BUREAU OF RECLAMATION

Technical Memorandum No. ENV-2022-086

Rio Grande Silvery Minnow October Monitoring: 2020

Rio Grande Delta Channel, Middle Rio Grande, New Mexico
Upper Colorado Basin Region

U.S. Department of the Interior **August 2022**

Mission Statements

The U.S. Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated Island Communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Cover Photo – Shoreline of the Rio Grande River (Bureau of Reclamation/Eric Best).

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Acronyms and Abbreviations

CPUE	catch per unit effort
FR	Federal Register
LFCC	Low Flow Conveyance Channel Outflow
m	meter(s)
n	sample size
Reclamation	Bureau of Reclamation
RM	River Mile
silvery minnow	Rio Grande silvery minnow (*Hybognathus amarus*)
USFWS	U.S. Fish and Wildlife Service
VIE	visible implant elastomer

Symbols

≈	approximately
°C	degrees Celsius
>	greater than
<	less than
µs/cm	microsiemens per centimeter
%	percent

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Executive Summary

In late October 2020, the Bureau of Reclamation (Reclamation) conducted surveys for the federally endangered Rio Grande silvery minnow (*Hybognathus amarus*) at select sites along the Rio Grande below the San Acacia Diversion Dam to the South Monticello boat ramp in Elephant Butte Reservoir. Reclamation and U.S. Fish and Wildlife Service biologists sampled 10 sites using seine nets. Surveys were conducted to maintain compliance with the Endangered Species Act requirements for Reclamation's river maintenance and water management activities and to evaluate potential habitat restoration projects.

During the fall seining efforts, 17 Rio Grande silvery minnows were captured: 9 at the South Monticello site, 3 at the Upper Escondida site, 2 at the Lower Escondida site, 2 at the San Acacia site, and 1 at the Nogal Canyon site. The length-frequency histograms indicated that roughly half of the silvery minnows captured in 2020 were young-of-year, which suggests a lack of recruitment associated with the low flows that attributed to the lower numbers of age-0 silvery minnows observed in 2020, and it also informs us that there was some recruitment experienced.

1.0 Introduction

The Rio Grande silvery minnow (silvery minnow; *Hybognathus amarus*)) is a State and federally listed endangered species. It had historically been found throughout the Rio Grande mainstem stretching from the confluence of the Rio Chama in northern New Mexico downstream to the Gulf of Mexico (Bestgen and Platania 1991). The population began to decline with the destruction and modification of its habitat due to dewatering and water diversions, water impoundments, and river modifications. The silvery minnow has been extirpated from about 93 percent of its native range—currently persisting in only one 280-kilometer reach of the Rio Grande in New Mexico, downstream from Cochiti Dam to the headwaters of Elephant Butte Reservoir and a portion of the Rio Grande in Big Bend National Park in Texas (U.S. Fish and Wildlife Service [USFWS] 2010). The USFWS federally listed the species in 1994 (59 FR 36988–36995) and designated critical habitat in February 2003 (68 FR 8087). See the USFWS recovery plan (USFWS 2010).

Since 1992, the Bureau of Reclamation (Reclamation) has funded fish community surveys (Silvery Minnow Population Monitoring Program) of the Middle Rio Grande (Dudley and Platania 1993, 1997). Starting in 2010, Reclamation initiated additional annual surveys for the silvery minnow during fall and winter throughout the Middle Rio Grande to obtain silvery minnow data from areas not evaluated during the Silvery Minnow Population Monitoring program and during winter periods when such surveys were rare, and to document the fish community at certain habitat restoration sites.

Survey efforts for this study were conducted to determine the distribution and relative abundance of the silvery minnow within and downstream from designated critical habitat (Figure 1). From 2010 through 2013, survey site locations were not standardized; starting in 2014, the Rockhouse, North Monticello, and South Monticello sites were randomly selected and have been sampled on an annual basis. Additional survey sites have been added over the years in order to monitor areas for possible restoration projects. These sites can best be described as “presence only” rather than “presence/absence” because the survey locations within sites were not randomly selected, and not all of the habitat types were surveyed equally.

Reclamation biologists surveyed 10 sites in October 2020. The Low Flow Conveyance Channel Outflow (LFCC), Nogal Canyon, and Pete Well sites have been surveyed each year during fall seining efforts. The Upper Escondida and Lower Escondida sites were added in 2017. The San Acacia site was added in 2018. The Rhodes Canyon site was incorporated in 2020 to include baseline data for proposed Reclamation restoration projects.

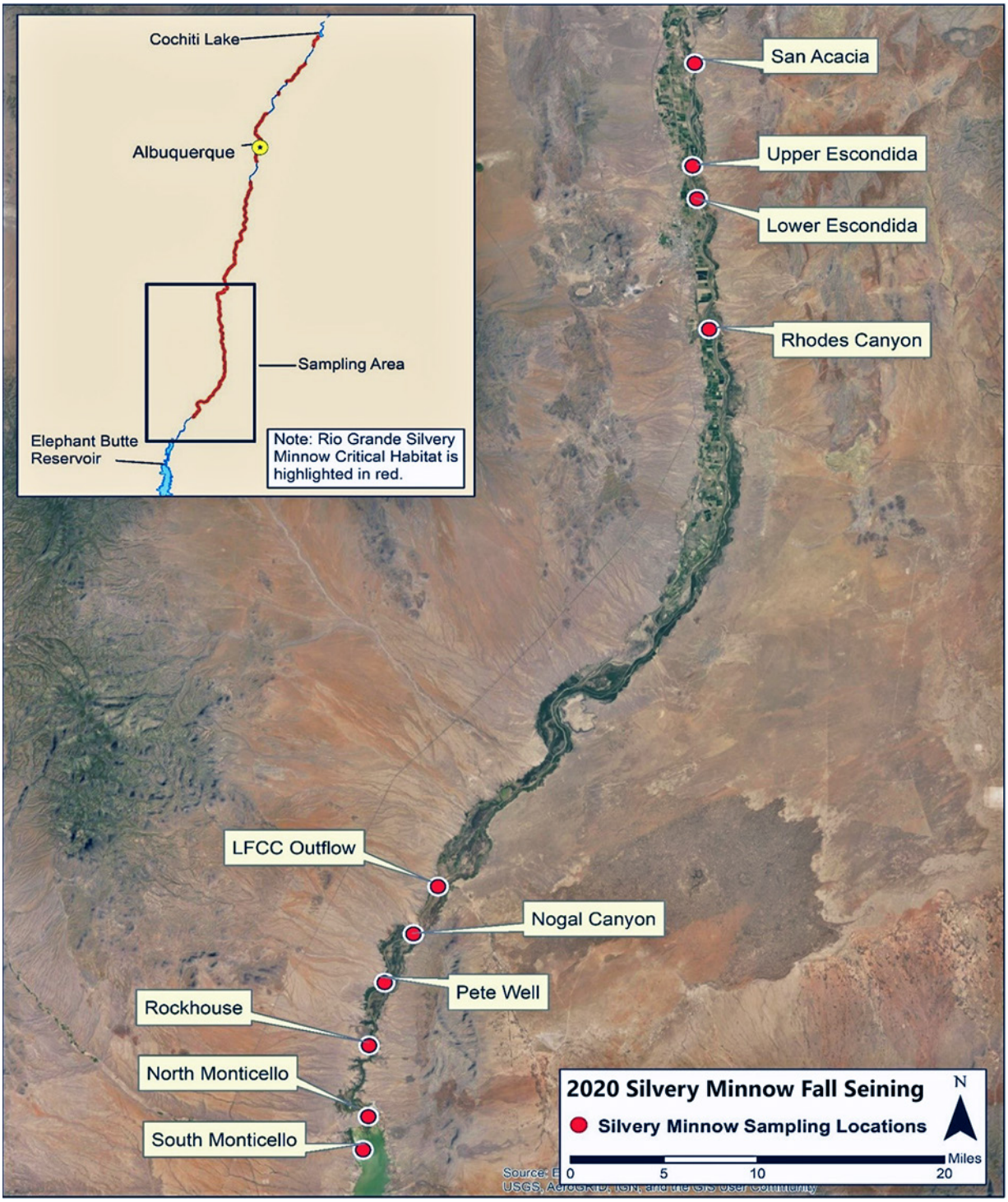

Figure 1.—Study area overview for fall 2020 Rio Grande silvery minnow survey sites.

2.0 Methods

2.1 Study Area

Survey sites were selected within and downstream from silvery minnow critical habitat throughout the Middle Rio Grande. Ten sites were sampled in October 2020. These sites have a multitude of mesohabitats with varying depths and velocities. The sampling sites stretched from roughly 3 miles downstream from the San Acacia Diversion Dam to the delta of Elephant Butte Reservoir: San Acacia (River Mile [RM] 112), Upper Escondida (RM 104), Lower Escondida (RMs 102–103), Rhodes Canyon (RM 92), LFCC (RM 54), Nogal Canyon (RM 51), Pete Well (RMs 47–48), Rockhouse (RM 44), North Monticello (RMs 38–39) and South Monticello (RM 37). With the continued recession of the reservoir, more of the reservoir pool has been exposed, making additional surveys possible (see Figure 1). Surveys took place from October 19 through 23 generally between 9 a.m. and 5 p.m. These sites were selected in an effort to continue the long-term data collection associated with each site and river reach (2010 to 2020). Site selection was based on the need for the collection of baseline or monitoring data from Reclamation operations that may include habitat restoration projects or channel maintenance activities.

Rio Grande flows fluctuate regularly and can change the dynamics of its geomorphology and habitats. With lower flows, previously inundated sandbars and side channels can become more prevalent and form shallow areas of low-velocity habitats used by silvery minnows up until flow intermittency. With increased flows, inundation of some of these sandbars and side channels become deeper with higher velocities, and the higher elevation flood plain becomes inundated, possibly forming shallow, low-velocity habitats. During our survey efforts, we focused on locations likely occupied by silvery minnows, including shallow, low-velocity shorelines with emergent vegetation rather than locations with a high gradient bank and swift laminar flow.

The mesohabitat classification was recorded at each seine haul location. Each area surveyed was classified as one of five habitat types (Table 1). Mesohabitats may be further described by habitat features if present (e.g., shoreline, mid-channel, debris pile, vegetation, and undercut bank). Substrates at the seine haul locations were also recorded (e.g., silt, sand, gravel, or cobble) as was the relative velocity (e.g., slack water, slow, medium, or fast). To ensure crew safety, all seine hauls were conducted in water no more than waist deep (≈3.5 feet).

