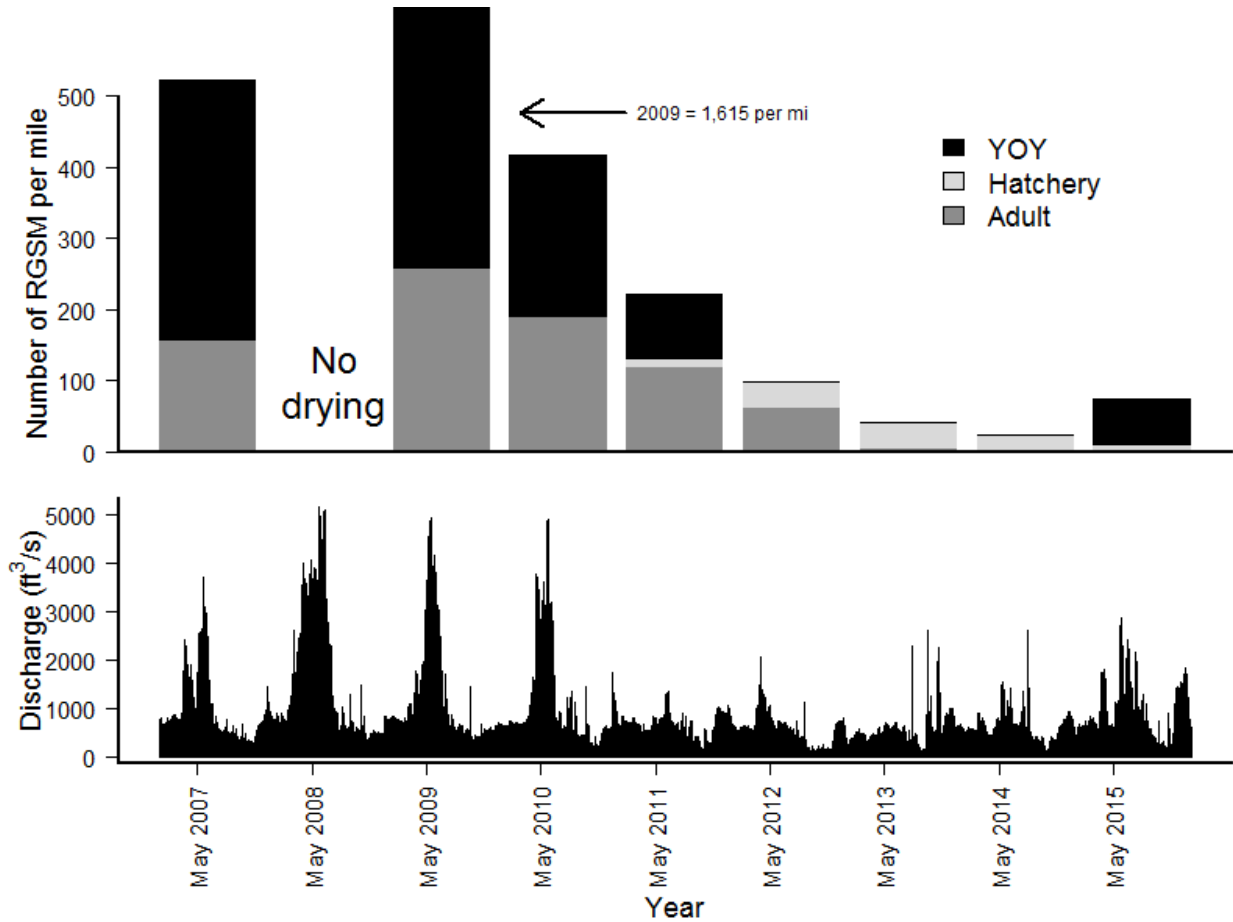


Rio Grande Silvery Minnow Salvage and Rescue 2015 Annual Report



Prepared For:
Middle Rio Grande Endangered Species Collaborative Program

Submitted To:
U.S. Bureau of Reclamation
555 Broadway NE, Suite 100
Albuquerque, NM 87102-2352

