Rio Grande Silvery Minnow Fish Rescue

2024 Annual Report

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2024 ANNUAL REPORT

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Cover photo: USFWS staff Jaidyn Armijo-Sonnenberg (left) Nate Caswell (middle) and Chasity Barnes (right) seine an isolated pool near Fort Craig. Credit: Lyle Thomas, USFWS

DISCLAIMER

The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

EXECUTIVE SUMMARY

Rio Grande Silvery Minnow *Hybognathus amarus* (hereafter RGSM) are often trapped in isolated pools during river drying from April to October each year in the Middle Rio Grande (MRG) of New Mexico. Rescue of RGSM is performed by staff from the New Mexico Fish and Wildlife Conservation Office (New Mexico FWCO) with assistance and coordination from several other agencies. Rio Grande Silvery Minnow are collected from isolated pools each day and transported on off-road utility vehicles equipped with water tanks and supplied with pure oxygen. Rescued RGSM are then transported and released into areas with continuous flows. Rescued RGSM are classified as either dead or alive, hatchery or wild origin, and adult or young-of-year (YOY) based on their standard length.

During 2024, river drying began in July and the initial separation likely occurred between river kilometer (rkm) 240 and rkm 250 near the south boundary of Bosque del Apache National Wildlife Refuge. Between 15 July and 21 August, we conducted rescue activities on 22.5 unique kilometers of main channel of the MRG that became intermittent. During rescue activities, we relocated 2,250 live RGSM. Of these, 1,027 were YOY RGSM, 111 were hatchery reared RGSM, and 1,112 were wild RGSM. In addition, we found 340 dead RGSM during river intermittency. Spring run-off was average, and more fish were rescued compared to years 2020-2022, but there were fewer than in 2023. Overall, more adult fish were rescued in 2024 and wild adults made up the greatest proportions of RGSM caught. However, the number of YOY reflected poor recruitment during 2024.

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INTRODUCTION

Prior to the 1960s, the Rio Grande Silvery Minnow (hereafter RGSM or Minnow) *Hybognathus amarus* was widespread through the Rio Grande and large tributaries from Brownsville, Texas to northern New Mexico (Treviño-Robinson 1959; Bestgen and Platania 1991). Currently, RGSM are extirpated from the Pecos River and are restricted to an approximately 250 km segment of the Middle Rio Grande (MRG) in central New Mexico (Bestgen and Platania 1991). In 1994, RGSM was listed as endangered by the U.S. Fish and Wildlife Service (USFWS 1994). Channel intermittency due to drought and water abstraction (Blythe and Schmidt 2018) is one of many threats to RGSM persistence and channel drying now occurs on a nearly annual basis (Archdeacon and Reale 2020).

Prior to the 1900s, river drying was a relatively rare occurrence in the MRG, happening once or twice per decade (Scurlock 1998). Following extensive human development and abstractions, river drying became more common by the mid-20th century. Since regular monitoring of river intermittency began in 2001, sections of the MRG have become intermittent due to water operations and drought in all years except 2008 (Archdeacon 2016). Intermittent stream flow conditions occurred in significant portions (up to ~110 km) of the contemporary range of RGSM (Bestgen and Platania 1991; Archdeacon 2016). The areas of intermittent flow were generally in the Isleta and San Acacia Reaches of the MRG but can occur upstream of the Isleta Diversion Dam during extreme drought years (Figure 1). Rio Grande Silvery Minnow are frequently stranded in the isolated pools that form during streamflow intermittency (Archdeacon and Reale 2020).

The December 2, 2016, *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* (BiOp) describes several Survival Strategy Conservation Measures to minimize adverse effects to RGSM associated with project-related June to October water volume reductions. One measure is to rescue RGSM stranded in isolated pools during summer drying events and transport them to areas of perennial flow. Rescue of stranded RGSM is intended to reduce mortality during irrigation season, improve distribution of RGSM, and prevent further genetic losses by increasing survival of the current cohort. Each year since 2003 when river drying has occurred, fish rescue operations have been conducted. Here, we document our efforts to rescue RGSM during periods of stream flow intermittency during 2024.

