

Rio Grande Silvery Minnow Rescue and Salvage Fiscal Year 2004

Interagency Agreement 02-AA-40-8190

United States Fish and Wildlife Service
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April 11, 2005

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Executive Summary

This report documents efforts during 2004 to reduce the magnitude of adult (greater than 30 mm TL) Rio Grande silvery minnow (*Hybognathus amarus*, silvery minnow) mortality due to intermittent and near intermittent conditions and evaluates the effectiveness of those efforts using the limit of incidental take defined in the March 17, 2003 Biological Opinion (U. S. Fish and Wildlife Service, 2003; BO) as the standard of performance.

Prevailing drought conditions in 2004 resulted in water shortages throughout the Middle Rio Grande, New Mexico. Flows in the Rio Grande began to recede on June 16, 2004. Ultimately, 68 miles of the Middle Rio Grande were dewatered upstream of the South Boundary of Bosque del Apache National Wildlife Refuge (NWR) to a point several miles downstream of the Isleta Diversion Dam. This necessitated that the silvery minnow be salvaged from isolated pools as the river receded to reduce the probability that the mortality associated with water operations would exceed the limit for post-larval incidental take as established in the March 17, 2003 BO. A total of 12,865 silvery minnows, mostly young-of-year, was documented to exist in the dewatered reaches of river. Of these, approximately 92.5% were transported alive to Albuquerque Reach of the Rio Grande where they were released. Incidental take of adult silvery minnows (greater than 30 mm TL) that occurred as a result of water operations in the Middle Rio Grande was 521 – within the limitations established in the March 17, 2003 Biological Opinion. “The Service anticipates that up to 38,000 silvery minnows (greater than 30 mm [1.2 in]) may be taken in any year due to the Federal and non-Federal actions described and analyzed in this biological opinion (Service, 2003).”

Introduction

Until the 1950s, the Rio Grande silvery minnow (*Hybognathus amarus*, silvery minnow) was distributed throughout many of the larger order streams of the Rio Grande Basin upstream of Brownsville, Texas to points north in New Mexico primarily below 5,500.0 ft elevation (1,676.0 m). This elevation coincides with the approximate vicinities of Abiquiu on the Chama River, Velarde on the Rio Grande, and Santa Rosa on the Pecos River. Today, absent from much of its historic range, the silvery minnow is restricted to a variably perennial reach of the Rio Grande in New Mexico, from the vicinity of Bernalillo downstream to the headwaters of Elephant Butte Reservoir, a distance that fluctuates as the size of the pool of water in storage in Elephant Butte Reservoir changes, but that approximates 150.0 river miles (241 km). Most descriptions of the contemporary range of silvery minnow cite the entire reach of the Rio Grande between Cochiti Dam and Elephant Butte Reservoir. However, that assertion cannot be made with certainty. The species' status in the Rio Grande between Cochiti Dam and Angostura Irrigation Diversion Dam is unknown; that reach of river has not been surveyed in recent years.

The silvery minnow is currently listed as endangered by the State of New Mexico, having first been listed May 25, 1979 as an endangered endemic population of the Mississippi silvery minnow (*Hybognathus nuchalis*; New Mexico Department of Game and Fish, 1988). The species is also listed as endangered by Texas (Sections 65.171 - 65.184 of Title 31 T.A.C.) and the Republic of Mexico (Secretaria de Desarrollo Social, 1994). On July 20, 1994, the U. S. Fish and Wildlife Service (Service) published a final rule to list the silvery minnow as a Federal endangered species with proposed critical habitat (Federal Register, 1994). In 2003, the Service designated critical habitat for the silvery minnow in the Middle Rio Grande. The designation extends from Cochiti Dam downstream about 157.0 mi (252 km) to the utility line crossing the Rio Grande in Socorro County. This location is at 4,450.0 feet of elevation (1,356.0 m), corresponding to the elevation of the spillway crest for Elephant Butte Dam. The lateral limits (width) of critical habitat extend between the existing levees or, in areas without levees, the riparian zone, extending 300.0 feet (91.4 m) laterally from each side of the bankfull stage of the Middle Rio Grande. Portions of the Pueblos of Santo Domingo, Santa Ana, Sandia, and Isleta fall within the broader area designated as critical habitat but are specifically excluded from the critical habitat designation.