Table 1.—Mesohabitat classification types on the Middle Rio Grande, New Mexico

Mesohabitat type	Description
Run	Swiftly flowing reaches with little surface agitation and no major flow obstructions. Mesohabitat often appears as flooded riffles.
Pool	The portion of the river within the channel that is deep and has relatively little velocity compared to the rest of the channel; usually created by debris or a sandbar.
Backwater	A small body of water that is connected to the main channel, with no appreciable flow; often created by a drop in flow that partially isolates a former channel.
Riffle	A shallow, high-velocity habitat where the water surface is irregular and broken by waves; generally indicates gravel-cobble substrates.
Plunge pool	A pool created by water spilling over a riffle; substrate particle size is variable depending upon velocity.

2.2 Seine Nets

Biologists used seine nets measuring 3 meters (m) wide by 1 m high with 4.8-millimeter knotless mesh. The nets had floats on top and a weighted lead line on the bottom. Each crew member held one end of the net perpendicular to the current and then hauled it downstream for a distance of 1–13 m. The length of the seine haul was measured with a distance tape, and the average depth of the seine haul was recorded with a wading rod. Where possible, crews seined 20–30 mesohabitats at each of the 10 sites. Waypoints, defined as Universal Transverse Mercator points, were recorded at the beginning of each seine haul location.

All fishes captured were placed into a 5-gallon bucket after each seine haul. Endangered fishes (e.g., silvery minnow) were processed first in order to reduce stress from capture and handling. Each fish was identified to species and measured for standard length as well as total length. Any silvery minnows caught were examined for any visible implant elastomer (VIE) tags, and tag color and location were verified and recorded.

Catch per unit effort (CPUE) was calculated for each site by dividing the number of silvery minnows captured by the area sampled and multiplying by 100 to provide fish per 100 square meters (m^2). Area was calculated by multiplying the length of the seine haul by the width of the seine (3 m). Length data were rounded to the nearest 10-millimeter bin category for length-frequency histograms. All data on silvery minnow captures are provided in appendix 1.

3.0 Results

3.1 Observations During the 2020 Fish Surveys

3.1.1 2020 Rio Grande Flows and Water Quality Parameters

Flows in 2020 were variable and below average, tapering quickly in spring to early summer, leading to subsequent drying of over 37 miles of the Rio Grande in the San Acacia Reach in three different segments (Figure 2) (E. Kandl 2020, personal communication). In late July, the Middle Rio Grande experienced a large rain event, and the river was continuous; however, by early August, portions of the Middle Rio Grande flows were once again discontinuous.

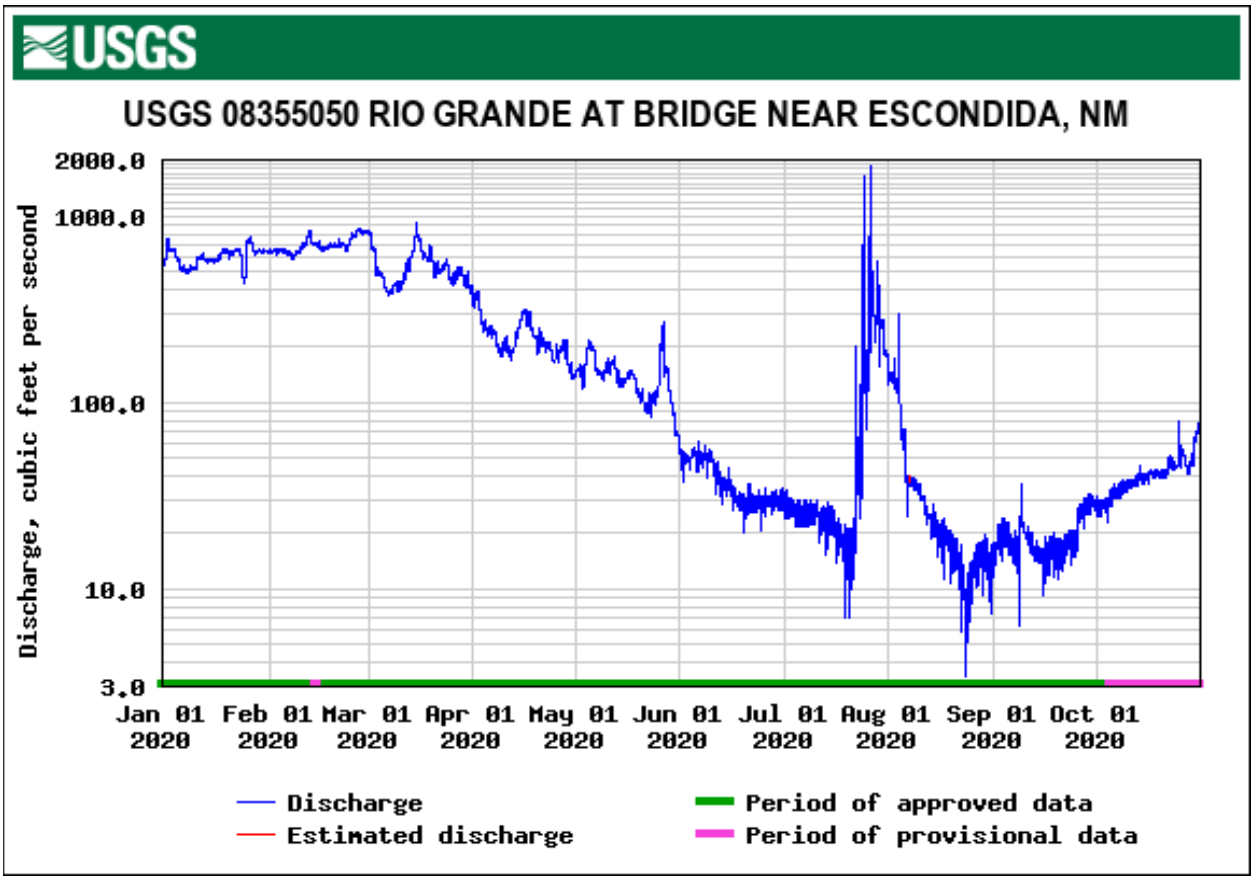

Figure 2.—Daily mean discharge for U.S. Geological Survey Station 08355050 Rio Grande near Escondida, New Mexico, from January 1 to October 30, 2020.

Water quality parameters, such as temperature and dissolved oxygen, are summarized in Table 2. Water quality was found to be within ranges determined to be adequate for aquatic life (New Mexico Environment Department 2020) and at an acceptable level for silvery minnow survival (Hutson et al. 2012).

Table 2.—Water quality measurements for all survey locations

Site	Date	DO (mg/L)	Oxygen saturation (%)	Temperature (°C)	Specific conductivity µs/cm
San Acacia	10/23/2020	8.2	92.8	12.2	955
Upper Escondida	10/22/2020	10.3	114.6	11.9	965
Lower Escondida	10/22/2020	8.2	99.9	10.3	955
Rhodes Canyon	10/22/2020	9.6	129.6	21.0	897
LFCC	10/21/2020	8.9	103.6	14.2	849
Nogal Canyon	10/20/2020	9.4	105.3	12.5	854
Pete Well	10/20/2020	10.1	128.2	18.4	853
Rock House	10/21/2020	9.7	104.2	10.7	839
North Monticello	10/19/2020	8.3	103.1	17.3	888
South Monticello	10/19/2020	8.1	94.5	13.9	711

3.1.2 2020 Rio Grande Silvery Minnows Captured and Catch per Unit Effort

Seventeen silvery minnows were captured in 2020 (Figure 3); a majority (9; 53%) were captured at the South Monticello site (Table 3). The corresponding CPUEs (fish/100 square meters) for each sampling site were:

- South Monticello: 1.57
- Upper Escondida: 0.82
- San Acacia: 0.52
- Lower Escondida: 0.42
- Nogal Canyon: 0.12 (Figure 4).

The silvery minnows were primarily captured in slow to medium flows with a sandy substrate. The depth in which the silvery minnows were caught ranged from 0.1 to 0.3 m. A variety of fish size classes were caught throughout the sampling sites. Length-frequency histograms are provided in the subsections below to illustrate the size classes of silvery minnows caught at each sampling site. No silvery minnows collected were observed to have VIE tags.

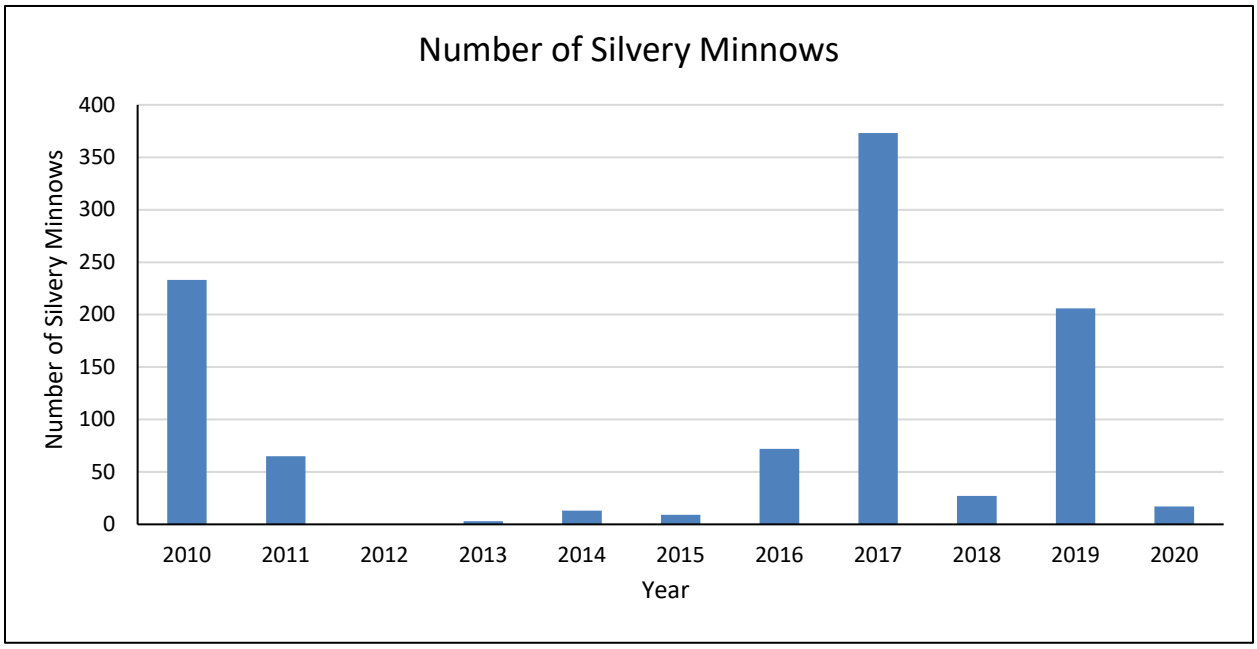

Figure 3.—Total number of silvery minnows captured in each sampling year on the Middle Rio Grande, New Mexico.