Thomas P. Archdeacon, Tristan J. Austring, and Eileen B. Henry
U.S. Fish and Wildlife Service
New Mexico Fish and Wildlife Conservation Office
3800 Commons Avenue NE
Albuquerque, NM 87109
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Executive Summary

Rio Grande Silvery Minnow (RGSM) are often trapped in isolated pools during times of river drying from June to October each year in the Middle Rio Grande (MRG). Salvage of RGSM is performed by staff from the New Mexico Fish and Wildlife Conservation Office with assistance and coordination from several other agencies. Rio Grande Silvery Minnow are collected from isolated pools each day drying occurs and transported on UTVs equipped with water tanks supplied and aerated with pure oxygen. Rescued RGSM are then transported and released into areas with continuous flow. Any RGSM found dead are classified as either incidental take (IT) if found during first drying, or attributed to U.S. Fish and Wildlife Service permit if found during subsequent drying events.

Between 11 September and 1 October 2015, 17.4 unique miles of the main channel of the MRG became intermittent, with 5.2 miles in the Isleta reach, and 12.2 miles in the San Acacia reach. Two areas of discontinuous flow were salvaged in the San Acacia reach, 2.1 miles from the south boundary of Bosque del Apache National Wildlife Refuge (BDANWR) upstream and 10.1 miles from the north boundary BDANWR upstream. We observed 1,319 RGSM > 30 mm standard length (SL) in isolated pools during this time. Of these, 1,246 (109 hatchery origin) were found alive and transported to a location with flowing water. We found 73 dead RGSM during this time. Eleven of the 73 dead RGSM were associated with first river drying and attributed as IT to water operations in the MRG during the 2015 irrigation season (under the 2003 Biological and Conference Opinions on the effects of the Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers Flood Control Operation, and related Non-Federal Actions on the MRG). The other RGSM found dead were assigned to the USFWS take permit. Additionally, 18 RGSM died during transport and were assigned to USFWS take permit. The level of approved IT (11 observed take multiplied by 50) was 550 RGSM for 2015.

Introduction

Since 2001, with the exception of 2008, sections of the MRG have become intermittent due to water operations (Smith 2001; Smith and Munoz 2002; Smith and Basham 2003; U.S. Fish and Wildlife Service 2005; U. S. Fish and Wildlife Service 2006b; Remshardt 2008; Remshardt 2010; Remshardt and Archdeacon 2011; Remshardt and Archdeacon 2012; Archdeacon and Remshardt 2013; Archdeacon et al. 2014; Archdeacon et al. 2015). During those years, intermittent summer stream flow conditions existed in significant portions (up to 68 miles) of the contemporary range of RGSM. These areas of intermittent flow are located in the Isleta and San Acacia reaches of the MRG (Figure 1).

The March 17, 2003, Biological Opinion (BiOp) describes Reasonable and Prudent Alternative with Multiple Elements, Reasonable and Prudent Measures, and Conservation Measures that serve in part to secure adequate conditions for RGSM and Southwestern Willow Flycatcher (U.S. Fish and Wildlife Service 2003). As part of the BiOp, the U.S. Fish and Wildlife Service established annual IT by mortality limits for RGSM. These limits are established for RGSM over 30 mm SL for water operations in the MRG. The limit is amended annually, incorporating a formula that includes October standard population monitoring data (from the previous year), habitat conditions during the spawn (spring runoff), and hatchery augmentation numbers from the previous autumn. Action agencies are notified of the annual IT limit by April 1 each year. Estimates of IT in the field are derived from surveys where observed mortality is multiplied by 50, based on the assumption that the probability of observing a single mortality is 0.02. U.S. Fish and Wildlife Service biologists estimated this value (U.S. Fish and Wildlife Service 2003).