On March 17, 2003, the Service issued a Biological Opinion 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" (Service 2003; March 17, 2003 BO). The consultation involved two Federal agencies, U. S. Bureau of Reclamation and the Army Corps of Engineers, and two non-Federal entities. The Service concluded that water operations and river maintenance activities in the Middle Rio Grande, as proposed (Reclamation and Corps, 2003), were likely to jeopardize the continued existence of the silvery minnow (along with the southwestern willow flycatcher (*Empidonax traillii extimus*; flycatcher) and adversely modify critical habitat of the silvery minnow (Service, 2003). The March 17, 2003 BO describes a Reasonable and Prudent Alternative (RPA), Reasonable and Prudent Measures (RPMs), and Conservation Measures that serve in part to secure baseline conditions for the silvery minnow and flycatcher. As a part of the March 17, 2003 BO, the Service established the annual incidental take limit for adult (greater than 30 mm TL) silvery minnows at 38,000. Estimates of incidental take are derived from surveys in which observed mortality is multiplied by 50, based on the assumption that the probability of observing a single mortality is 0.02. The incidental take limit is equivalent to 760 adult silvery minnows that are observed dead.

This report documents efforts during 2004 to reduce the magnitude of post-larval silvery minnow mortality due to intermittent and near intermittent conditions and evaluates the effectiveness of those efforts using the permitted limit of incidental take defined in the March 17, 2003 BO as the standard of performance. Observations of river corridor dynamics are presented in relation to patterns of silvery minnow distribution and abundance.

Methods

Salvage of Silvery Minnows

Using seines of various sizes, fish were collected from pools that formed as flow in the Rio Grande became discontinuous. All captured fish were identified to the species level and silvery minnows were quickly culled from the collections. Prior to handling silvery minnows, hands were washed to remove the residue of lotions (e.g., suntan lotions), and care was taken to handle silvery minnows with wetted hands. Captured silvery minnows were placed into five gallon buckets filled with river water and subsequently transferred to plastic bags (about 30 per bag) for hauling to a release site. Often, silvery minnows were placed directly into plastic bags to reduce handling. Plastic bags were filled to half capacity with water that was treated to achieve a 0.5 percent NaCl solution (18.9 grams/gallon). Additionally, stress coat was added to the bags to achieve a 0.26 ml/l (1 ml/gallon) solution. Bags with fish were inflated with oxygen as soon as practical. Plastic bags containing silvery minnows were cushioned with bubble wrap (to reduce trauma from impact and vibration association with transport), and subsequently placed in ice chests with just enough ice to maintain temperatures in the bags about 5° C lower than the river. Silvery minnows were then transported as quickly as possible to the Albuquerque Reach of the Rio Grande (usually at the Alameda Bridge) where live fish were released to the river. Bags of silvery minnows were placed in the river until the temperature of the water in the bags was within 1° C of ambient conditions. Silvery minnows that died in transit were frozen and retained for use in future research projects.

The age of silvery minnows was inferred from their standard length as reported by Cowley et al. (in press) to form an impression of the age class distribution of salvaged silvery minnows (although the lengths of individual silvery minnows were not precisely measured). However, it is acknowledged that silvery minnow size is a relatively fallible index of age on a regional scale because growth will vary with longitudinally variable energy inputs and length of the growing season, and because the species' extended spawning season does not always provide for a clear demarcation of age by size.

In a separate study, hatchery-produced silvery minnows have been stocked into the Albuquerque Reach of the Rio Grande. Each batch of the hatchery-produced silvery minnows was distinguished by a unique visible implant elastomer mark before being released. The location, condition, and fate of these marked silvery minnows were noted as they were encountered during salvage operations.