Table 3.—Number of silvery minnows captured at each sampling site on the Middle Rio Grande, New Mexico, October 2020

Sampling site	Silvery minnow
South Monticello	9
Upper Escondida	3
San Acacia	2
Lower Escondida	2
Nogal Canyon	1

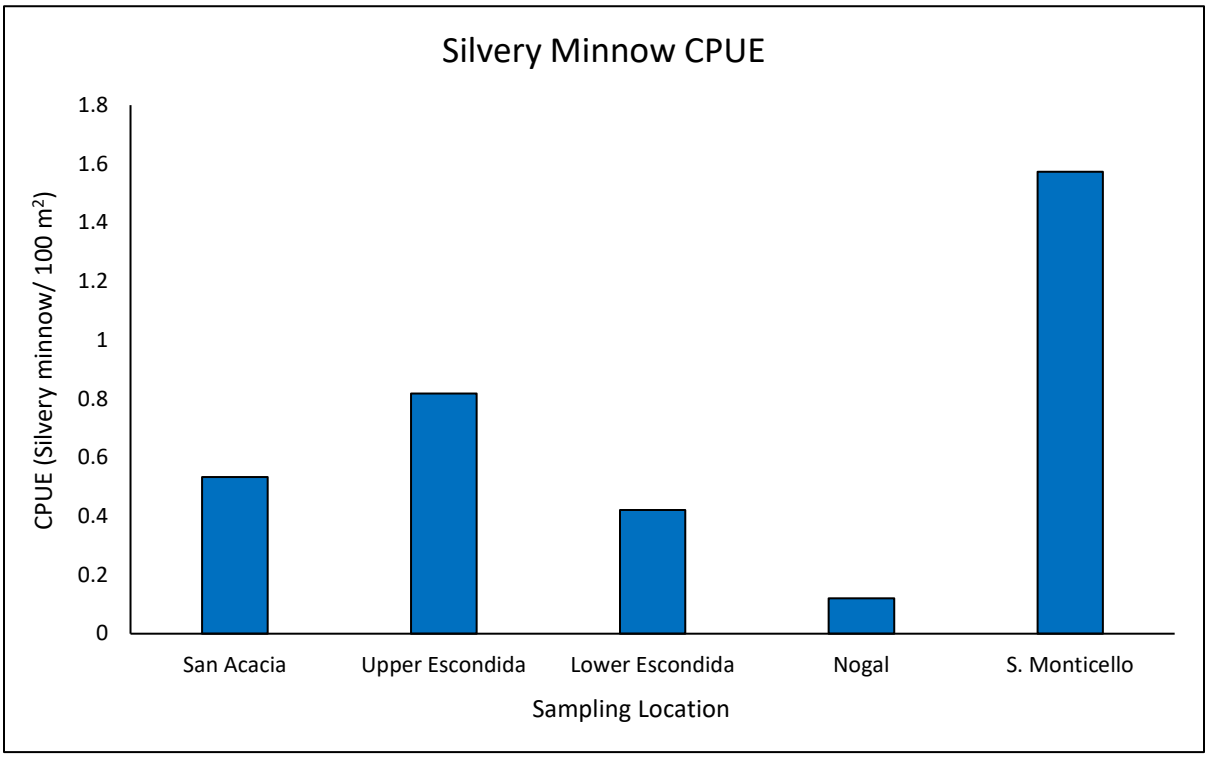

Figure 4.—CPUE (fish/100 square meters) for silvery minnows during October seining on the Middle Rio Grande, New Mexico.

3.2 Sampling Site Results

The number of silvery minnows caught and species composition at each sampling site are described below. (Note: The aerial imagery used in the figures might not be contemporaneous).

3.2.1 San Acacia (River Mile 112)

Twenty-one seine hauls were completed at this site. A total of 1,438 fishes were captured, comprised of 5 different species (Table 4). Red shiners (*Cyprinella lutrensis*) were the most abundant species caught (99%). Two silvery minnows were captured at this sampling site (Figure 5). Figure 6 illustrates the 21 seining locations and silvery minnow capture locations at the San Acacia site.

Table 4.—Species composition at the San Acacia site (Totals are > 100% due to rounding.)

Species[1]	Percent composition
Red shiner	99
Gambusia	1
Channel catfish	< 1
Silvery minnow	< 1
Flathead chub	< 1

[1] Scientific names for fish species are included in appendix B.

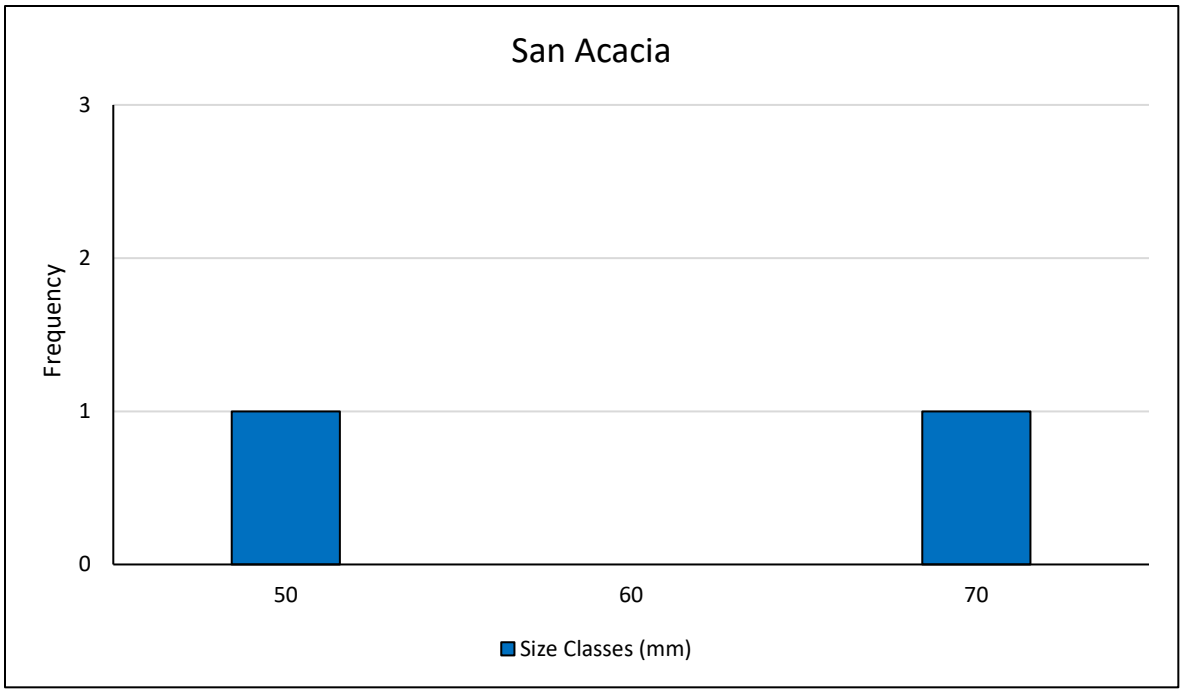

Figure 5.—Silvery minnow length-frequency histogram from the San Acacia site (RM 112) on the Middle Rio Grande, New Mexico, October 2020.

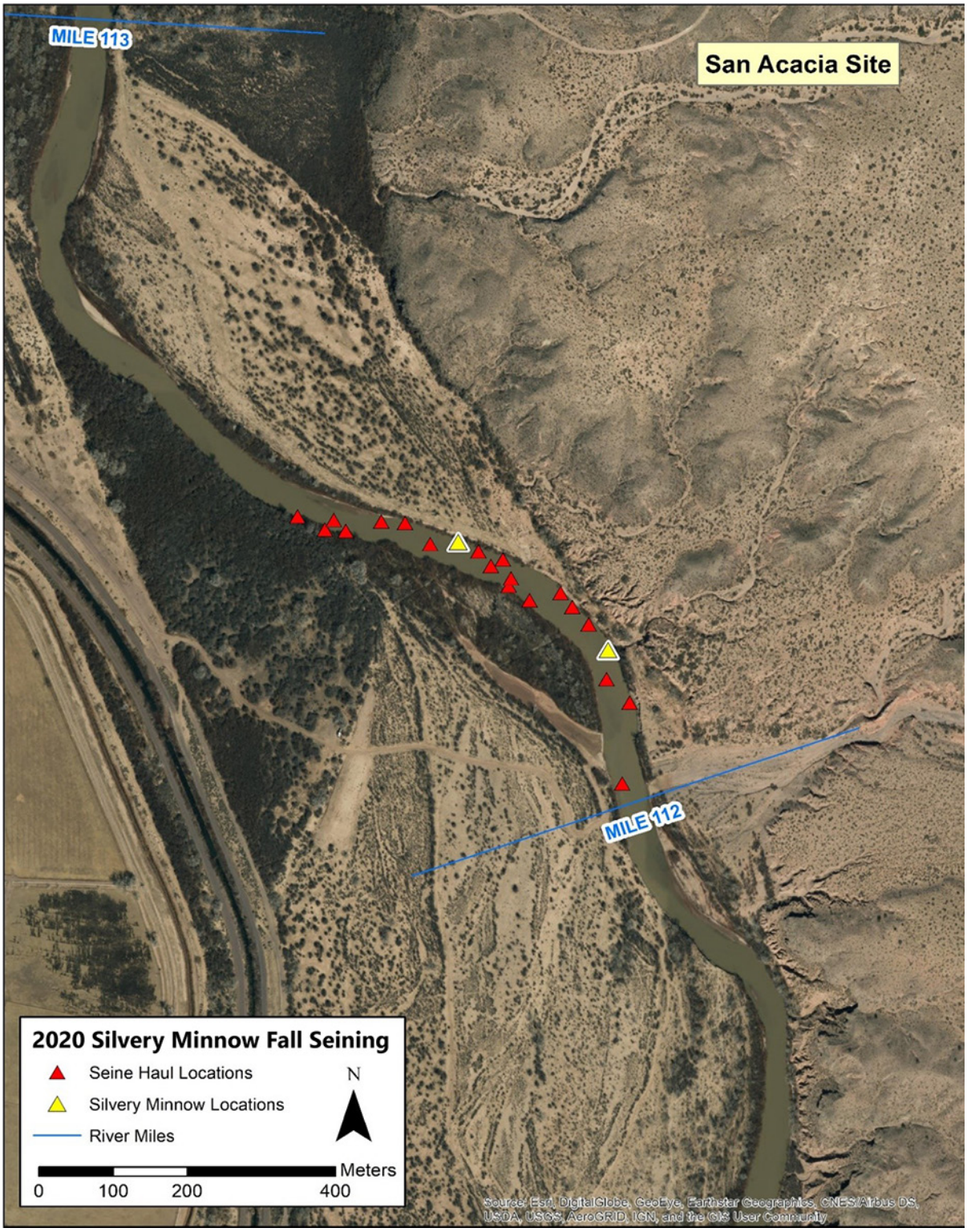

Figure 6.—San Acacia seining locations and silvery minnow capture locations (RM 112), Middle Rio Grande, New Mexico, October 2020.

