce risk of extinction and increase recovery potential for RGSM in the MRG. The response of the fish community in the vicinity of habitat restoration projects in the months following recruitment provides a broad measure of project utilization. Measuring CPUE during post runoff monitoring enables general comparisons among sites and assessments of the effectiveness of the various treatment types.

POPULATION AUGMENTATION & PROPAGATION

Operations and Maintenance of the Los Lunas Silvery Minnow Refugium

The LLSMR was built by NMISC with federal financial assistance, and is 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, quarantine building, outdoor tanks, and office building. The facility has a permanent staff of two aquaculturists and one technician, and NMISC works with the Program's ScW/HR and USFWS's Genetics and Captive Propagation Work Group to accomplish the facility's goals and objectives. The LLSMR is permitted by USFWS.

IMAGES: LLSMR includes a stream, ponds, islands, and overbank areas to mimic the Rio Grand habitats
CREDIT: NMISC

In 2016 and 2017, NMISC and USFWS worked on developing a MOA to provide guidance for better communication between the agencies and progress the LLMSR toward becoming one of the primary facilities for captive propagation of RGSM in the MRG. NMISC completed plans for expansion of the facility with the installation of large raceway tanks that have the capacity to produce 50,000 fish for augmentation each year. The LLSMR began construction of the new tanks in spring 2017 and completed construction in September 2017. The culture

systems at the LLSMR were plumbed to primarily use groundwater from an on-site well, and with the capacity to use the municipal water supply as a backup source.

Benefits to Species: The LLSMR benefits RGSM by protecting the fish from extinction and assisting in its recovery in the following ways:

1. Raising RGSM for augmentation of wild populations in the MRG
2. Housing a broodstock population for species protection against extinction in case of river disasters
3. Housing an additional captive population in case of disease affecting the other two RGSM breeding and propagation facilities
4. Conducting studies that provide insight into the species, as well as improving hatchery management of the species

City of Albuquerque Rearing/Breeding Operations and Maintenance

The CoA ACF (formerly the RGSM Rearing and Breeding Facility) is located at the Albuquerque BioPark and it is maintained by CoA with funding from Reclamation and ABCWUA. The facility promotes the recovery of RGSM and increases RGSM numbers in the wild through captive propagation and augmentation. The ACF is a practical breeding and rearing center, and a research center. The facility includes indoor culture systems, outdoor culture systems, and a naturalized refugium. The indoor systems are used for quarantine, breeding, egg hatching, and rearing larvae. The outdoor systems are used for raising larvae to sub-adult age and for holding large numbers of broodstock. The outdoor naturalized refugium is a river-like environment with controllable flow, variable depth, variable habitat, and natural substrate.

IMAGE: ACF Broodstock
CREDIT: Kathy Lang, CoA BioPark

In 2016 and 2017, elevated flow rates in the MRG made collection of RGSM eggs difficult. In both years, collections of juvenile RGSM were also made to retain minimal levels of hatchery broodstock from these spawning years.

In 2016, ACF staff collected 910 RGSM eggs and approximately 3,300 juvenile RGSM. USFWS personnel made a separate collection of juvenile RGSM for the Southwestern Native ARRC. Captive spawning conducted at the ACF produced approximately 98,100 viable RGSM eggs. A total of 55,000 RGSM were tagged and released in November 2016.

In 2017, a significant amount of natural spawning of RGSM was expected, so operations at the CoA ACF were adjusted accordingly. ACF staff collected 10 RGSM eggs and approximately 5,500 juvenile RGSM. Approximately 3,000 of the juvenile RGSM were transferred to the Southwestern Native ARRC in October 2017. Captive spawning at the ACF produced approximately 30,068 viable RGSM eggs. A total of 12,000 tagged RGSM were released at three sites in the Isleta Reach in November 2017, and another 18,000 tagged RGSM will be released in February 2018.

Benefits to Species: The propagation techniques used by the facility staff have produced fish, eggs, and substantive information for other fish culturists. The CoA's facility aids in reestablishing, stabilizing, and enhancing populations of RGSM within its historic range of the Rio Grande Basin.