Enumeration of Incidental Take of Silvery Minnow

Mortality of adult (greater than 30 mm TL) silvery minnows that was attributable to water operations in the Middle Rio Grande was enumerated during 2004. Adult silvery minnow mortality that occurred in reaches of river that were rewetted due to forces outside of the operations of the Action Agencies was not considered to be incidental take under the March 17, 2003 BO.

Results

Salvage of Silvery Minnows

Prevailing drought conditions in 2004 resulted in water shortages throughout the Middle Rio Grande, New Mexico. Beginning on June 16, 2004, and as described in the March 17, 2003 BO, flow in the Rio Grande first became discontinuous in the vicinity of Bosque del Apache NWR. Ultimately, several discontinuous sections of the Middle Rio Grande totaling 68.0 miles (109.4 km) were dewatered. The sections of river that went dry extended north from the South Boundary of Bosque del Apache NWR (river mile 74.0) to a point several miles downstream of the Isleta Diversion Dam (approximately river mile 165.0). Between these geographic limits, the river remained perennial from a point about four miles downstream of the San Acacia Irrigation Diversion Dam (river mile 111.0) to Bernardo (river mile 130.0). Isolated perennial pools also persisted between the LP2DR irrigation outfall (river mile 144.0) and the Jarales Bridge (river mile 140.8).

Silvery minnows were salvaged from isolated pools that formed as the river receded to reduce the probability that the mortality associated with water operations would exceed the limit of incidental take as

established in the March 17, 2003 BO. A total of 12,865 silvery minnows was salvaged from the dewatered reaches of river. Most of these were *in situ* produced young-of-year (i.e., most were not marked, indicating that they were not of immediate hatchery origin). This number of salvaged silvery minnows greatly exceeds that salvaged in the recent past: 713 during 2003, 3,662 during 2002, and 240 during 2001 (Smith and Basham, 2003; Smith and Munoz, 2002; Smith, 2001). Of the silvery minnows salvaged during 2004, approximately 92.5% were transported alive to the Albuquerque Reach of the Rio Grande where they were released (usually at the Alameda Bridge).

Silvery minnow salvage operations were initiated on June 16, 2004 at the South Boundary of Bosque del Apache NWR, and progressed upstream in synchrony with river recession over the course of the 2004 irrigation season. River recession generally occurred at or below the rate allowed in the March 17, 2003 BO (4.0 miles/reach/day).

On five occasions, flood pulses resulting from thunderstorm events rewet the river sufficiently for the Middle Rio Grande to become a continuously flowing system. Additionally, there were numerous flood pulses of lesser magnitude and extent that rewet limited portions of the river during the irrigation season, but that did not result in a continuous flowing river. During the warmest part of the summer, reduced nighttime rates of evaporation and transpiration would produce diurnal pulses in flow of limited extent (generally affecting less than 0.5 river miles) and limited duration. Silvery minnows were inevitably transported downstream with each event of channel rewetting, necessitating that salvage operations begin anew with subsequent episodes of channel drying. Silvery minnow mortality that occurred in reaches of river that were rewetted due to forces outside of the operations of the Action Agencies was not considered to be incidental take under the March 17, 2003 BO.

The river became discontinuous in the Isleta Reach on June 24, 2004. Of the silvery minnows salvaged during the 2004 irrigation season, most (10,158; 79.0%) were captured in the Isleta Reach (primarily upstream of Belen). The abundance of silvery minnows in this reach progressively increased with distance upstream (i.e., the greatest densities of silvery minnows were observed proximal to the next upstream irrigation diversion).

Very few silvery minnows were captured in the Socorro Reach before August 3, 2004. Up to that date, sampling in this reach did not progress upstream beyond Brown's Arroyo (river mile 94.1). It wasn't until salvage operations resumed in that reach on August 03, 2004, following a flood pulse on July 24, 2004 that rewet the entire Socorro Reach of the Rio Grande, that many silvery minnows were found there (silvery minnows apparently descended downstream with the July 24, 2004 flood pulse). Over the duration of sampling during 2004, decisively fewer (2,707) silvery minnows were found in the Socorro Reach compared to the number of silvery minnows found in the Isleta Reach. The number collected there represents 21.0% of the total number of silvery minnows salvaged during the 2004 irrigation season. Like the Isleta Reach, abundance of silvery minnows in the Socorro Reach progressively increased with distance upstream.