3.2.2 Upper Escondida (River Mile 104)

Twenty seine hauls were completed at this site. A total of 646 fishes were captured, comprised of 7 different species (Table 5). Red shiners were the most abundant species caught (98%). Three silvery minnows were caught at this sampling site (Figure 7). Figure 8 illustrates the 20 seining locations and silvery minnow capture locations at the Upper Escondida site.

Table 5.—Species composition at the Upper Escondida site

Species[1]	Percent composition
Red shiner	98
Gambusia	1
Common carp	< 1
River carpsucker	< 1
Flathead chub	< 1
Silvery minnow	< 1
Channel catfish	< 1

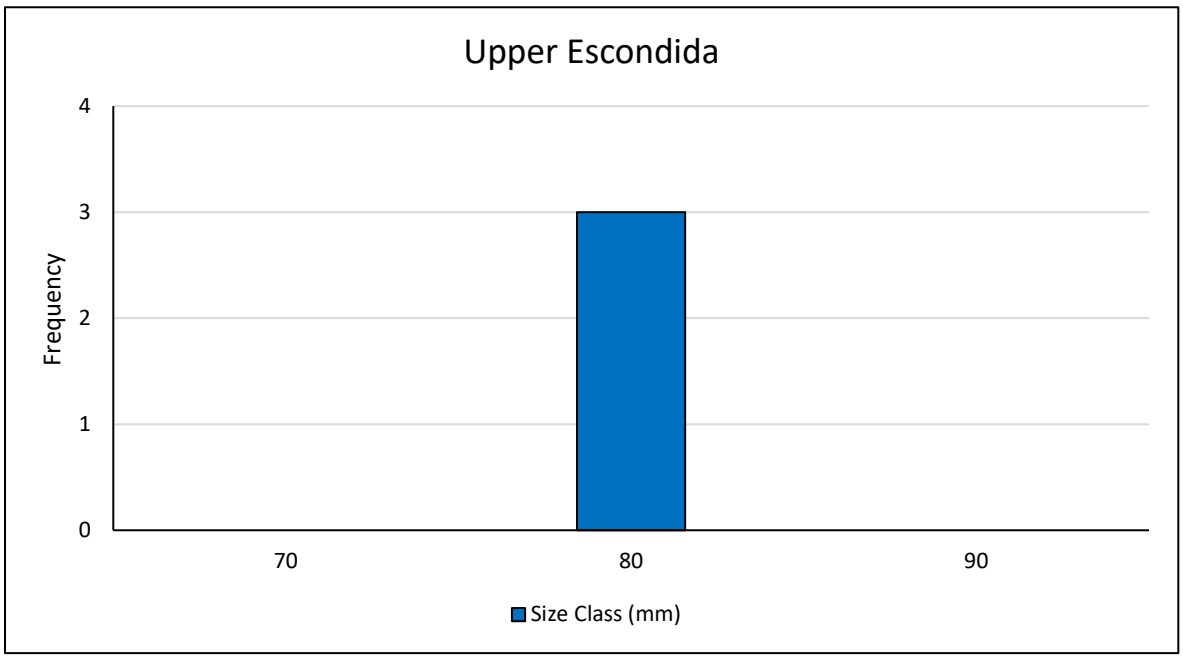

Figure 7.—Silvery minnow length-frequency histogram from the Upper Escondida site (RM 104) on the Middle Rio Grande, New Mexico, October 2020.

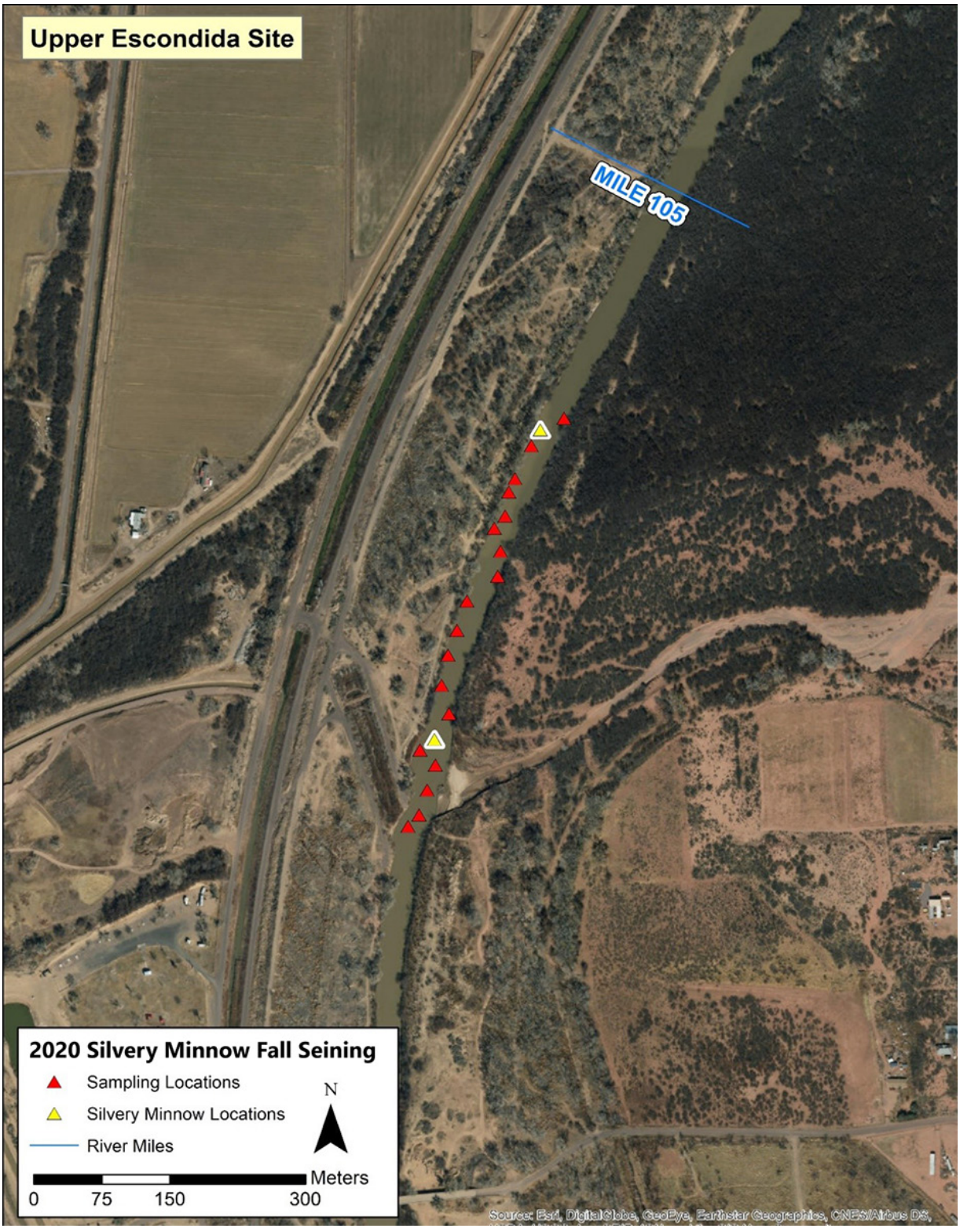

Figure 8.—Upper Escondida seining locations and silvery minnow capture locations (RM 104), Middle Rio Grande, New Mexico, October 2020.

3.2.3 Lower Escondida (River Miles 102–103)

Twenty-two seine hauls were completed at this site. A total of 1,549 fishes were captured, comprised of 6 different species (Table 6). Red shiners were the most abundant species caught (99%). Two silvery minnows were captured at this sampling site (Figure 9). Figure 10 illustrates the 22 seining locations and silvery minnow capture locations at the Lower Escondida site.

Table 6.—Species composition at the Lower Escondida site

Species	Percent composition
Red shiner	99
Common carp	< 1
Flathead chub	< 1
Gambusia	< 1
Silvery minnow	< 1
River carpsucker	< 1

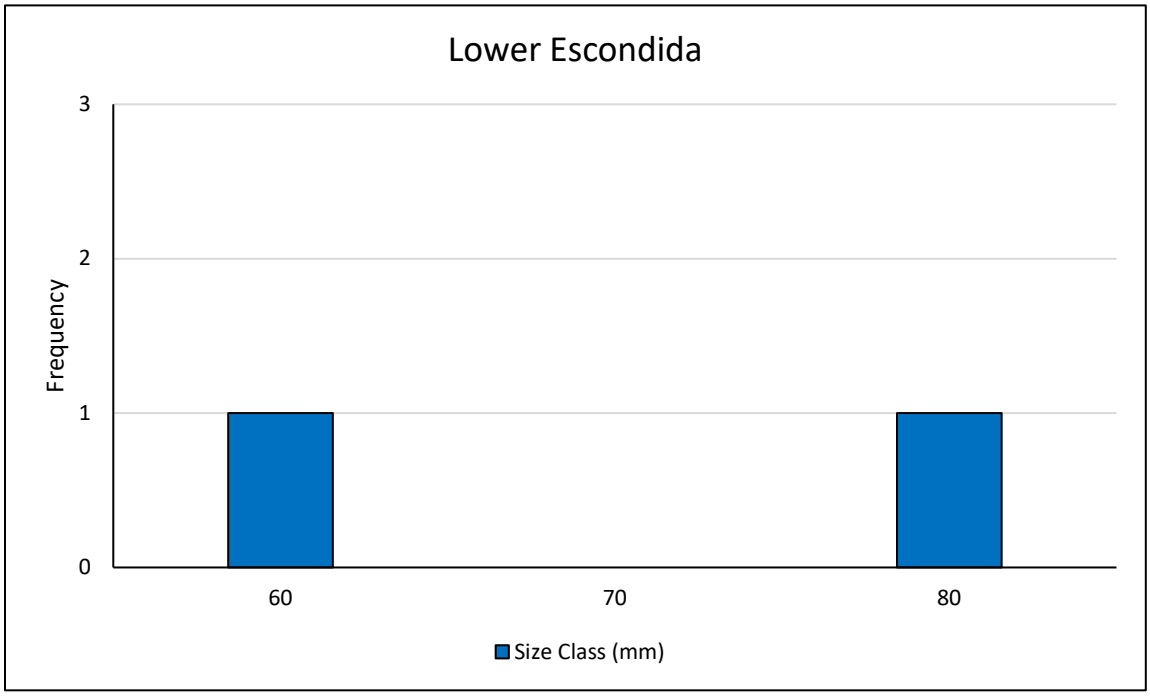

Figure 9.—Silvery minnow length-frequency histogram from the Lower Escondida site (RMs 102–103) on the Middle Rio Grande, New Mexico, October 2020.