The amended IT limit for the 2015 season was 2,683 RGSM, which is equivalent to 53 RGSM observed dead (U.S. Fish and Wildlife Service 2015). Each year since 2003 when stream flow intermittency occurred, salvage and rescue activities have been conducted in an attempt to limit the IT by mortality of RGSM due to water operations. Here, we document our efforts to rescue RGSM during periods of stream flow intermittency in 2015.

Methods

Salvage of RGSM

Through coordination with other agencies, we determine what, if any, sections of the MRG were intermittent each day. We used off-road utility vehicles to access intermittent sections of the river. Once we arrived at areas reduced to isolated pools, we used seines of various sizes to collect RGSM from isolated pools that formed as flow in the MRG became intermittent. We did not salvage RGSM that exhibited advanced clinical signs of poor health (e.g., lethargy and hemorrhagic lesions). Prior to handling RGSM, personnel washed their hands to remove the residue of lotions (e.g., suntan lotions and mosquito repellent).

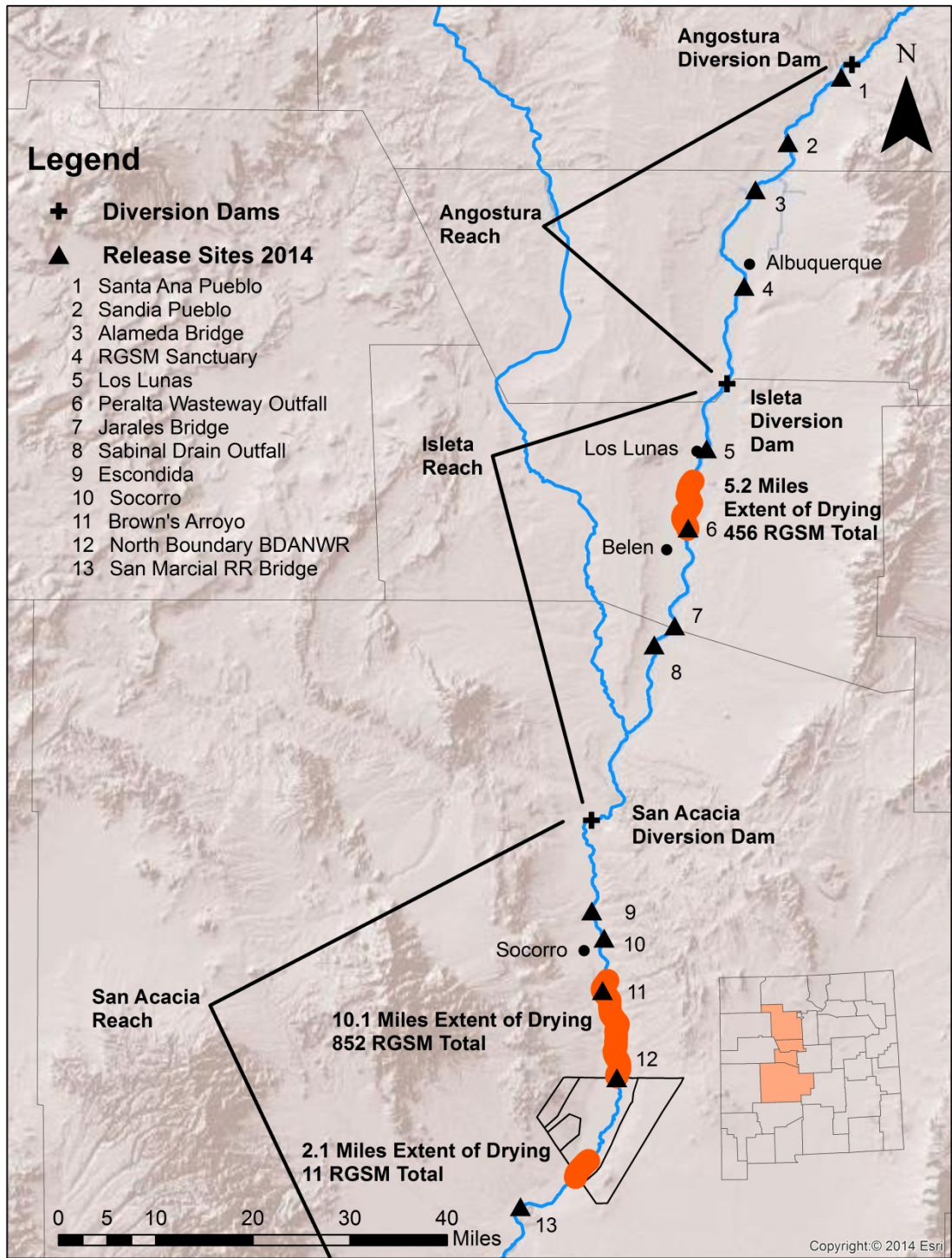


Figure 1-Map of the Middle Rio Grande and areas that Rio Grande Silvery Minnow were rescued from between September and October 2015. Rio Grande Silvery Minnow were released in November 2014 at the black triangles as part of the augmentation program.

In previous years, once a location was identified as a potential salvage site, we applied a set of criteria to determine whether salvage should occur, including dissolved oxygen > 1.0 ppm, pH < 9.0, and temperature < 34 °C (Archdeacon et al. 2014). During salvage operations in 2014, we abandoned these criteria and seined all pools that potentially had RGSM. Over past salvage seasons, only the temperature criterion was regularly exceeded; this could be avoided by ending salvage operations at approximately 1400 h daily (Archdeacon et al. 2014), depending on current weather conditions. Thus, to improve efficiency in 2015, we no longer recorded any data from pools except temperature, time of day, and location (river mile to nearest 0.1 mile).