RGSM Propagation, Augmentation, and Rescue/Salvage

The RGSM is restricted to a stretch of the Rio Grande in New Mexico, from the vicinity of Bernalillo downstream to the headwaters of Elephant Butte Reservoir. This distance is approximately 150 river miles, which fluctuates as the level of water in Elephant Butte Reservoir changes. The objectives of this project include the following:

1. Continued propagation of RGSM
2. Continued monitoring and augmentation of wild RGSM with hatchery-raised fish
3. Salvage, rescue, and transport of stranded RGSM when flow in the MRG becomes intermittent

For 2016, the project also determined the amount of incidental take, as defined in the 2003 MRG BO, due to water operations and drying. For 2017, the new 2016 MRG BO was in place, which no longer uses salvage data to calculate incidental take, and the project now informs adaptive management processes under the 2016 MRG BO.

Between July 13 and September 21, 2016, rescue/salvage efforts documented 15,282 live RGSM in isolated pools. Of these, 13,986 were released alive into the Rio Grande at sections of continuous flow within the same reach. Salvage efforts documented 13,940 dead RGSM, of which, 742 were considered incidental take associated with the first river drying and water operations in the MRG during the 2016 irrigation season as covered under the 2003 MRG BO. The other dead RGSM were assigned to the USFWS take permit, along with 1,296 RGSM that died during transport. The level of approved incidental take was 1,109 observed RGSM for 2016.

Between July 10 and September 11, 2017, rescue/salvage efforts documented 61,664 live RGSM in isolated pools. This represents the highest number in any year since 2007, likely due to high spring runoff conditions. Salvage efforts documented 3,284 dead RGSM. In addition, shoals of RGSM were visually identified, trapped, and seined in groups of more than 1,000 in a single seine haul during 2017 efforts.

This project also evaluates the effectiveness of RGSM population augmentation in the MRG and monitors the temporal and spatial movements of released RGSM. In 2016 and 2017, the USFWS's New Mexico Fish and Wildlife Conservation Office (NMFWCO) monitored stocked fish during surveys at approximately one-month intervals to determine survival, growth, and movement of hatchery-reared RGSM.

IMAGES: Left - USFWS Releasing RGSM into the Rio Grande; Right - RGSM ***CREDIT:*** NMFWCO Staff

From January 2016 to September 2016, 485 hatchery-released RGSM were documented as recaptures from several combined research projects. The majority of these recaptures occurred during population monitoring activities. Results of the 2017 monitoring are expected to be available in April 2018. About 65,880 RGSM were stocked in 2016 at four sites located within the MRG and 60,366 RGSM were stocked in 2017 at three sites. All released fish were supplied by hatchery operations with guidance from the RGSM Genetics Management and Propagation Plan.

Benefits to Species: This project benefits RGSM through continued propagation of RGSM, continued monitoring and augmentation of wild RGSM with hatchery-raised fish, and salvage of RGSM from intermittent reaches of the Rio Grande that would likely result in substantial RGSM mortality without management intervention. RGSM are rescued from isolated pools, transported, and released alive at locations that are perennially wet.

Over 2.5 million hatchery-raised RGSM have been released in the MRG since 2002. Additional studies are being conducted to understand the quantitative contribution of augmentation in currently occupied reaches.

Table 5. RGSM Augmentation Releases by Reach (2002–2017)

Year	Angostura Reach Releases	Isleta Reach Releases	San Acacia Reach Releases	Total Released
2002	2,082	0	11,900	13,982
2003	124,884	0	0	124,884
2004	115,157	0	0	115,157
2005	153,664	54,422	46,642	254,728
2006	135,539	61,278	222,034	418,851
2007	38,188	22,164	72,802	133,154
2008	0	0	0	0
2009	0	0	21,218	21,218
2010	0	43,990	92,000	135,990
2011	0	47,318	147,276	194,594
2012	0	130,552	144,000	274,552
2013	123,850	89,077	80,142	293,067
2014	113,407	78,114	76,767	268,348
2015	59,357	51,071	90,121	200,549
2016	20,880	2,000	43,000	65,880
2017	0	0	60,366	60,366

Table 5 represents yearly totals of all seasonal releases in the Angostura, Isleta, and San Acacia Reaches from the USFWS Southwestern Native ARRC, LLSMR, and CoA ACF. Data are from annual reports by the USFWS's NMFWCO, and are available at http://www.fws.gov/southwest/fisheries/nmfwco/reports.html.