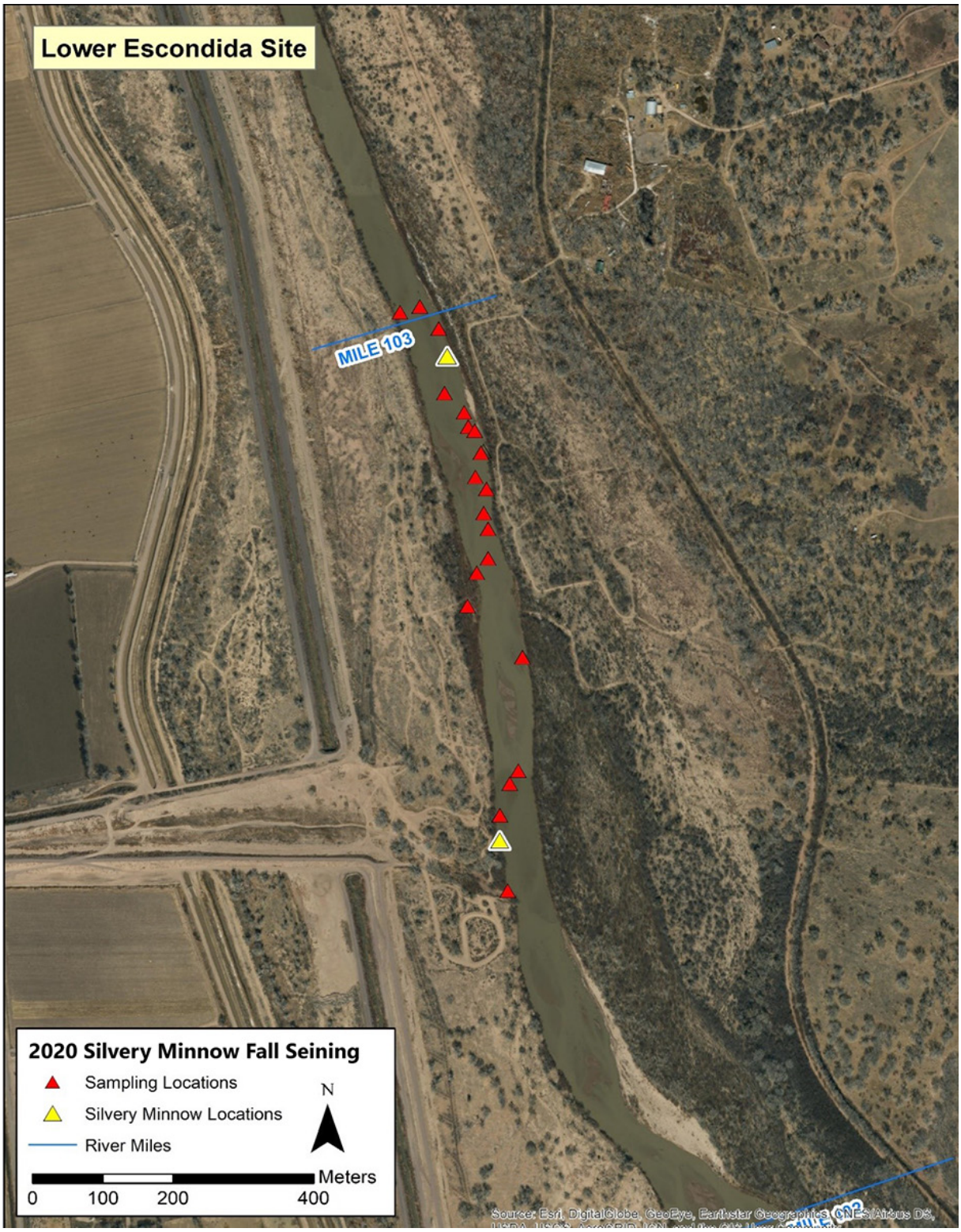

Figure 10.—Lower Escondida seining locations and silvery minnow capture locations (RMs 102–103), Middle Rio Grande, New Mexico, October 2020.

3.2.4 Rhodes Canyon (River Mile 92)

Twenty seine hauls were completed at this site; all were above a sediment plug that was forming above an irrigation pump. Only one red shiner was captured at this site (Table 7). No silvery minnows were captured at this sampling site. Figure 11 illustrates the 20 seining locations and silvery minnow capture locations at the Rhodes Canyon site.

Table 7.—Species composition at the Rhodes Canyon site

Species	Percent composition
Red shiner	100

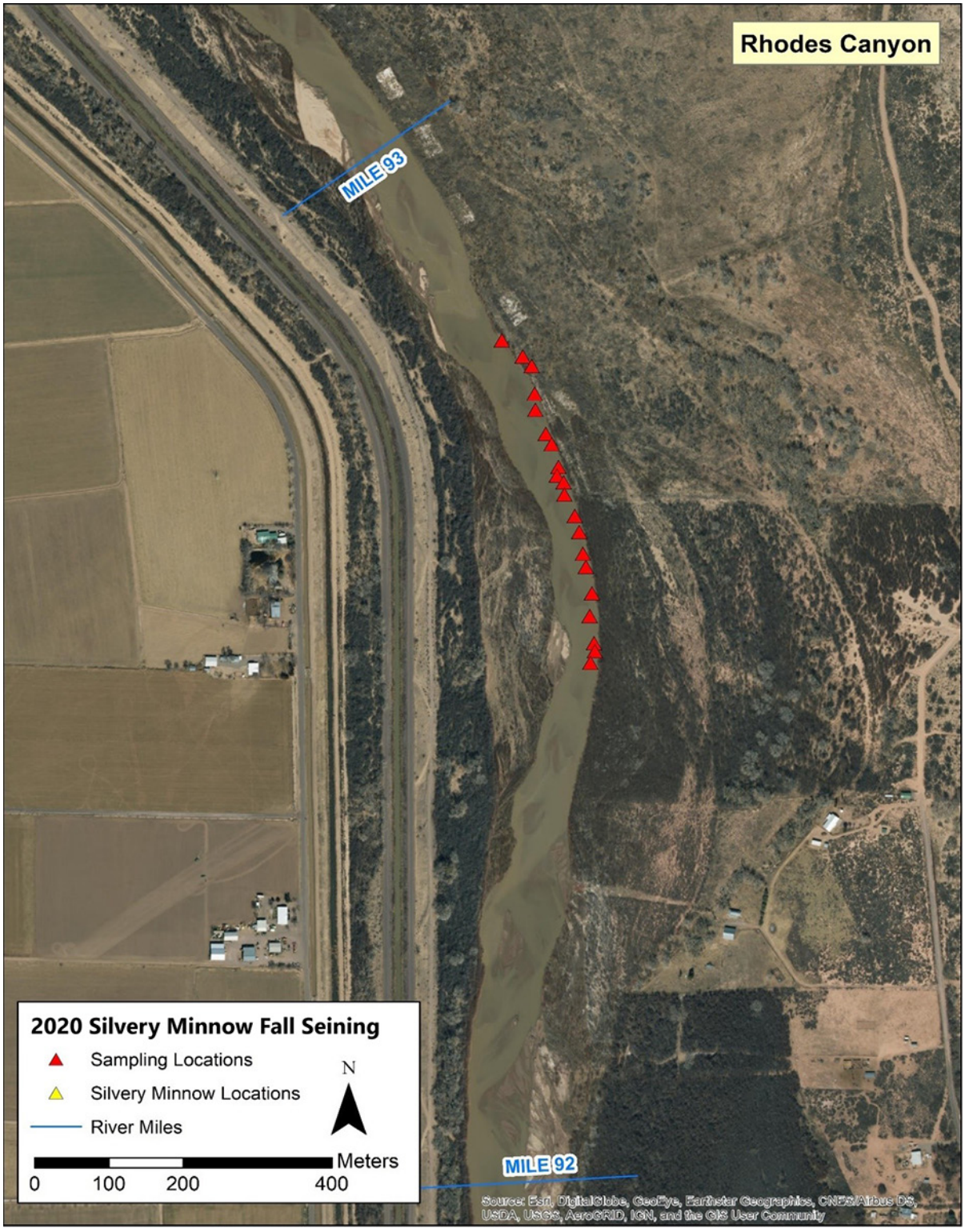

Figure 11.—Rhodes Canyon seining locations and silvery minnow capture locations (RM 92), Middle Rio Grande, New Mexico, October 2020.

3.2.5 LFCC (River Mile 54)

Thirty seine hauls were completed at this site. A total of 1,642 fishes were captured, comprised of 7 different species (Table 8). Red shiners were the most abundant fish caught (93%). No silvery minnows were captured at this sampling site. Figure 12 shows the 30 seining locations and silvery minnow capture locations at the Pete Well site.

Table 8.—Species composition at the LFCC site (Totals are > 100% due to rounding.)