METHODS

Rescue of RGSM

Each day during irrigation season (April through October), through coordination with other agencies, we determined if any sections of the MRG had dried. If new drying occurred, we used off-road utility vehicles to access these areas. During the 2024 season, only areas of new drying were rescued (e.g., “first drying”). There are typically fewer fish during subsequent wet and dry events (Archdeacon 2016) and survival of rescued fish declines through summer

(Archdeacon et al. 2020). Thus, rescuing fish after repeated drying and wetting cycles is not beneficial and therefore rescue was limited to the first drying event only.

Once we arrived at areas reduced to isolated pools, we used seines (3.0 x 1.0 m, mesh size = 3.2 mm) to collect RGSM from isolated pools. We recorded the river kilometer (nearest 0.1 km), measured maximum pool depth (0.01 m), temperature (0.1 C) and recorded time of day. Next, we seined the pool and counted all RGSM captured. In some years, large numbers (e.g., > 1,000) of RGSM were collected from individual pools or found dead. In these cases, crews were forced to estimate numbers to prevent excessive mortality from handling. Crews counted several handfuls and then estimated total numbers. Estimates were purposely conservative, so the numbers reported can be considered minimums. Seining continued until crews judged that few or no RGSM remained in the pool.

We categorized each RGSM based on size as young-of-year (YOY; < 45 mm standard length [SL]), or adult (adults are >55 mm SL). All adults were examined for a visible implant elastomeric paint mark (VIE) given to all hatchery fish, recorded as either wild (naturally spawned, no hatchery mark) or hatchery origin. Colors and positions of any VIE tags were recorded to identify age and release locations (Archdeacon 2023). Not all fish released in 2020 and 2021 were marked with VIE, but it is unlikely any survived to 2024. We categorized each RGSM as alive or dead. Wild adult RGSM were collected and preserved in 95% ethanol for genetic materials. Preserved RGSM and field notes were accessioned to the University of New Mexico Museum of Southwestern Biology.

We ensured that all RGSM rescued had the highest probability of survival. Prior to handling RGSM, personnel washed their hands to remove residue of lotions (e.g., sunscreen and insect repellant) to increase fish survival. Previous research on handling and transportation stress has refined our collection and transportation methods (Cho et al. 2009). Generally, we moved rescued RGSM immediately into five-gallon buckets filled with transport tank water. After all fish from a pool were counted, we transferred fish to a 50-gallon transport tank attached to an off-road utility vehicle. Each tank was fitted with an oxygen tank, and filled with filtered, deionized water from a municipal source when possible. We supplied pure oxygen to transport tanks through diffusers, and adjusted rates depending on water temperature and number of fish in the tank to maintain oxygen levels near 100% saturation. We added salt (NaCl) to transport tanks to achieve a 1% NaCl solution to reduce stress to RGSM prior to fish collection.

During 2024, rescued RGSM were transported and released within the same reach, in the nearest section of river that we did not expect to dry. Prior to releasing RGSM, we tempered the transport tank water by slowly adding river water until the temperature in the tank was within 1° C of the river water temperature.

Analysis of Data

We calculated reach and overall totals for all categories of RGSM encountered during rescue activities. We also summarized the temporal and spatial extent of each drying period, number of days and number of pools rescued. For daily data, we totaled the number of RGSM observed in isolated pools, number of pools rescued, number of river kilometers rescued, and the

amount of time required to rescue that distance. We plotted the number of YOY RGSM collected per kilometer from 2007 to 2024, separately for the Angostura, Isleta, and San Acacia Reaches, against the average May discharge at the Albuquerque (USGS gage 08330000), Bosque Farms (USGS gage 08331160), or San Acacia (USGS gage 08354900) gages to show the importance of spring runoff for recruitment, as well as the variability in that relationship. We fit a generalized liner mixed-effects model using a negative binomial function to examine the relationship between YOY per km and mean May discharge.