We counted all RGSM captured in an individual pool, categorized them as young of year (YOY) < 30 mm SL, YOY > 30 mm SL, or adult based on size (adults are generally > 55 mm SL by June), and recorded any visible implant elastomer (VIE) tags. Visible implant elastomer tags indicate a hatchery-reared fish; white left dorsal and yellow left dorsal were fish released in October and November 2014 (Archdeacon 2015). We categorized each RGSM as alive (rescued), sick (not rescued and attributed to the U.S. Fish and Wildlife Service permit), or dead (either counted as IT during first drying, or on the U.S. Fish and Wildlife Service permit if found during subsequent drying events). At each pool, we noted the time of day, pool temperature, and river mile to the nearest tenth. Any RGSM found dead on first drying were fixed in 10% formalin and later transferred to 70% ethanol. Preserved RGSM were accessioned in the Museum of Southwestern Biology.

We made efforts to ensure that all RGSM salvaged had the highest probability of survival. We moved salvaged RGSM immediately into five-gallon buckets filled with transport tank water and subsequently transferred them to 50-gallon transport tanks attached to utility terrain vehicles. The transport tanks were equipped with oxygen tanks and filled with water to near capacity with water from reverse osmosis de-ionized water from a municipal source when possible. Otherwise, we used water from flowing sections of river to fill tanks prior to salvage operations. We supplied pure oxygen to transport tanks through micro-bubble oxygen diffusers, and adjusted the rate with varying water temperatures and loading rates of fish to maintain dissolved oxygen levels near 100% saturation. We added salt (NaCl) to transport tanks to achieve a 1.0 % NaCl solution to reduce stress to RGSM.

We transported and released RGSM in the nearest section of river in the same reach that would not experience drying. Prior to releasing RGSM into the river, we tempered water in the transport tanks by slowly adding river water to the transport tanks until it was within 1° C of the water temperature of the river at the release site.

Determination of Incidental Take

Incidental take of post-embryonic RGSM (i.e. any age after hatching) is defined for two size classes, those shorter ≤ 30 mm SL and those > 30 mm SL. All smaller sized post embryonic RGSM (≤ 30 mm SL) are presumed to be taken as a result of federal water operations when the river dries downstream of Isleta Diversion (U. S. Fish and Wildlife Service 2003), but no limit on the amount of IT is calculated for RGSM ≤ 30 mm SL is calculated.