Species	Percent composition
Red shiner	93
Gambusia	6
Threadfin shad	1
Channel catfish	< 1
Gizzard shad	< 1
River carpsucker	< 1
Bullhead minnow	< 1

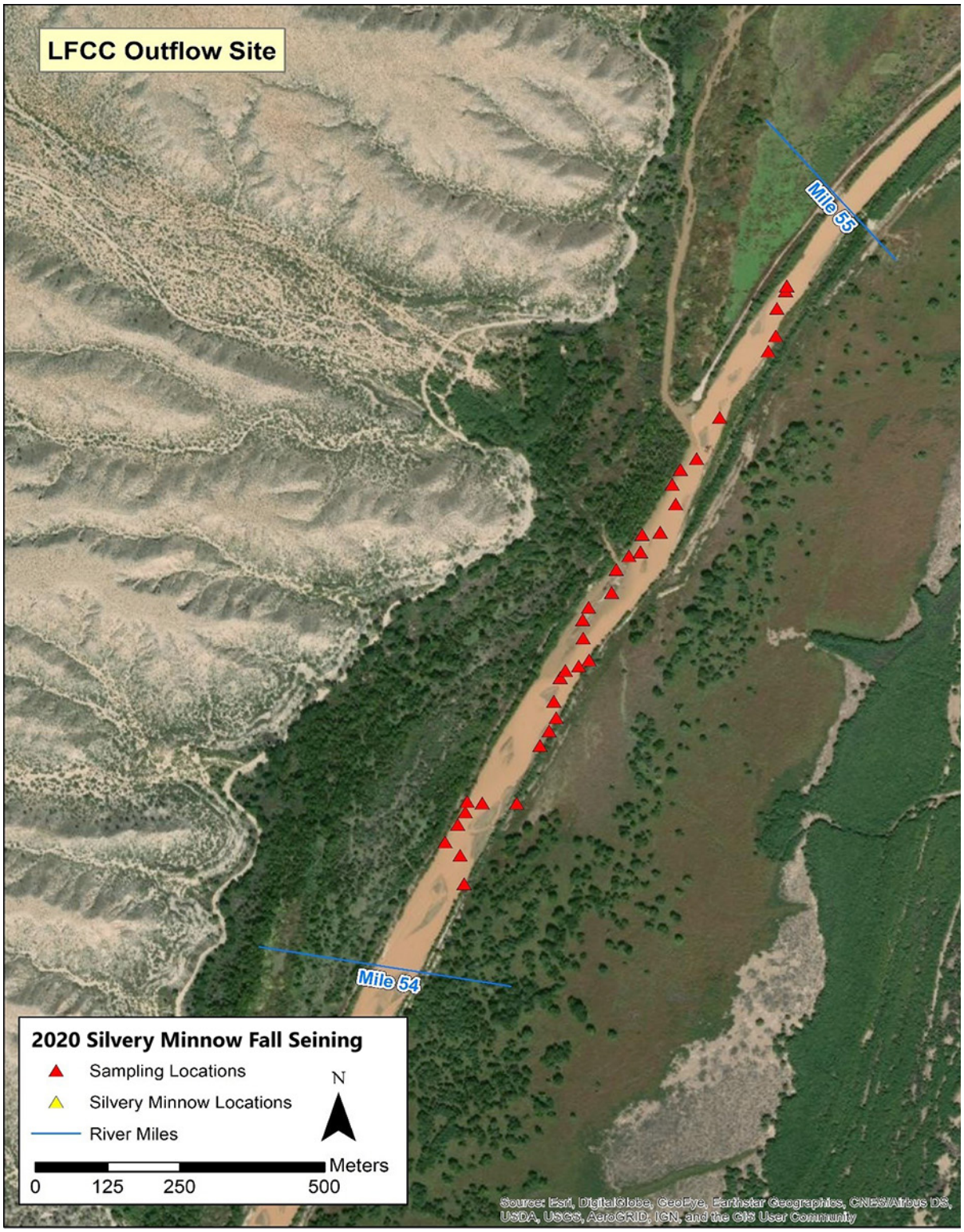

Figure 12.—LFCC seining locations and silvery minnow capture locations (RM 54), Middle Rio Grande, New Mexico, October 2020.

3.2.6 Nogal Canyon (River Mile 51)

Thirty seine hauls were completed at this site. Among all the sampling locations, the highest number of fishes captured (all species) was at this location. A total of 1,961 fishes were caught, comprised of 7 different species (Table 9). Red shiners were the most abundant species captured (93%). One silvery minnow was captured in this sampling site (Figure 13). Figure 15 illustrates the seining locations and silvery minnow capture locations at the Nogal Canyon site.

Table 9.—Species composition at the Nogal Canyon site

Species	Percent composition
Red shiner	93
Gambusia	6
Threadfin shad	< 1
Channel catfish	< 1
Common carp	< 1
Freshwater drum	< 1
Silvery minnow	< 1

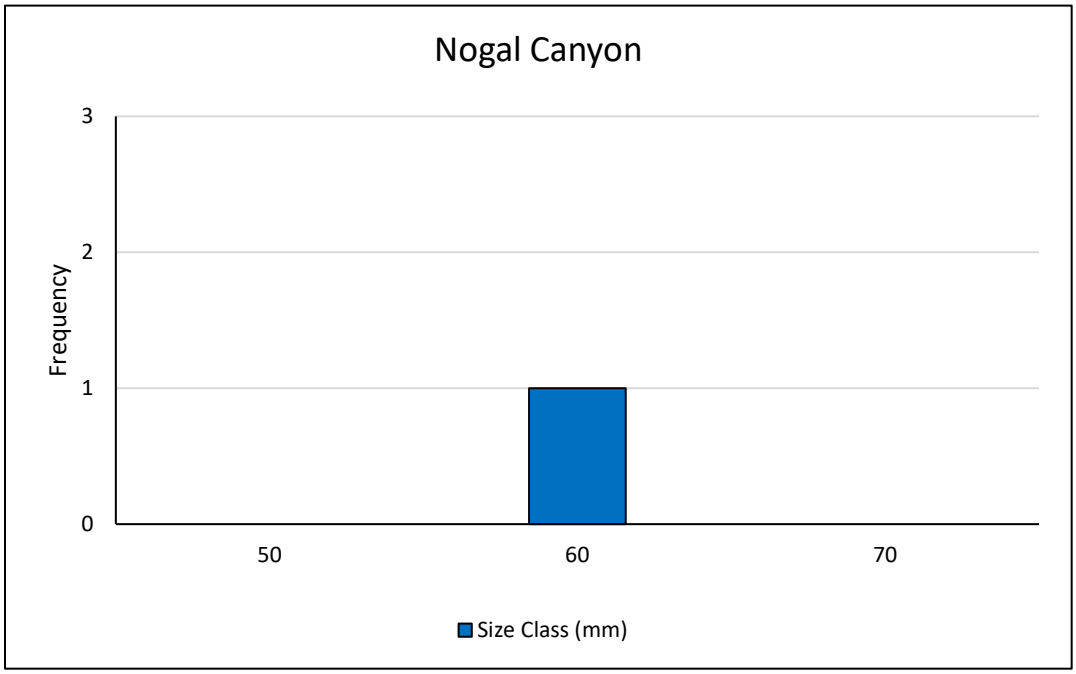

Figure 13.—Silvery minnow length-frequency histogram from the Nogal Canyon site (RM 51) on the Middle Rio Grande, New Mexico, October 2020.

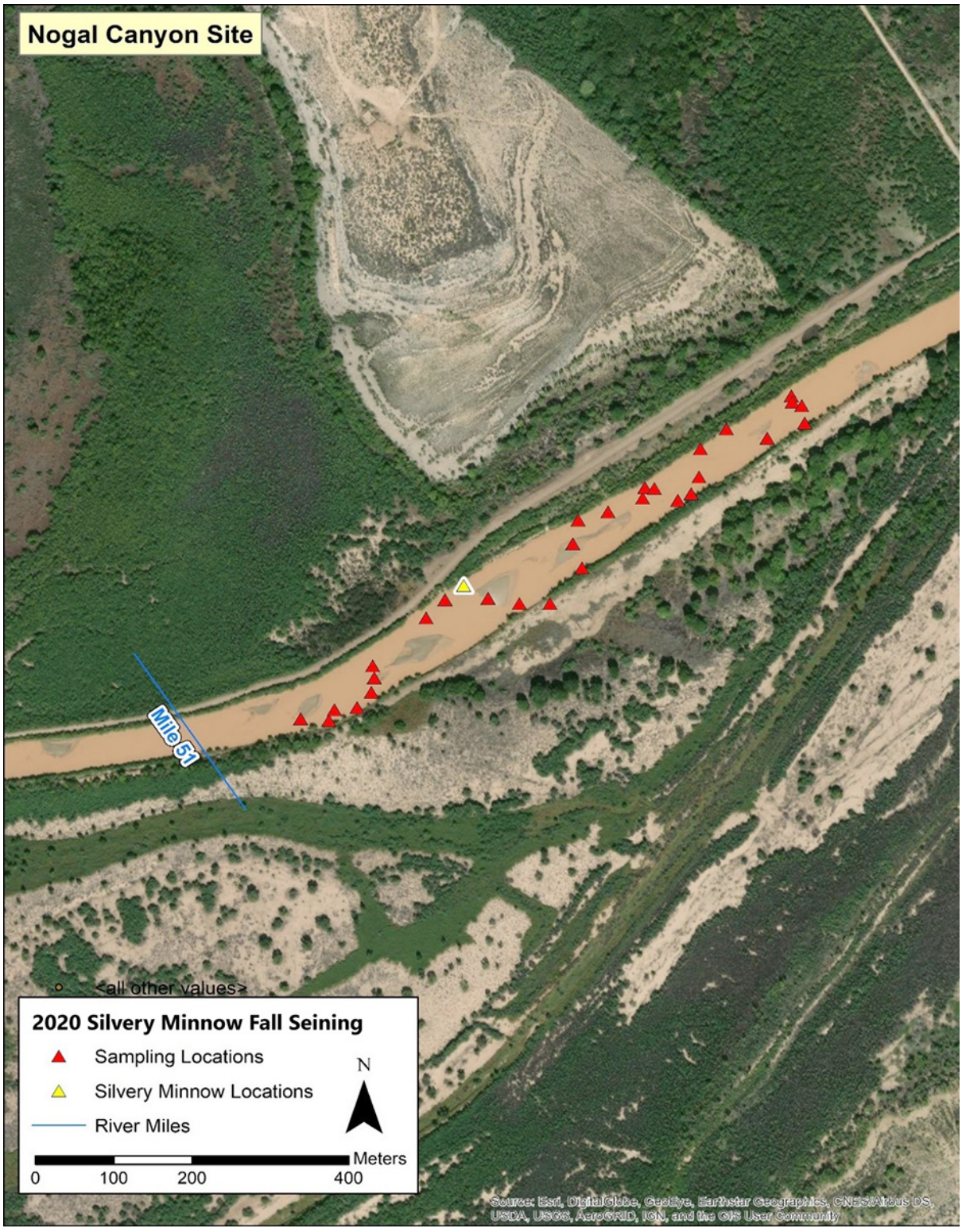

Figure 14.—Nogal Canyon seining locations and silvery minnow capture locations (RM 51), Middle Rio Grande, New Mexico, October 2020.