At the time that flow in the river became discontinuous (i.e., during salvage operations), silvery minnows were typically found in pool-habitats with steep sides that, at the time of their formation, were approximately a meter deep or deeper. Such pools were most numerous in reaches relatively heterogeneous in channel features, often in association with relatively well-defined channels. During periods of extreme water scarcity, the species appears to seek out habitats that are cooler and deeper. Silvery minnows were often found in relatively high abundance in habitats associated with overhead cover and in habitats with an influx of shallow groundwater or irrigation drain return flows. Significantly, when the river became discontinuous in the Isleta Reach, large numbers of silvery minnows were observed in the irrigation wasteways, so long as a sufficient volume of running water existed there to maintain water quality. Generally, few silvery minnows would remain in these habitats while adjacent portions of the river were rewetted. Clearly, the species exhibits a rheotactic response to flow, one that could be interpreted as adaptive to life in a system subject to intermittency. Silvery minnows show a propensity to move to the more favorable habitats for survival – most critically including those with a reduced extent and frequency of intermittent and near intermittent conditions.

Four distinct size classes of silvery minnows, likely indicative of four age classes, comprised the sample of salvaged silvery minnows. As would be expected, 2004 was the most abundant year class; older age classes were progressively and dramatically less numerous. The 2004 year class of salvaged silvery minnows exhibited a tri-modal distribution in sizes – evidence of multiple spawning bouts by the species during the year. Further, it seems that recruitment was relatively strong, judging from the large number of unmarked young of year silvery minnows observed during the 2004 fish salvage operation.

Four hatchery-produced silvery minnows were encountered during surveys to locate and salvage silvery minnows from isolated pools that formed as the river receded. These fish were distinguished by a unique visible implant elastomer mark that signified the location, date and size of the fish at the time of stocking. These fish have been introduced into the Rio Grande as a part of an experimental augmentation study being conducted by the Service's Fishery Resources Office. The significance of these observations will be addressed in a separate report for that study. Observations of these collections are presented here for documentation purposes. On June 17, 2004, one silvery minnow, with a red left predorsal mark, was captured adjacent to Bosque del Apache NWR at river mile 83.0 (Table 1). That fish was part of a batch of fish that was stocked adjacent to Sandia Pueblo (river mile 198.0) on April 3, 2003. The point of recapture was approximately 115.0 miles (185.0 km) downstream of its point of release. On July 7, 2004, one silvery minnow, with an orange left predorsal mark, was captured adjacent to Bosque Farms at river mile 164 (Table 1). That fish was part of a batch of fish that was stocked adjacent to Corrales (river mile 194.0) on December 9, 2002. The point of recapture was approximately 30.0 miles (48.3 km) downstream of its point of release. Finally, on August 1, 2004, two silvery minnows, both with a green left predorsal mark, were collected adjacent to the Los Lunas Airport at river mile 157 (Table 1). These fish were part of a batch of fish that was stocked adjacent to Bernalillo (river mile 203.0) on January 2, 2003. The point of recapture was approximately 46.0 miles (74.0 km) downstream of their point of release.

During the week of January 10, 2005, 27 silvery minnows were collected from one site just downstream of Alameda Bridge. These fish were variously marked indicating their release in the reach between Bernalillo and Sandia Pueblo during November, 2004. Those recaptures are listed in Table 1.

Documentation of Incidental Take of Silvery Minnow

Beginning on June 16, 2004, and as allowed in the March 17, 2003 BO, flow in the Rio Grande first became discontinuous in the vicinity of Bosque del Apache NWR. Ultimately, 68.0 miles of the Middle Rio Grande were dewatered, ranging upstream of the South Boundary of Bosque del Apache NWR (river mile 74.0) to a point several miles downstream of the Isleta Diversion Dam (approximately river mile 165.0). Such channel drying resulted in the incidental take of 521 adult silvery minnows. This level of incidental take was within the amount of incidental take (760) established in the March 17, 2003 BO. Of the total amount of incidental take, one silvery minnow death occurred in the Isleta Reach and the rest (520 silvery minnows) occurred in the Socorro Reach.