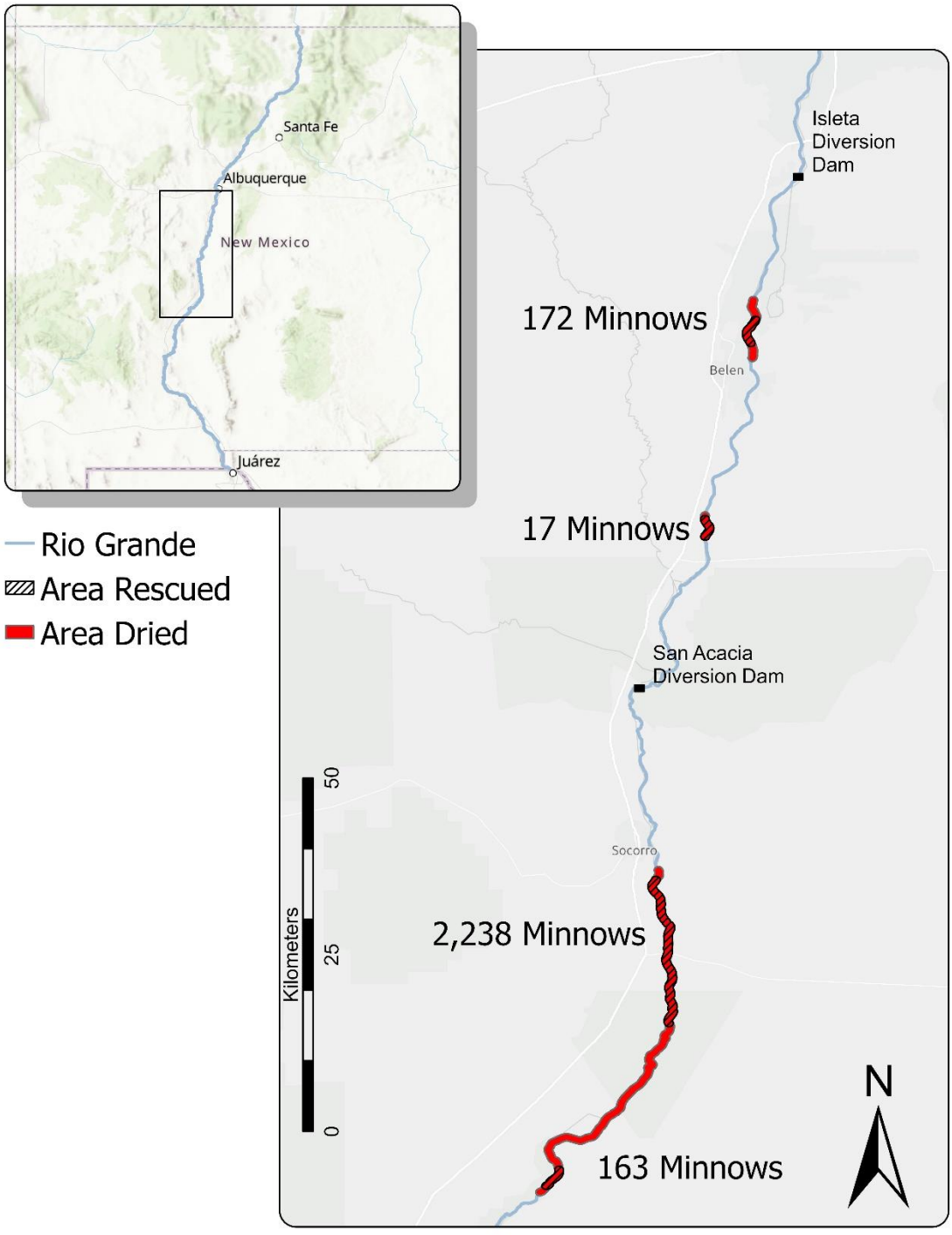

Figure 1- Map of drying, areas rescued, and total number of Rio Grande silvery minnow observed in the Middle Rio Grande, New Mexico, in July and August 2024.