3.2.7 Pete Well (River Miles 47–48)

Twenty-one seine hauls were completed at this site. A total of 602 fishes were captured, comprised of 4 different species (Table 10). Red shiners were the most abundant species captured (90%). No silvery minnows were captured at this sampling site. Figure 15 illustrates the 21 seining locations and silvery minnow capture locations at the Pete Well site.

Table 10.—Species composition at the Pete Well site (Totals are > 100% due to rounding.)

Species	Percent composition
Red shiner	90
Gambusia	8
Threadfin shad	2
Channel catfish	< 1

Figure 15.—Pete Well seining locations and silvery minnow capture locations (RMs 47–48), Middle Rio Grande, New Mexico, October 2020.

3.2.8 Rockhouse (River Mile 44)

Twenty seine hauls were completed at this site. A total of 1,541 fishes were captured, comprised of 4 different species (Table 11). Red shiners were the most abundant species captured (76%). No silvery minnows were captured at this sampling site. Figure 16 illustrates the seining locations and silvery minnow capture locations at the Rockhouse site.

Table 11.—Species composition at the Rockhouse site

Species	Percent composition
Red shiner	76
Gambusia	22
Threadfin shad	1
Blue catfish	< 1

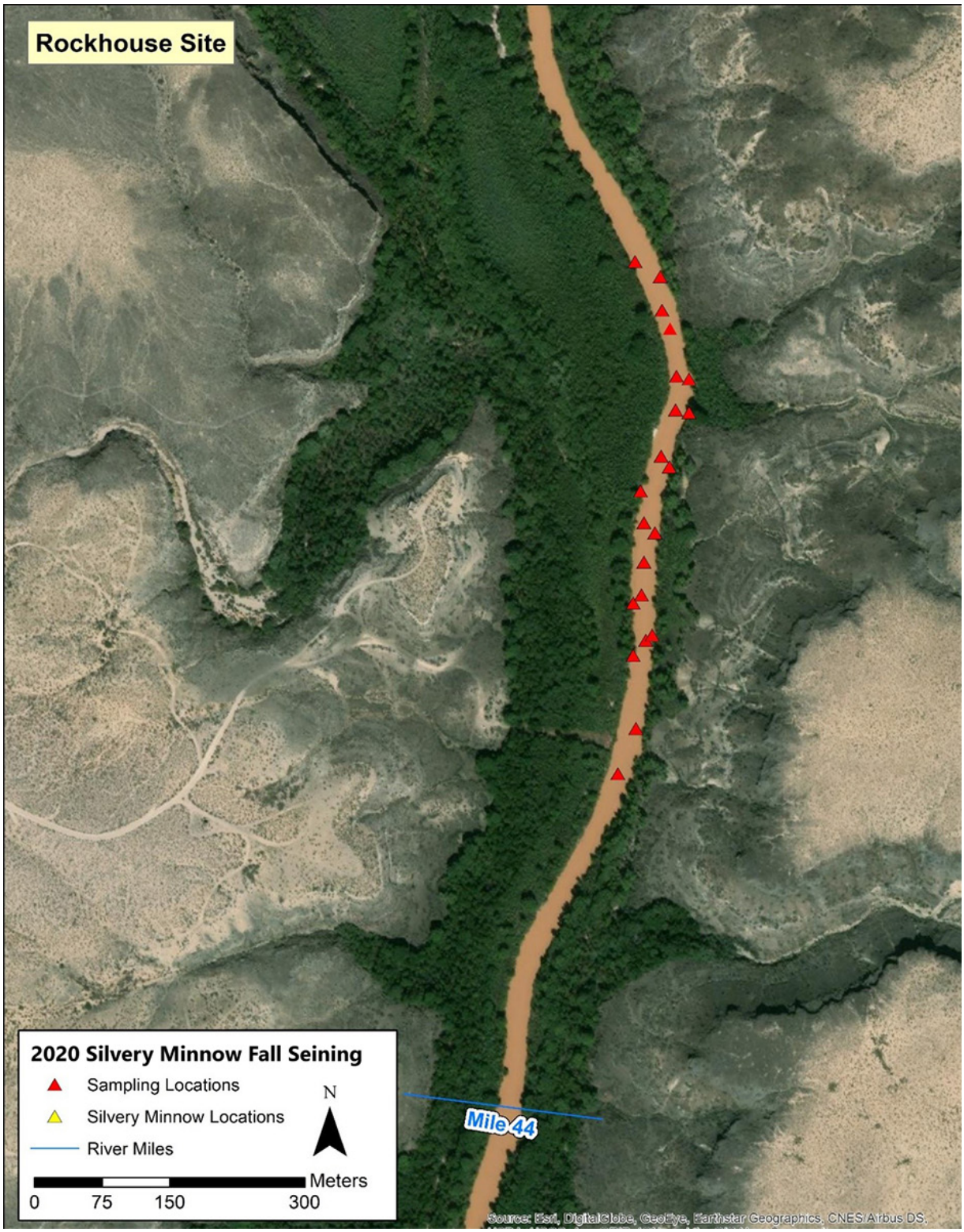

Figure 16.—Rockhouse seining locations and silvery minnow capture locations (RM 44), Middle Rio Grande, New Mexico, October 2020.

3.2.9 North Monticello (River Miles 38–39)

Twenty-six seine hauls were completed at this site. A sediment plug had formed in the channel, and seine hauls were conducted upstream of and downstream from this plug: 5 were upstream, and 21 were downstream. A total of 1,373 fishes were caught, comprised of 8 different species (Table 12). No silvery minnows were captured at this sampling site. Figure 17 illustrates the 26 seining locations and silvery minnow capture locations at the North Monticello site.

Table 12.—Species composition at the North Monticello site

Species	Percent composition
Red shiner	87
Gambusia	8
Bullhead minnow	4
Channel catfish	< 1
Gizzard shad	< 1
Blue catfish	< 1
Common carp	< 1
Bluegill	< 1

Figure 17.—North Monticello seining locations and silvery minnow capture locations (RMs 38–39), Middle Rio Grande, New Mexico, October 2020.

3.2.10 South Monticello (River Mile 37)

Twenty seine hauls were completed at this site. A total of 441 fishes were caught, comprised of 6 different species (Table 13). Red shiners were the most abundant species caught (70%). Nine silvery minnows were captured at this sampling site; this was the highest concentration of silvery minnows captured at a single location (Figure 18). Figure 19 illustrates the seining locations and silvery minnow capture locations at the South Monticello site.

Table 13.—Species composition at the South Monticello site

Species	Percent composition
Red shiner	70
Gambusia	27
Silvery minnow	2
Bigscale logperch	< 1
Blue catfish	< 1
Threadfin shad	< 1

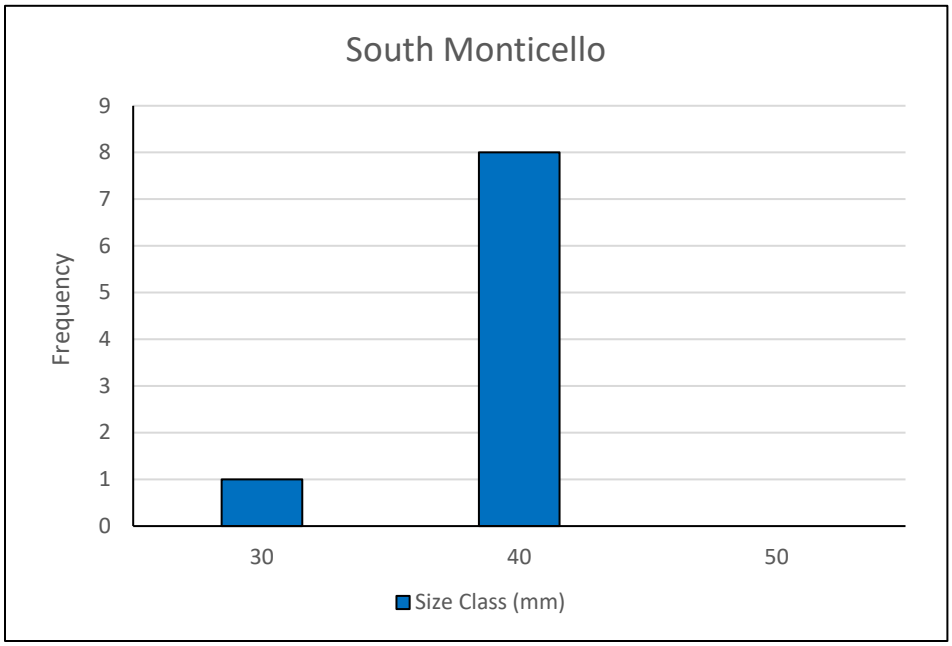

Figure 18.—Silvery minnow length-frequency histogram from the South Monticello site (RM 37) on the Middle Rio Grande, New Mexico, October 2020.

Figure 19.—South Monticello seining locations and silvery minnow capture locations (RM 37), Middle Rio Grande, New Mexico, October 2020.

3.3 Mesohabitat Utilization

Seine hauls were completed in seven different mesohabitats and further categorized based on their location within the river channel (Table 14). Silvery minnows were captured in:

- 50 percent of the mid-channel pools sampled (n = 2)
- 10 percent of riffle habitats (n = 10)
- 5 percent of shoreline run habitats (n = 121)
- 13 percent of mid-channel run habitats (n = 71)

Table 14.—Number of each mesohabitat sampled and corresponding silvery minnow captures

Mesohabitat type	Number seined	Silvery minnow captured
Mid-channel pool	2	1
Shoreline pool	8	0
Backwater	9	0
Riffle	10	1
Plunge pool	15	0
Shoreline run	121	6
Mid-channel run	71	9

No silvery minnows were collected in plunge pools (n = 15), backwaters (n = 9) or shoreline pools (n = 8) in 2020. Figure 20 illustrates the mesohabitat types where silvery minnows were captured.