The first occurrence of incidental take (involving a single post-larval silvery minnow) was observed on June 20, 2004, near the northern boundary of Bosque del Apache NWR. Nearly two months later, the next silvery minnow mortality occurred as a result of water operations. Most of the incidental take of silvery minnows occurred between August 12, 2004, and September 9, 2004. The last occurrence of incidental take was on September 16, 2004.

Acknowledgments
Agencies and Individuals Assisting in the Salvage of Silvery Minnows During 2004

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. There are many people that contributed to this effort. The list of agencies and persons that contributed to this effort appears below. If efforts to salvage silvery minnows in 2004 can be regarded as successful, it is because of the tremendous cooperation and the professionalism of all involved.

A special note of thanks is extended to Jude Smith, formerly of the Service's NMESFO, for his tutorage and advice before and during the 2004 field season. The NMESFO is thankful to Jude Smith's editorial comments on this report as well as those of Jennifer Parody. The NMESFO would also like to acknowledge the very special contributions of: Gregory Pargas, the entire SWCA crew, Martin Rivera and Mary Chapler and other personnel of the Socorro Office of the Bureau of Reclamation, and David Gensler of the Middle Rio Grande Conservancy District.

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Table

Table 1. Capture Histories of Marked Hatchery-produced Silvery Minnows During 2004 and January, 2005.

| Capture Date | Number of Silvery Minnows | Capture Location | Mark | Release Date | Release Site |
|------------------|---------------------------|-------------------------------|----------------------------|------------------|----------------------------|
| June 17, 2004 | 1 | Bosque del Apache NWR (RM 83) | Red, left predorsal fin | April 3, 2003 | Sandia Pueblo (RM 198) |
| July 7, 2004 | 1 | Bosque Farms (RM 164) | Orange, left predorsal fin | December 9, 2002 | Corrales (RM 194) |
| August 1, 2004 | 2 | Los Lunas Airport (RM 157) | Green, left predorsal fin | January 2, 2003 | Bernalillo (RM 203) |
| January 11, 2005 | 1 | Alameda (RM 192) | Red, anal fin | November, 2004 | Bernalillo/Sandia (RM 198) |
| January 12, 2005 | 3 | Alameda (RM 192) | Red, anal fin | November, 2004 | Bernalillo/Sandia (RM 198) |
| January 13, 2005 | 1 | Alameda (RM 192) | Green, left predorsal fin | January 2, 2003 | Bernalillo (RM 203) |
| January 13, 2005 | 1 | Alameda (RM 192) | Red, anal fin | November, 2004 | Bernalillo/Sandia (RM 198) |
| January 14, 2005 | 1 | Alameda (RM 192) | Green, anal fin | November, 2004 | Bernalillo/Sandia (RM 198) |
| January 14, 2005 | 2 | Alameda (RM 192) | Red, anal fin | November, 2004 | Bernalillo/Sandia (RM 198) |
| January 15, 2005 | 2 | Alameda (RM 192) | Green, anal fin | November, 2004 | Bernalillo/Sandia (RM 198) |
| January 15, 2005 | 3 | Alameda (RM 192) | Red, anal fin | November, 2004 | Bernalillo/Sandia (RM 198) |
| January 15, 2005 | 1 | Alameda (RM 192) | Orange, anal fin | November, 2004 | Bernalillo/Sandia (RM 198) |
| January 17, 2005 | 10 | Alameda (RM 192) | Green, anal fin | November, 2004 | Bernalillo/Sandia (RM 198) |
| January 17, 2005 | 2 | Alameda (RM 192) | Orange, anal fin | November, 2004 | Bernalillo/Sandia (RM 198) |