RESULTS

Rescue and Mortality of RGSM

A total of 2,250 RGSM were rescued during the 2024 season (Table 1**). Most adult RGSM were found in the southern portion of the San Acacia Reach, below the San Acacia Dam (**Table 1**). The San Acacia Reach had the highest effort, with the most days, pools, and kilometers rescued (**

Table **2**). Tagged individuals, indicating hatchery origin, were found only in the San Acacia Reach, and all but four were 2023 cohort fish. Two fish were recaptured wild fish tagged during the 2023 mark-recapture study and two fish had tags matching the 2022 cohort. Out of the total number of RGSM found, 340 were found dead in or around pools that were salvaged. All the dead RGSM salvaged were in the San Acacia Reach.

Table 1-Summary of rescue operations for Rio Grande Silvery Minnow in the Middle Rio Grande, 2024. Rescued numbers of RGSM do not include transport losses.

Reach	YOY	Adults	Hatchery	Dead	Total
Isleta	17	172	0	0	189
San Acacia	1,010	940	111	340	2,401
Total	1,027	1,112	111	340	2,590

Table 2-Number of days rescued, number of pools evaluated, number of kilometers (KM) rescued, and extent of drying per reach during 2024 rescue operations. Extent of drying is the number of unique river kilometers of discontinuous flow observed for the season by River Eyes.

Reach	Number of Days	Number of Pools	KM Rescued	KM Extent of Drying

Isleta	3	134	4.9	10.9
San Acacia	10	323	17.6	51.2
Total	13	457	22.5	62.1

Channel Drying

Rescue operations generally progressed in synchrony with river recession over the 2024 season. Fish rescue began July 15th in the San Acacia Reach and continued through August 21st. In total, 21.2 kilometers were rescued during first drying (Figure 1). Over 30 km of the San Acacia Reach dried on July 15-16, most of which could not be rescued within a 24-hour period.

In the San Acacia Reach, drying occurred near the confluence with the Low Flow Conveyance Channel to the city of Socorro, New Mexico (Figure 1). Much of the reach dried on the first day (>20 km) and crews were not able to visit all pools. In the Isleta Reach, approximately 10.9 kilometers of river dried near the Peralta Wasteway and Abeytas, New Mexico. We conducted fish rescue operations on 13 days during the 2024 irrigation season (Table 2).

Monitoring Activities

Adult RGSM were more common in 2024 compared to 2022-2023, but overall number of RSGM rescued were lower in comparison to 2023 (Table 3). When broken down by life stage and origin, RGSM numbers varied among years, with 2024 YOY numbers below average (Figure **2** and **Error! Reference source not found.**).

A similar number of adults and YOY were found during salvage, though most YOY were found in the San Acacia Reach (Table **1**). A lower spring run-off occurred compared to 2023, resulting in a reduce number of YOY rescued in 2024. Examining the annual spring discharge graphs reveals the importance that higher spring run-offs have on number of YOY collected during fish rescue, though there is variation between reaches and among years (Figure 3). Abundance of YOY is greatest in pools in years with higher spring run-off and fewer YOY in years with lower spring run-off (Archdeacon 2016).