USFWS Southwestern Native ARRC Rearing/Breeding Operation and Maintenance

This cooperative project at the USFWS's Southwestern Native ARRC in Dexter, NM utilizes the joint expertise of federal and state agencies and educational institutions to aid in reestablishing, stabilizing, and enhancing RGSM populations within its historic range of the Rio Grande Basin. The two facilities contributing to the effort are the USFWS Southwestern Native ARRC and the NMFWCO. USFWS Southwestern Native ARRC produces 250,000 to 300,000 RGSM annually for river augmentation. The facility holds an additional 16,000 to 20,000 refuge/broodstock year-round. The primary purpose of this activity is to propagate RGSM for augmentation efforts.

In 2016, USFWS Southwestern Native ARRC maintained a refuge/broodstock of 18,000 wild-caught adult fish, and 4,000 larvae from egg salvage operations. Additionally, the facility tagged age-0 fish with a Visible Implanted Elastomer (VIE) tag and stocked them into several locations in the MRG (Table 6). In October and November, an additional 180,135 age-0 fish were stocked at Shaffer's Crossing near Big Bend National Park in Texas. RGSM production for the year totaled 420,830.

In 2017, the facility maintained a refuge/broodstock of 18,000 wild-caught adult fish, and 2,000 larvae from larval collection operations. USFWS Southwestern Native ARRC tagged 10,880 age-0 fish with a VIE tag and stocked them into one location in the Angostura Reach of the MRG. An additional 290,175 age-0 marked fish were stocked in two locations near Big Bend National Park in Texas. Total RGSM production for the year equaled 441,055.

In both years, USFWS Southwestern Native ARRC also provided 140,000 newly hatched larval fish to the Uvalde National Fish Hatchery in Texas for grow-out and eventual stocking in the Big Bend Reach of the Rio Grande. This three year project evaluates the capacity of that facility to contribute to ongoing conservation efforts for the species by developing rearing and culture techniques in support of 10(j) population stockings.

Benefits to Species: The facility is used to conduct research for fish health assessments, maintain captive broodstocks, assist in preservation of genetic makeup, and rear and maintain larvae and adults. The propagation program began in 2001, and has made significant advances in developing appropriate and consistent propagation and culture methods.

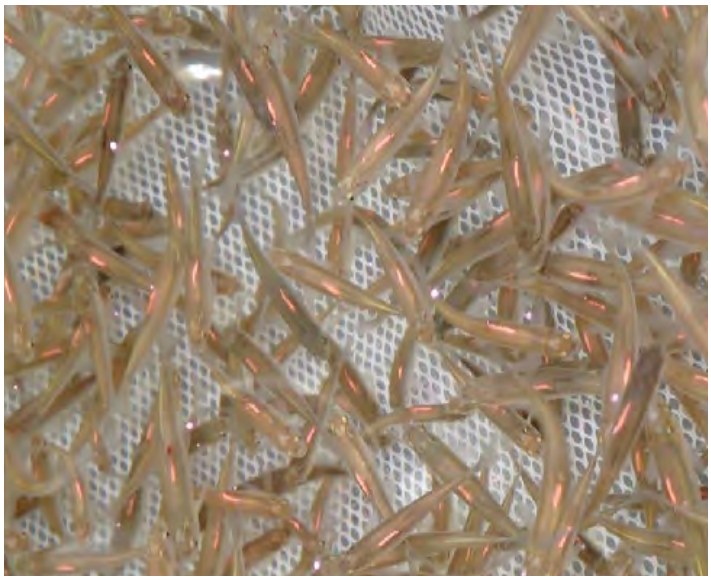


IMAGE: VIE Tagged RGSM ***CREDIT:*** USFWS Staff

Table 6. RGSM Releases per Reach

	2016	2017
Angostura Reach	62,479	10,880
San Acacia Reach	38,216	-
Isleta Reach	-	-
Cochiti Reach	**-**	**-**
Big Bend	180,135	290,175
Uvalde	140,000	140,000
Total Released	**420,830**	**441,055**

3.4 Avian Species Monitoring & Studies

In FY16 and FY17, the MRGESCP completed monitoring and studies related to SWFL, YBCU, and other avian species and their habitat. Table 7 lists projects that Program signatories funded and implemented during FY16 and FY17.