Determination of IT for the larger size class of RGSM (> 30 mm SL and > Age-0) is conditional. Mortality of the larger sized RGSM that occur in portions of the river that have rewet due to forces that are not directly or indirectly related to the operations of the Action Agencies are not considered to be IT under the March 17, 2003 BiOp (U.S. Fish and Wildlife Service 2003). Rio Grande Silvery Minnow mortality involving the larger sized individuals that occurred outside of the active river channel was generally not considered IT under the March 17, 2003 BiOp (U. S. Fish and Wildlife Service 2003). The exception to this generalization involves areas outside of the active channel that are wetted as a consequence of federal water pumping operations (i.e., water pumped from the low flow conveyance channel in an effort to maintain specified flows in the river) or river maintenance activities. Finally, the larger sized RGSM that are “rescued” but die in transit to relocation sites are not considered IT under the 2003 BiOp, but are attributed to U.S. Fish and Wildlife Service permitted activities during salvage operations. Likewise, RGSM that exhibited advanced clinical signs of poor health (e.g., lethargy and hemorrhagic lesions) are deemed not salvageable and also are not considered IT.

Analysis of Data

We calculated reach and overall totals for all categories of RGSM encountered during salvage activities. We also summarized the temporal and spatial extent of each drying period, number of days and number of pools salvaged. For daily data, we totaled the RGSM observed each day of salvage, number of pools salvaged, number of river miles salvaged, and the amount of time required to salvage that distance.

Results

Rescue and Incidental Take of RGSM

We found 129 live adult RGSM and 1,117 live young of year within the river channel in 2015 (Table 1). Of these, we released 1,228 alive in continuous segments of the river within the same reach (98.6% transport survival of salvaged RGSM). Eleven RGSM were found dead due to water operations after June 15th and counted as IT. We found 62 dead fish during subsequent drying events; this was counted towards the U.S. Fish and Wildlife Service permit. We counted an additional 18 RGSM that died during transport towards the USFWS permit.

Channel Drying

Rio Grande Silvery Minnow salvage operations progressed in synchrony with river recession over the course of the 2015 irrigation season. Ultimately, the linear extent of drying was 17.4 miles of the main channel, with 12.2 unique miles being in the San Acacia Reach and 5.2 unique miles (maximum extent of drying, does not include multiple salvage events) in the Isleta reach (Table 2). The daily extent of drying in salvage operations per day was at or below the 8.0 miles of drying per day rate allowed in the March 17, 2003 BiOp (U. S. Fish and Wildlife Service 2003), as modified on June 15, 2006 (U. S. Fish and Wildlife Service 2006a).

In the San Acacia reach, discontinuous flows occurred from the south boundary of BDANWR to about two miles upstream of the south boundary, and from the north boundary of

BDANWR to about three miles downstream of Socorro, New Mexico (Figure 1). Pumping from the low-flow conveyance channel prevented much of BDANWR from drying. In the Isleta reach, discontinuous flows occurred from the Peralta Wasteway outfall upstream 5.2 miles. Multiple re-wetting and drying events were recorded in all three areas in 2015 due to monsoons, changes in plant evapotranspiration, increasing or decreasing human demand, and irrigation system maintenance.

We conducted salvage operations on 10 days during the 2015 irrigation season, with six days in the San Acacia reach, and six days in the Isleta reach (Table 2). Salvage occurred between 11 September and 1 October 2015. In total, we salvaged 14.4 river miles in the San Acacia reach, and 8.9 miles in the Isleta reach (Table 2). This includes salvage operations in miles that experienced repeated drying events. For a chronological summary of salvage operations, see Appendix A.

Monitoring Activities

Nearly all the RGSM collected in 2015 were wild YOY (Table 1). This is reversal of the declining trend in 2010-2014, but still fewer than 2007 or 2009 (Figure 2). Although the overall extent drying and number of times dried was limited through management actions, the overall number of YOY RGSM per kilometer was comparable to 2011 when much more severe drying occurred (Figure 2). Examining the spring discharge graphs reveals the importance of spring hydrograph to the number of YOY collected during salvage, as there are much greater numbers of YOY present in years with higher spring run-off and reduced numbers of YOY in years with low spring run-off (Figure 2).