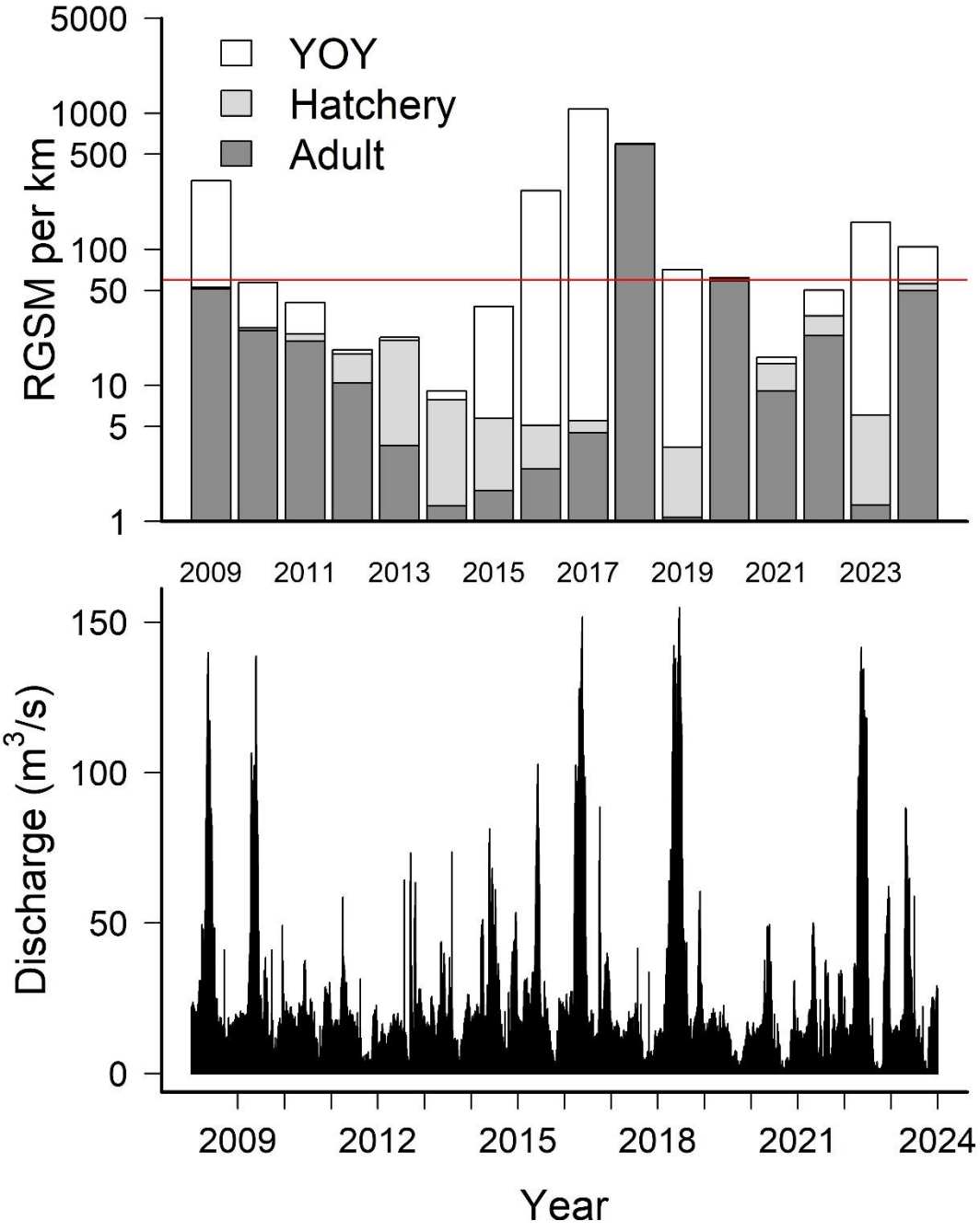

Figure 2- Number of young-of-year (YOY), hatchery marked adult, and wild adult RGSM observed per kilometer in the MRG, 2009-2024 (top) and the average daily discharge (bottom) in the Rio Grande at Albuquerque, NM (USGS gage 08330000). Red line indicates average RGSM per kilometer over all sampling occasions. Note y-axis is log transformed for number of RGSM per km.

Table 3- Summary of rescue activities in the Middle Rio Grande, New Mexico, during summer drying, 2007-2024.