Table 7. Avian Species Monitoring and Studies Activities List

Project Name	Begin	End	Contributing Signatories
Avian Species Monitoring and Studies			
SWFL Monitoring	Ongoing		Pueblo of Santa Ana
SWFL Surveys and Nest Monitoring	FY95	Ongoing	USACE; Reclamation
Avian Monitoring	Ongoing		USACE
SWFL Surveys on the Rio Grande in the Albuquerque Metro Area	Ongoing		USACE

SWFL Monitoring

The Pueblo of Santa Ana is committed to protecting and enhancing wildlife habitat on its land. Through collaboration with federal, state, and local partners, the Pueblo and their economic enterprise, Hyatt Tamaya, have undertaken numerous ecosystem-based restoration initiatives resulting in the reduction of hazardous fuel loads from 1,321 acres. This has been accomplished by removing exotic plant species, restoring wetlands, promoting overbank flooding and widening of the floodplain by lowering river bars, arresting river channel incision within the active floodplain, and restoring habitat important to sensitive and endangered species.

In 2016 and 2017, the Pueblo monitored for SWFL according to standardized survey protocols (Table 8). Along the Pueblo's six mile reach of the MRG, three to five surveys occurred across eight locations of restored riparian habitat (67 acres). Surveyors observed that the riparian habitat adjacent to four of the survey polygons had grown enough to be considered suitable for flycatchers, and thereby increased the original survey areas by an additional nine acres (76 acres).

A minimum of one survey was conducted in each of the three survey periods. If willow flycatchers were only detected during the first survey period, it is most likely they were migrants and only three surveys were conducted. For survey locations that had willow flycatcher detections in both the first and second surveys, two additional surveys were conducted to determine status (resident versus migrant).

Table 8: Dates of each Survey Period as Set by SWFL Survey Protocol

Survey Periods	
First Survey Period	May 15 - May 31
Second Survey Period	June 1 - June 23
Third Survey Period	June 24 - July 17

During 2016, 42 SWFL's were detected at all eight survey polygons during either the first or second surveys (May 18 - June 10, 2016). No SWFL's were detected during the third, fourth, or fifth surveys (Table 8). Thus, all 2016 SWFL detections were considered migrants.

During 2017, 45 SWFL's were detected at seven of eight survey polygons. Thirty-nine of these were only detected once (Survey One only: 37 [May 16-30], Survey Two only: 2 [June 2-9]), and thus were considered migrants (Table 9). At five detection locations, SWFL's were present during both the first and second surveys. Four of these were gone by mid-June. So, despite being re-located during the second survey, detections were still within the migratory window. However, during 2017, the first confirmation of SWFL breeding on the Pueblo was recorded. On May 19, a male was first detected and consistently redetected at the same location. He appeared to be defending a territory from migrants moving through. On June 13, a pair was detected and the first documented SWFL nest on the Pueblo was found on June 15.

Table 9. 2016 and 2017 SWFL Detections along Pueblo of Santa Ana's Stretch of the MRG

Year	Survey Hours	S1	S2	S3	S4	S5
2016	76:35	38	5	0	0	0
2017	89:00	41	7	2	2	0

Benefits to Species: The Pueblo continues to perform habitat restoration and species monitoring on its lands. Metrics from monitoring help to gauge project effectiveness, guide the Pueblo's management direction adaptively, monitor population changes, and ensure restoration project implementation.

SWFL Surveys and Nest Monitoring

Program signatory 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 provide insight into potential threats to SWFL populations and their habitats, and now they focus on completing presence/absence surveys and nest monitoring.

Reclamation conducted surveys and nest monitoring at selected project sites within the MRG Basin in 2016 and 2017. Survey resultsare used to determine the distribution, abundance, and productivity of breeding SWFL within the defined study area. These surveys are required to achieve compliance with the ESA and meet project obligations.