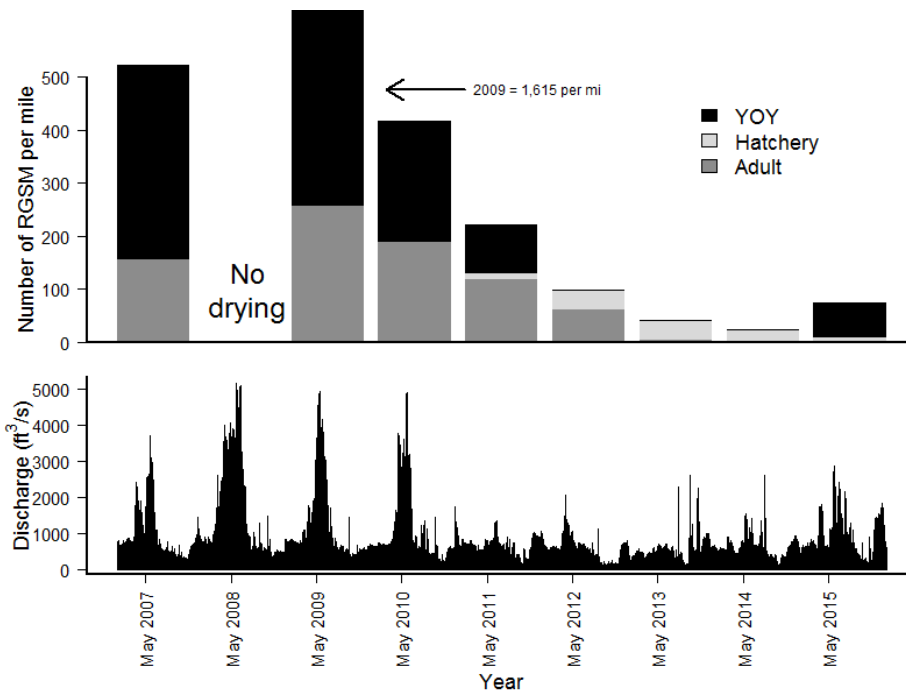


Figure 2-Number of young of year (YOY), hatchery marked adult, and wild adult Rio Grande Silvery Minnow collected per km during salvage activities in the Middle Rio Grande in 2007-2015 and average daily discharge ($m^3 s^{-1}$) in the Rio Grande at Albuquerque, NM (USGS gage 08330000).

Table 1- Summary of salvage operations for Rio Grande Silvery Minnow in the Middle Rio Grande, 2015. Salvaged numbers of RGSM do not include transport losses. USFWS Permit column includes the number of RGSM found dead that count towards the USFWS permit, and parenthetically the number of RGSM that died during transport. Fish origin for adults (i.e. hatchery or wild) is given parenthetically (wild; yellow left dorsal [YLD]; white left dorsal [WLD]).

Reach	YOY <30 mm	YOY >30 mm	Adults	USFWS Permit	IT
Isleta	0	435	14 (6; 8 YLD)	6 (6)	1 (1 YLD)
San Acacia	0	682	115 (17; 88 YLD; 10 WLD)	56 (12)	10 (3; 6 YLD; 1 WLD)
Total	0	1,117	129 (23; 96 YLD; 10 WLD)	62 (18)	11 (3; 7 YLD; 1 WLD)

Table 2-Number of days salvaged, number of pools evaluated, number of miles salvaged, and extent of drying per reach during 2015 salvage operations. The miles salvaged include repeated drying events. Extent of drying is the number of unique river miles of discontinuous flow observed for the season.