Year	Extent of drying (km)	KM Rescued	Pools Rescued	Total RGSM
2007	48.3	191.8	1,048	14,792
2008	0.0	NA	NA	NA
2009	32.0	87.5	522	24,372
2010	45.4	217.5	1,215	11,312
2011	64.7	235.8	1,974	8,913
2012	82.1	328.3	2,684	5,014
2013	58.8	76.3	1,059	1,492
2014	39.5	100.7	755	629
2015	28.0	37.5	396	1,319
2016	46.1	56.9	547	29,222
2017	39.0	57.3	299	64,948
2018	65.4	158.0	1,435	93,981
2019	28.3	14.5	126	1,127
2020	89.5	66.1	772	4,048
2021	73.3	62.3	935	869
2022	88.4	49.4	852	2,326
2023	56.3	26.9	514	3,904
2024	62.1	22.5	444	2,590

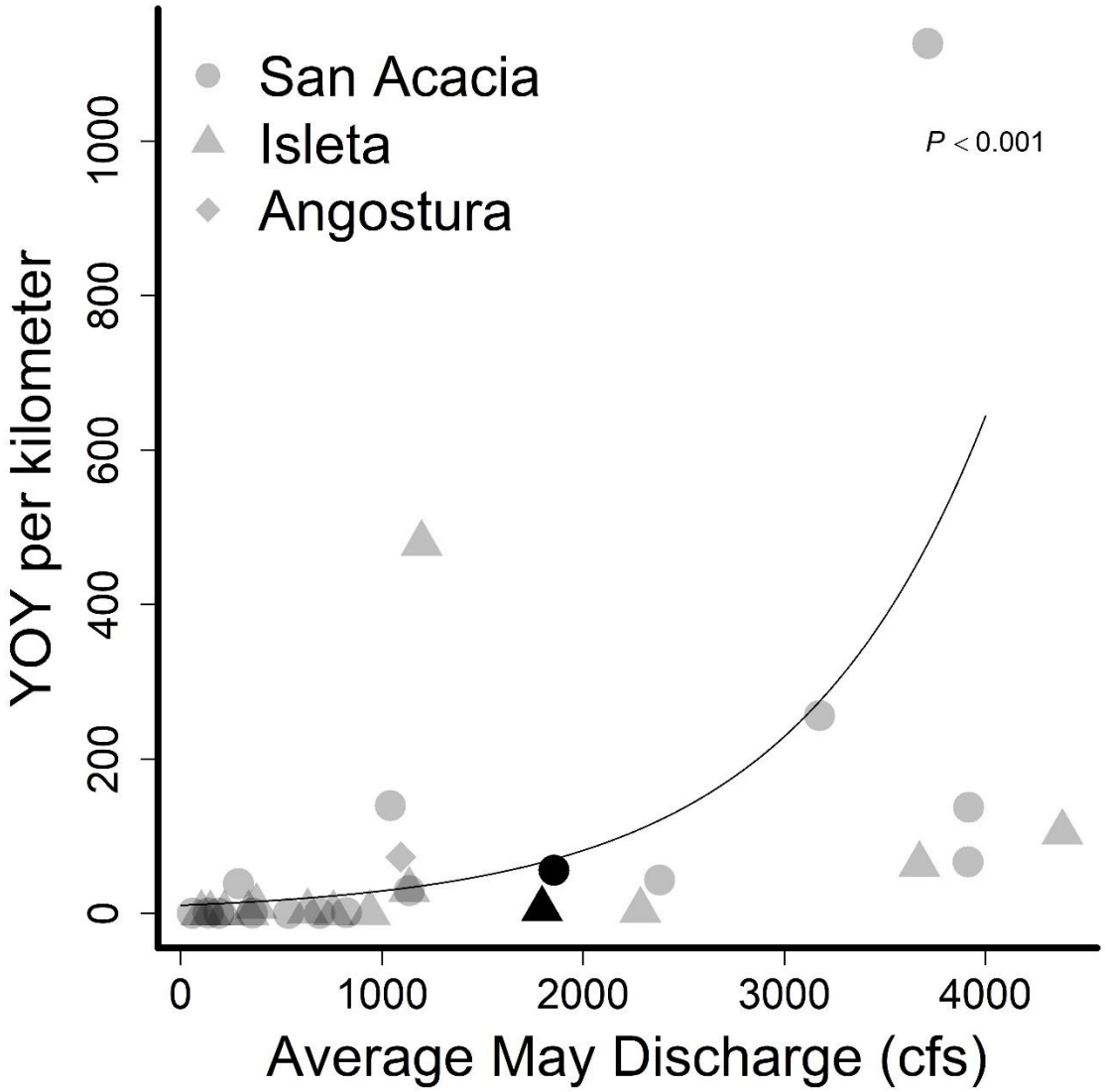

Figure 3- Scatterplot of the average number of young-of-year (YOY) RGSM collected per mile per year, 2007-2024, and the average May discharge (cfs) at the Albuquerque (Angostura), Bosque Farms (Isleta), and San Acacia gaging stations. Black points represent data from 2024.

DISCUSSION

Rescue operations extended across the second half of the irrigation season in 2024. Spring runoff extended well into the middle of July, but extensive amounts of river channel dried August through October. Much of the river downstream of Bosque del Apache National Wildlife Refuge to the San Marcial USGS station was not rescued due to excessive drying during the first two days (>30 km). In total, 22.5 of 62.1 kilometers dried were rescued in 2024 (Chad McKenna, personal communication). Fish rescue operations began near Fort Craig. Crews then relocated to the middle of Bosque del Apache National Wildlife Refuge, when the extensive amount of drying became more than could be rescued during a single day. Generally, there are fewer RGSM downstream of the refuge compared to upstream (Archdeacon et al. 2022). Future fish rescue efforts will incorporate a stratified design where 3 km near Fort Craig will be rescued, 3 km near the south boundary of Bosque del Apache are rescued, and then the remaining rescue will follow river recession.

Spring runoff is an important requirement for recruitment of RGSM (Yackulic et al. 2022). Higher spring runoff results in more fish in October standardized monitoring as well as more RGSM trapped in isolated pools during the summer (Archdeacon 2016). In past years, RGSM numbers have responded positively in years of high spring runoff even after prolonged drought (e.g., 2012-2014). However, it is apparent that more than just spring run-off is important for RGSM recovery as catch in the Isleta Reach appear to be lower compared to the other reaches. With declining populations since 2019, the adult RGSM population shifted to more wild adult fish detected in 2024. Following moderately low recruitment in 2024, the hatchery fish should make up a significant portion of the population in 2025.