In both fiscal years, SWFL surveys were also conducted in the Albuquerque bosque as part of USACE's MRG Restoration Project using USACE-permitted staff. Presence/absence surveys, based on established survey protocols were conducted during the breeding season. Results are shown in Table 10.

Benefits to Species: This project is an essential component of tracking the status of the species. It provides a census of the present population, population trends, and the current distribution of SWFL in the region. These data enable managers to determine impacts to the species from specific actions and to adapt management actions as necessary.

Table 10. 2016 and 2017 SWFL Survey Results

MRG Area	Number of SWFL Territories	
	2016	2017
Frijoles	0	0
Belen	20	17
Sevilleta/La Joya	5	4
San Acacia	0	0
Escondida	5	8
Bosque del Apache NWR (active floodplain)	17	16
Tiffany	5	0
San Marcial	303	257
Annual Total	**355**	**302**

Avian Monitoring

Habitat suitability has been declining and transitioning to include more saltcedar in more recent years given drought conditions. 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. Established sites within the MRG are surveyed during both the breeding and wintering seasons. Locations within each reach are surveyed per previous survey data, and nest search and monitoring are also conducted. Various nest parameters including nest success, brood parasitism, predation, abandoment, and productivity are determined for raptors and songbirds, as well as SWFL and YBCU. An additional objective established in 2017 focused on changes in the bosque since the 1984 Middle Rio Grande Biological Survey. These include providing a 20-plus year comparison of changes in avian abundance and species richness, as well as changes in C/S types; and types present 20-plus years ago versus changes based upon construction of the MRG restoration sites.

Benefits to Species: 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 study tracks avian activity and assists in determining safe and usable avian habitat within the MRG.

IMAGE: Yellow-Billed Cuckoo
CREDIT: J. A. Spendelow, USFWS

SWFL Surveys on the Rio Grande in the Albuquerque Metro Area

This project aims to determine the presence or absence of SWFL within the MRG as a component of Program monitoring activities. Five locations in the Albuquerque Metro Area bosque are surveyed annually: Montano Southwest since 2004, Brown Burn and Rio Bravo Northeast since 2010, and Durand Outfall and South Corrales since 2011. Nest searches and monitoring are conducted at each site to determine various parameters including nest success, brood parasitism, predation, abandonment, and productivity. These variables are then compared under different hydrologic conditions found at the nest site.

Benefits to Species: The results of this study assist in determining available SWFL habitat and in tracking their activity within the MRG.

IMAGE: Potential SWFL Breeding Habitat at Rio Bravo
CREDIT: Hawks Aloft, Inc.

3.5 Program Science Support

In FY16 and FY17, Program signatories funded and implemented several scientific studies and projects toward benefiting listed and protected species. Signatories and contractors conducted spatial analyses and comparisons of historic and current MRG conditions, monitored and studied species habitat, and participated in regional climate change planning efforts. Table 11 lists activities related to Program Science Support, project duration, and contributing signatories.

Table 11. Program Science Support Activities List

Project Name	Begin	End	Contributing Signatories
Program Science Support			
Bosque School BEMP Site Monitoring	FY14	Ongoing	USACE; BEMP
Collaborative Aerial Data Collection and Analysis	FY16	FY18	USACE
All Hazards Bosque Runbook	FY10	FY17	USACE
Monitoring Climate Change in the MRG	FY12	Ongoing	USACE
Production of 1962 Image and Terrain Maps of the MRG	FY17	FY17	USACE
Rio Grande Study and Tributaries Geomorphic Characterization Study	FY11	FY17	USACE
Rio Grande Sediment Gages: Rio Puerco, San Acacia, San Marcial	FY10	Ongoing	USACE

Bosque School BEMP Site Monitoring

BEMP is a collaborative ecological monitoring program between UNM and the Bosque School funded, in part, by Reclamation in FY16, and USACE in both FY16 and FY17. BEMP uses volunteers and students to conduct regular and systematic monitoring of habitats on the historic floodplain while promoting education and awareness of the bosque's overall condition. BEMP collects long-term data at a total of 27 research sites along 270 miles of the Rio Grande including weather data, shallow groundwater table depth, monthly precipitation, surface arthropod activity, and forest-production measurements (leaf litter biomass, tree diameter, growth rates, and plant distribution). The data are shared with Program signatories and other land and natural resource managers.