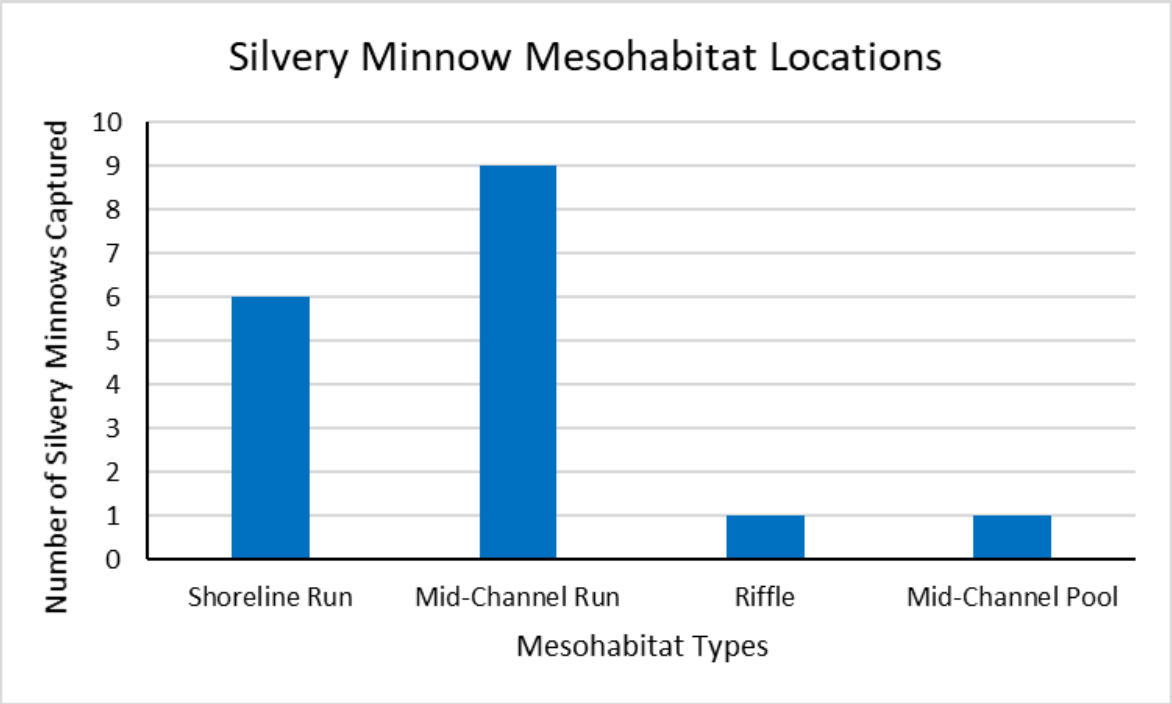

Figure 20.—Silvery minnow captures according to mesohabitat classification during October seining on the Middle Rio Grande, New Mexico, 2020.

4.0 Discussion

Sampling in the San Acacia reach remains a high priority because of the large morphological changes to the Middle Rio Grande (e.g., the formation of sediment plugs in the historic pool of Elephant Butte Reservoir) and the higher levels of operational activities (such as channel realignment) in these locations. Reclamation's annual October seine surveys in the Middle Rio Grande contribute to a long-term monitoring program that began in 2010. Since 2010, the number of silvery minnows captured during the fall seining efforts have greatly fluctuated with the annual variation in water levels throughout the Rio Grande. Higher densities of silvery minnows are linked to extended high flows in spring that allow for dispersal of eggs and larvae into suitable nursery habitats and provide suitable rearing conditions, leading to recruitment and increased survival (Dudley and Platania 2011).

The low flows and drying of portions of the Middle Rio Grande experienced in 2020 negatively impacted silvery minnows, and our low catch appeared to reflect that. Some of the drier years were from 2012 through 2015, which coincided with some of the lowest numbers of silvery minnows collected. The highest silvery minnow capture rates were in 2017, a year when the Rio Grande had increased surface water and greater flood plain inundation. The river did not dry out throughout most of summer 2017, likely attributing to the increased densities (Archdeacon et al. 2019). In 2020, stretches throughout the Middle Rio Grande were dry due to reduced water flow. Drying of portions of the channel occurred as early as May and may have interfered with

spawning or recruitment dynamics. The numbers of silvery minnows captured dropped dramatically this year compared to 2019 (17 versus 207 in 2020 versus 2019, respectively). Given the magnitude of the difference between years, or when only comparing sites that were sampled with similar effort and collection gears, it can be reasonably assumed that the higher flows in 2019 were directly correlated to the numbers of silvery minnows collected that fall.

The South Monticello site had the highest number of silvery minnows captured. This stretch of river did not dry out throughout the year. Conversely, sites upstream of South Monticello all experienced drying to some extent, and the lower numbers, or absence of minnows, are most likely attributed to both low silvery minnow densities and that they may not have repopulated these recently rewetted stretches of river by the time our surveys were conducted.

The length-frequency histograms indicated that roughly half of the silvery minnows captured in 2020 were young-of-year, which suggests a lack of recruitment associated with the low flows that attributed to the lower numbers of age-0 silvery minnows observed in 2020, and it also informs us that there was some recruitment experienced.

5.0 References

Archdeacon, T.P., S.A. Mullner, and J.D. Grant. 2019. Rio Grande Silvery Minnow Fish Rescue 2018, Annual Report. U.S. Fish and Wildlife Service, New Mexico Fish and Wildlife Conservation Office, Albuquerque, New Mexico.

Bestgen, K.R. and S.P. Platania. 1991. Status and conservation of the Rio Grande silvery minnow, *Hybognathus amarus*. The Southwestern Naturalist 36:225–232.

Dudley, R.K. and S.P. Platania. 1993. 1993 Population Monitoring of Rio Grande Silvery Minnow, Final Report. University of New Mexico, Albuquerque.

_____. 1997. 1996 Population Monitoring of Rio Grande Silvery Minnow. Submitted to the Bureau of Reclamation and the U.S. Army Corps of Engineers, Albuquerque, New Mexico, USA. DOI: 10.13140/RG.2.1.4533.1362.

_____. 2011. Rio Grande Silvery Minnow Population Monitoring Program Results from September 2009 to October 2010. Submitted by the American Southwest Ichthyological Researchers, LLC, for the Middle Rio Grande Endangered Species Act Collaborative Program, Bureau of Reclamation, Albuquerque, New Mexico.

Hutson, A.M., L.A. Toya, and D. Tave. 2012. Production of the endangered Rio Grande silvery minnow, *Hybognathus amarus*, in the rearing facility at the Los Lunas Silvery Minnow Refugium. Journal of the World Aquaculture Society 43:84–90. Production of the Endangered Rio Grande Silvery Minnow, Hybognathus amarus, in the Conservation Rearing Facility at the Los Lunas Silvery Minnow Refugium (conanp.gob.mx)

Kandl, E. 2020. Bureau of Reclamation, Water Management Division, Albuquerque, New Mexico, personal communication. December 1.

New Mexico Environment Department. 2020. New Mexico's Water Quality Standards as approved by the New Mexico's Water Quality Control Commission. https://www.env.nm.gov/surface-water-quality/wqs/ (accessed on November 16, 2021).

U.S. Fish and Wildlife Service (USFWS). 1994. Endangered and Threatened Wildlife and Plants: Final rule to list the Rio Grande silvery minnow as an endangered species. Federal Register 59: 36988-36995.

_____. 2003. Endangered and Threatened Wildlife and Plants; Final rule for the Designation of Critical Habitat for the Rio Grande silvery minnow. Federal Register 68: 8087-8135.

_____. 2010. Rio Grande Silvery Minnow (*Hybognathus amarus*) Recovery Plan, First Revision. Albuquerque, New Mexico.

USFWS (see U.S. Fish and Wildlife Service).

Appendix A

Silvery Minnow (*Hybognathus amarus*) Collection Data:
October 2020

Table A-1.—Date, location of capture, tag information, and standard length of silvery minnows captured during the October 2020 surveys in the Middle Rio Grande in New Mexico

Scientific name	Survey date	Easting	Northing	Universal Transverse Mercator zone	Site	Species not found	Visible implant elastomer tag information	Standard length (millimeters)
Hybognathus amarus	10/19/2020	297547	3686246	13	South Monticello		No mark	32
Hybognathus amarus	10/19/2020	297547	3686246	13	South Monticello		No mark	39
Hybognathus amarus	10/19/2020	297547	3686246	13	South Monticello		No mark	40
Hybognathus amarus	10/19/2020	297547	3686246	13	South Monticello		No mark	40
Hybognathus amarus	10/19/2020	297547	3686246	13	South Monticello		No mark	40
Hybognathus amarus	10/19/2020	297547	3686246	13	South Monticello		No mark	43
Hybognathus amarus	10/19/2020	297547	3686246	13	South Monticello		No mark	43
Hybognathus amarus	10/19/2020	297566	3686217		South Monticello		No mark	40
Hybognathus amarus	10/19/2020	297569	3686168		South Monticello		No mark	40
Hybognathus amarus	10/19/2020				North Monticello (upstream sediment plug)	X		
Hybognathus amarus	10/19/2020				North Monticello (downstream sediment plug)	X		
Hybognathus amarus	10/20/2020	301862	3706172		Nogal		No mark	61
Hybognathus amarus	10/20/2020				Red Rock/Pete Well Road	X		
Hybognathus amarus	10/21/2020				Rockhouse	X		
Hybognathus amarus	10/21/2020				LFCC confluence	X		
Hybognathus amarus	10/22/2020	326447	3775509		Lower Escondida		No mark	59
Hybognathus amarus	10/22/2020	326522	3774803		Lower Escondida		No mark	75
Hybognathus amarus	10/22/2020	326143	3778043		Upper Escondida		No mark	77
Hybognathus amarus	10/22/2020	326143	3778043		Upper Escondida		No mark	79
Hybognathus amarus	10/22/2020	326026	3777694		Upper Escondida		No mark	75
Hybognathus amarus	10/22/2020				Rhodes Canyon	X		
Hybognathus amarus	10/23/2020	326012	3787936		San Acacia		No mark	66
Hybognathus amarus	10/23/2020	326214	3787788		San Acacia		No mark	52

Appendix B

Common and Scientific Names of Fish Species

Common name	Scientific name
Bigscale logperch	*Percina macrolepida*
Blue catfish	*Ictalurus furcatus*
Bluegill	*Lepomis macrochirus*
Bullhead minnow	*Pimephales vigilax*
Channel catfish	*Ictalurus punctatus*
Common carp	*Cyprinus carpio*
Flathead chub	*Platygobio gracilis*
Freshwater drum	*Aplodinotus grunniens*
Gambusia	*Gambusia affinis*
Gizzard shad	*Dorosoma cepedianum*
Red shiner	*Cyprinella lutrensis*
River carpsucker	*Carpiodes carpio*
Silvery minnow	*Hybognathus amarus*
Threadfin shad	*Dorosoma petenense*