Environmental differences in the Isleta Reach could be affecting habitat quality and leading to higher mortality of Isleta RGSM or poor-quality habitats. Analysis of the hydrological conditions of the Isleta reach has found that channel width, discharge, and low flow channels have decreased over time (Yang et al. 2020). The habitat in this area may no longer be optimal for RGSM since tagged hatchery fish were also released in this area (Archdeacon 2022), but fewer RGSM were collected compared to the numbers recaptured in the San Acacia Reach. However, fish rescue covers only a small subset of the entire Isleta Reach. Additional work may be needed to determine the cause of the loss of RGSM on the Isleta Reach. Further, the Isleta Reach is typically rescued later in the irrigation season, when there are fewer RGSM due to natural mortality.

With the possibility of increased frequency of low spring runoff flows and increased duration and extent of summer drying, the continued presence of RGSM in the San Acacia and Isleta Reaches may require increased annual augmentation efforts with hatchery fish if no other management actions addressing spring run-off and improved recruitment are made available. Augmentation with hatchery fish has proven useful for increasing the number of spawning adults following years of low natural recruitment (Archdeacon et al. 2023). Augmentation has slowed loss of genetic diversity, but not completely prevented it (Osborne et al. 2023). New conservation tools are needed to offset low natural recruitment and high summer mortality

during moderate and extreme drought years, such as larger conservation water storage and environmental flows that reduce the negative impacts of low water years, or habitat restoration.

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DATA AVAILABILITY

Data used in this study are available at Mendeley Data. The citation is: Archdeacon, T. (2025). Rio Grande Silvery Minnow salvage 2007-2024, Mendeley Data, V5, doi.org/10.17632/c4j4dttksm.5

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