Benefits to Species: BEMP provides long-term data collection, promotes public outreach, and furthers preservation of endangered species habitat.

IMAGE: Bosque Monitoring
CREDIT: WEST, Inc. Staff



IMAGES: Camera Array with USACE-produced Mount, In-flight Data Collection, and View from Aircraft Sensor Port
CREDIT: USACE Staff

Collaborative Aerial Data Collection and Analysis

Movement of sediment in the southwestern U.S. tends to be initiated by flash flood events due to monsoons. These events are short-term and occur under monsoonal weather conditions, which makes it difficult to accurately measure sediment volumes and movement 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.

Since 2016, USACE has collaborated with the UNM GIScience for Environmental Management Lab, the U.S. Air Force (USAF) Civil Air Patrol (CAP), and Bureau of Land Management (BLM) 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) have also collaborated on arroyo data collection and ground control for aerial flights. Initial flights have been conducted with promising provisional results, and work is being done to produce additional tools for ongoing monitoring.

In 2017, this project conducted multiple flights along the MRG, including the full Arroyo de los Piños watershed. Data collected during peak spring runoff included floodplain habitat and levee inundation. The Arroyo de los Piños research site in Socorro, NM, is the focus of extensive, ground-based, instrumented sediment monitoring developed by Reclamation, USGS, and New Mexico Institute of Mining and Technology (NMT). The imagery from these flights will be used for high resolution geomorphic and vegetation analysis.

Benefits to Species: Sediment transport volume data provide important geomorphic snapshots for the calibration of hydraulic models. These models provide the foundation for Rio Grande tributary and main stem restoration efforts and efficient endangered species protection measures.


All Hazards Bosque Runbook

Wildfires burned over 300 acres within the Albuquerque bosque in the summers of 2003 and 2004. Firefighters working to battle these blazes were hampered by jettyjacks that blocked access to burn areas, by the small number of bridges providing access to the bosque from the levee roads, and by limited information available about other bosque landscape features. Following these fires, USACE's Albuquerque District received emergency Federal funds to assist local efforts to restore the burned areas and to improve access to and reduce the fire risk within the bosque. A part of this effort included keeping the public informed of these changes through the creation of the "All Hazards Bosque Runbook." The first edition of the book was created in 2010, and was updated in FY16 and FY17. However, to address the changing conditions in the bosque, the Albuquerque Fire and Rescue (AFR) convened a new All-Hazards Working Group to update the runbook on a five-year cycle, and expand its application for emergency response.

Benefit to Species: Provides public outreach and education about New Mexico's endangered species and their local habitat requirements.

IMAGE: Fire Access Run Book Cover
CREDIT: USACE

Monitoring Climate Change in the MRG

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 endangered species and suitable habitat by creating and maintaining an ongoing summary and analysis of current trends in climate and resulting hydrologic changes in the Rio Grande basin above Elephant Butte Reservoir. In addition, this project supports active participation in several regional climate change planning efforts including the following:

- Reclamation and MRGCD WaterSMART climate change projects, including the Rio Grande-New Mexico Basin Study and the Drought Framework Planning Study
- City of Las Cruces and Southwest Climate Science Center Extreme Weather Events, Critical Thresholds, and Climate Preparedness study
- Los Alamos National Laboratory Climate Research Symposium and Adaptation Round Tables
- Rio Grande basin representation on the South Central Climate Science Center Rio Grande Coordinating Call and to the Southern Rockies Landscape Conservation Cooperative
- Information sharing with federal agencies through the Watershed Futures initiative

Benefits to Species: This project contributes information necessary for planning and implementing projects that increase and improve occupied, suitable, and potential habitat for RGSM and SWFL.

Production of 1962 Image and Terrain Maps of the MRG

Structure from motion (SfM) is a technology that is commonly used to process drone-collected imagery. This project used SfM processing on 1,379 USGS high resolution 1962 prints to build a contiguous image that covers 175 miles of the Rio Grande from Cochiti Lake south to Elephant Butte Reservoir. Cochiti Dam was completed in 1974, creating Cochiti Lake, which impacted the downstream river environment. The contiguous image created by this process is of the river before Cochiti Dam was completed.