Reach	Number of Days	Number of Pools	Miles Salvaged	Extent of Drying
Isleta	6	133	8.9	5.2
San Acacia	6	263	14.4	12.2
Total	12	396	23.3	17.4

Table 3-Summary of salvage activities in the Middle Rio Grande, New Mexico, during summer intermittency, 2007-2015. Total Rio Grande Silvery Minnow (RGSM) is the number of fish found alive.

Year	Extent of drying	Miles Salvaged	Pools Salvaged	Total RGSM
2007	30.0	119.2	1,052	15,636
2008	0.0	0.0	0	0
2009	19.9	65.0	522	27,712
2010	28.2	118.2	1,232	12,349
2011	40.2	163.7	2,054	9,277
2012	51.0	204.0	2,774	5,014
2013	36.5	47.4	1,037	1,492
2014	24.5	62.6	754	630
2015	17.4	23.3	396	1,320

Discussion

Trends in the declining numbers of RGSM reversed in 2015. We found more RGSM per mile in 2015 than in any year since 2011. However, the number of adult RGSM collected per mile was nearly non-existent, due to failed recruitment of YOY in two previous years. Additionally, the proportion of hatchery-reared fish decreased substantially from 90% in 2014 to approximately 13% in 2015. Much of this is because of the substantial increase in YOY in 2015, making up 85% of all RGSM collected.

The number of wild adult RGSM found during salvage has declined each year since 2009. In 2015, we again found very few adult RGSM. From 2012 to 2014, very few YOY RGSM were collected, leading to decreases in adults and increased stocking of hatchery-reared fish (Archdeacon 2015). In 2015, 82% of adult RGSM collected were hatchery-reared fish. But, with the increase in YOY collected in 2015, it is likely more adults will be collected in 2016. Spring run-off is the overriding factor in RGSM recruitment, specifically peak discharge in May and June and the number of days in May and June with >3,000 cfs measured at the Albuquerque gage (Dudley et al. 2015). However, summer drying should not be ignored, as the short life span of RGSM (Horwitz et al. 2011) and lack of recruitment to October surveys (Dudley et al. 2015) likely led to the sharp decline of wild adults from 2011 to 2015, that is clearly shown in Figure 2.

Compared to 2014, we salvaged fewer days, fewer miles, and fewer pools (Archdeacon et al. 2015). Coordinated efforts helped maintain flows on Bosque del Apache National Wildlife Refuge and in the upper Isleta Reach. Later in the summer, monsoons provided continuous flows, which resulted in fewer subsequent drying events than in previous years. Fewer drying events potentially lowered the number of RGSM we observed; however, there were fewer adult RGSM on first drying than in previous years.

Trends in abundance of RGSM observed during salvage mirror those of standardized monitoring from 2012 to 2015 (Dudley et al. 2015). Standardized monitoring found no RGSM at any of 20 monitoring sites in October of 2012, only three sites in 2013, zero again in 2014,

and 8 sites in 2015 (Dudley et al. 2015, Jen Bachus, personal communication). The rebound in 2015 is most likely attributable to increased spring run-off in May, and higher flows continuing throughout June. Most of the RGSM collected during salvage in 2015 were wild, YOY fish, indicating the population could spawn and recruit, given adequate spring flows, to levels that are at least detectable in population surveys. The 2015 spring run-off was not as large as 2008 or 2009. Though lower than 2011 spring run-off, the number of YOY was similar in 2015. However, in 2011 there was still a much greater number of wild adult fish present in the river, which increased the overall numbers collected through summer of 2011.

Both salvage and monitoring data (Dudley et al. 2015) make it apparent that RGSM can recover from extremely low populations. However, river conditions and management over the last three of the past four years cannot support RGSM recruitment. In the face of future low spring runoff flows and summer drying, the continued existence of RGSM in the San Acacia and Isleta may reaches require heavy annual augmentation with hatchery fish if no other management actions addressing spring run-off are performed.