To ensure that the resulting image was correct, over 300 visible fixed objects were identified in the 1962 imagery and used for verification with those objects that are still visible today. To assign elevations to these points, a 2010 LiDAR set of this river reach was used to measure heights of the LiDAR points at the visible fixed object points. This was applied to the processed image, resulting in an excellent, accurate reference of the image to real world coordinates.

The SfM process also produced a digital surface model that represents a novel 3-dimensional picture of the river reach's braided stream geomorphology and adjacent riparian woodlands as they existed in 1962 before Cochiti Dam's influence affected the downstream environment.

Benefits to Species: As the most accurate pre-Cochiti Lake data set, the products produced by the SfM processes will enable multiple vegetation, sediment, and habitat analyses, including study of change over time, sedimentation monitoring, and restoration projects. These products also serve as an accurate baseline for future studies.

Restoration, Geomorphology, and Monitoring

This study investigates geomorphic trends at select high flow channels within the Rio Grande floodway. The high flow channels were constructed as part of various riparian and riverine habitat restoration projects. Detailed topographic surveys of the constructed features were conducted annually, and are anticipated to continue in coming years for adaptive management purposes. Reporting details which channels were analyzed and documents the geomorphic changes of the areas studied.

Current survey methods and practices were used to achieve the highest accuracy possible. Fiscal year 2017 continued use of a GPS RTK unit to allow efficient, versatile, and precise data collection. Monuments serve as the basis for ground control for the topographic surveys. Two monuments were installed at each site to provide better control over the large restoration areas. Monument installation has now become a standard practice at all monitoring sites. Flow and velocity measurements are being collected at multiple sites as well as refined sediment cross sections in order to provide calibration data for 2D hydraulic and sediment modeling.

Benefits to Species: The study establishes methods that allow engineers and scientists to investigate channel geomorphology and constructed features through an adaptively managed process.

IMAGE: MRG geomorphology has been affected by flood control and irrigation projects
CREDIT: USACE Staff

Rio Grande and Tributaries Geomorphic Characterization Study

The overall goal of the study is to assess the relative contributions of the dams and the secondary influences on the geomorphology of the Rio Grande through a combination of quantifying key secondary influences and numerical sedimentation modeling. The objective of the current phase of the study is to characterize the impact of primary and secondary influences on main stem geomorphology and sedimentation between Cochiti Dam and Angostura Diversion Dam.

Benefits to Species: This and related studies will aid in the understanding of how human activities impact endangered species' habitats, and will support operational and strategic decision-making.

Rio Grande Sediment Gages: Rio Puerco, San Acacia, San Marcial

The overall goal of the data collection effort is to provide information by which to assess the relative contributions of dams and secondary influences 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, with secondary influences (dams, channel rectification measures, and sediment delivery from contributing drainage areas) altering the geomorphology of the channel.

Accurate sediment gage data are critical to understanding these effects, and this project supports data collection at three gages essential to this effort.

Benefits to Species: This data collection effort will aid in the understanding of how USACE project activities affect species' environments, and will support operational and strategic decision-making.

IMAGE: MRG geomorphology has been affected by flood control and irrigation projects
CREDIT: USACE Staff

3.6 Program Support

During FY16 and FY17, MRGESCP signatories worked to maintain the DBMS, contract third-party program and science support through Reclamation, and provide contract and signatory staff and resources toward achieving Program goals. Table 12 lists Program Support-related activities, project duration, and signatories that contributed to the projects.

Table 12. Program Support Activities List

Project Name	Begin	End	Contributing Signatories
Program Support			
Signatory Program Support	FY00	Ongoing	All Signatories
Database Management System	FY07	Ongoing	ABCWUA; USACE
Program Support Contractor Services	FY16	FY16	Reclamation
Program and Science Support Services	FY16	FY21	Reclamation
USFWS Management and Support	FY02	Ongoing	Reclamation
Adaptive Management Framework for the MRGESCP	FY15	FY18	USACE

Signatory Program Support

In FY16 and FY17, MRGESCP signatories provided management and support staff responsible for overall Program administration, coordination, and dissemination of information about Program activities. In addition, each signatory provided an EC member, CC member, and representatives for the technical work groups, and contracting support.

Benefits to Species: Program management and support staff are required to implement Program activities. Signatories also provide technical support representatives to assist with the evaluation of proposed projects, review project deliverables, develop scopes of work and independent government cost estimates, and develops monitoring and program assessment plans.

IMAGE: EC Meeting ***CREDIT:*** Reclamation

MRGESCP Database Management System

The DBMS is the Program's website, meeting calendar, and file library. It is regularly maintained and updated, and stores and facilitates access to all scientific data, reports, and papers relating to endangered species and suitable habitat in the MRG. It also functions as the document repository for the Program's administrative record for meetings and activities. Stored information and data is available for use by Program members and the public. The DBMS can be found at https://webapps.usgs.gov/MRGESCP/.

Benefits to Species: The DBMS provides a comprehensive clearinghouse for data and information related to endangered species and suitable habitat in the MRG to facilitate analysis, hypothesis testing, and management decisions.

IMAGE: Program DBMS Homepage ***ADDRESS:*** https://webapps.usgs.gov/MRGESCP/

MRGESCP Program Support Contractor Services

In FY16, Reclamation contracted Program support services to assist the PMT on specific projects and tasks. FY16 contracted support services included coordination and drafting of the Program's FY15 Annual Report with Genquest, Inc., and note-taking support for Program meetings with Alliant Environmental, LLC. Additionally, Reclamation contracted third-party program and science support services through WEST, Inc to support the MRGESCP.

Benefits to Species: Contracting MRGESCP support services is essential in moving the Program forward and in implementing Program activities. Coordination around research and monitoring allows for Program science and other activities to better inform management decisions on the MRG related to listed and protected species.

IMAGE: Bosque Vegetation
CREDIT: Mike Marcus

IMAGE: Scenic Views of the Rio Grande ***CREDIT:*** Mike Marcus

Program and Science Support Services

In FY17, Reclamation contracted WEST, Inc. to provide third-party program management and science support services to the MRGESCP. The WEST, Inc. PMT includes a Program Manager, a Science Coordinator, and support staff as described in Section 1.3. The PMT is responsible for facilitating achievement of Program goals by providing program management services, science coordination services, and statistical support services. Program management services include overall administration, coordination, and dissemination of information about Program activities. Science coordination services include support of the Program's science activities, and coordination with Program scientists and technical experts to begin development of an adaptive management plan.

Benefits to Species: Program management and science support activities are essential in moving the MRGESCP forward and in implementing Program activities. Coordination around research and monitoring allows for Program science and other activities to better inform management decisions on the MRG related to listed and protected species.

USFWS Management and Support

In 2016 and 2017, Reclamation provided funding to USFWS for personnel to support MRGESCP management activities and to facilitate ESA compliance. USFWS assisted in the coordination, planning, and management of work groups staffed by Program participants to fulfill Program By-Laws. Specific ESA compliance tasks included facilitating Section 7 consultations for the Program's federal partners, and managing Section 10 permits for other Program signatories.

Benefits to Species: USFWS provides program management and on-the-ground support for activities that advance the recovery of endangered species, including the facilitation of ESA compliance to minimize adverse effects of actions in the MRG on listed species and their suitable habitat.

IMAGE: USFWS Conducting Fish Community Surveys
CREDIT: WEST, Inc. Staff

IMAGE: Bosque Vegetation
CREDIT: Mike Marcus

Adaptive Management Framework

USACE contracted with GeoSystems Analysis to serve as a neutral third-party in developing a framework that includes the critical scientific uncertainties and key study questions that need to be addressed to better inform management actions. This framework builds on the Draft Adaptive Management Plan, Version 1 (from June 2011) and will help inform the development of a MRGESCP adaptive management plan.

Benefits to Species: The framework will identify critical scientific uncertainties and recommend associated studies for four of the federally listed listed and protected species in the MRG; these include the RGSM, SWFL, YBCU, and the NMMJM.

Middle Rio Grande Endangered Species Collaborative Program

New Mexico