Acknowledgments

The Middle Rio Grande Endangered Species Collaborative Program supported this work under Interagency Agreement 02-AA-40-8190 as administered by the Bureau of Reclamation. The contributions of everyone are greatly appreciated. Success in RGSM operations during 2015 can be attributed to the tremendous cooperation and the professionalism of all involved. Personnel of the New Mexico Fish and Wildlife Conservation Office served to plan and coordinate salvage operations, and represented the core of the salvage workforce, including Andy Dean and Angela James. Field assistance was also provided by the Bureau of Reclamation. Special thanks to Bosque Del Apache National Wildlife Refuge for providing housing.

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Appendix A: Chronology of Salvage Operations

Note: FWS permit includes those found dead that could not be attributed to Incidental Take including fish not salvaged due to health criteria, or died prior to release. Salvaged fish are those released alive > 30 mm SL, number after the slash is the number of adults. Release locations: a - Belen Bridge, b - Highway 346 Bridge, c - 1 mile below San Acacia Diversion Dam, d - Escondida Bridge, n/a - no fish released.

11 Sep 2015	^b Isleta Reach	TPA15-015
Rio Grande silvery minnow - Salvaged		361/6
Rio Grande silvery minnow - FWS Permit		5
Rio Grande silvery minnow - Incidental Take		0
12 Sep 2015	^d Isleta Reach	TPA15-017
Rio Grande silvery minnow - Salvaged		8/1
Rio Grande silvery minnow - FWS Permit		1
Rio Grande silvery minnow - Incidental Take		1
12 Sep 2015	^d San Acacia Reach	TPA15-016
Rio Grande silvery minnow - Salvaged		46/7
Rio Grande silvery minnow - FWS Permit		0
Rio Grande silvery minnow - Incidental Take		0
13 Sep 2015	^d San Acacia Reach	EBH15-009
Rio Grande silvery minnow - Salvaged		394/42
Rio Grande silvery minnow - FWS Permit		53
Rio Grande silvery minnow - Incidental Take		10
14 Sep 2015	^a Isleta Reach	TJA15-019
Rio Grande silvery minnow - Salvaged		15/5
Rio Grande silvery minnow - FWS Permit		0
Rio Grande silvery minnow - Incidental Take		0
16 Sep 2015	^c San Acacia Reach	TPA15-018
Rio Grande silvery minnow - Salvaged		304/59
Rio Grande silvery minnow - FWS Permit		14
Rio Grande silvery minnow - Incidental Take		0

17 Sep 2015	^b San Acacia Reach	EBH15-010
Rio Grande silvery minnow - Salvaged		30/6
Rio Grande silvery minnow - FWS Permit		1
Rio Grande silvery minnow - Incidental Take		0
17 Sep 2015	^b Isleta Reach	EBH15-011
Rio Grande silvery minnow - Salvaged		6/0
Rio Grande silvery minnow - FWS Permit		0
Rio Grande silvery minnow - Incidental Take		0
21 Sep 2015	^d San Acacia Reach	TJA15-020
Rio Grande silvery minnow - Salvaged		11/1
Rio Grande silvery minnow - FWS Permit		0
Rio Grande silvery minnow - Incidental Take		0
27 Sep 2015	^a Isleta Reach	TPA15-019
Rio Grande silvery minnow - Salvaged		37/1
Rio Grande silvery minnow - FWS Permit		5
Rio Grande silvery minnow - Incidental Take		0
30 Sep 2015	^{n/a} San Acacia Reach	TJA15-022
Rio Grande silvery minnow - Salvaged		0/0
Rio Grande silvery minnow - FWS Permit		0
Rio Grande silvery minnow - Incidental Take		0
1 Oct 2015	^a Isleta Reach	TPA15-023
Rio Grande silvery minnow - Salvaged		16/1
Rio Grande silvery minnow - FWS Permit		1
Rio Grande silvery minnow - Incidental Take		0
Grand Total		
Rio Grande silvery minnow - Salvaged		1228/129
Rio Grande silvery minnow - FWS Permit		80
Rio Grande silvery minnow - Incidental Take		11