

Rio Grande silvery minnow Rescue and Salvage – 2007



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Middle Rio Grande Endangered Species Act Collaborative Program

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Executive Summary

This report documents efforts during 2007 to reduce the mortality of post-larval Rio Grande silvery minnow (*Hybognathus amarus*) when flow in the Middle Rio Grande became intermittent. In January of 2007, New Mexico Fish and Wildlife Conservation Office (NMFWCO) assumed responsibility for salvage operations for Rio Grande silvery minnow. Initially, we formulated a new salvage protocol to more effectively manage the salvage activities. This included defining criteria for how and when we would salvage Rio Grande silvery minnow. These criteria were defined using field experience (air temperature and secondary fish health) and after reviewing tolerances of Rio Grande silvery minnow to environmental variables developed by K. Buhl, USGS Ecotoxicology Research Center in Yankton, South Dakota.

Also in 2007, we continued collaborative research efforts with Dr. Colleen Caldwell at New Mexico Cooperative Fish and Wildlife Research Unit in Las Cruces, New Mexico. This research was initiated to determine the effects of salvage and intermittency on stress and survival of Rio Grande silvery minnow. Results indicate that efforts undertaken in 2007 improved the survival of Rio Grande silvery minnow that had been subjected to poor habitat and water quality conditions during intermittency and subsequent handling during salvage.

Between 1 July and 29 October 2007, 30.0 miles of the main channel of the Middle Rio Grande were dried. Overall, flow became discontinuous in a 20.5 mile main channel segment of the San Acacia Reach and in a 9.5 mile segment of the main channel of the Isleta Reach. An estimated total of 13,953 Rio Grande silvery minnow were salvaged from isolated pools, transported, and released alive in the Middle Rio Grande in 2007. The death of 92 Rio Grande silvery minnow was attributed to water operations in the Middle Rio Grande during the 2007 irrigation season and assigned as incidental take. This level of observed incidental take was well below the legal limits established under the amended Biological Opinion of 22,242 individuals. The death of 2,902 Rio Grande silvery minnow was attributed to U.S. Fish and Wildlife Service permit activities. The implementation of a new salvage protocol in 2007 likely resulted in fewer numbers of Rio Grande silvery minnow being rescued than would have been otherwise. Cooperative work with other researchers has indicated that more definitive survival estimates for salvaged fish can be obtained when criteria are followed. These results should be available to further improve upcoming years of salvage when necessary.

Introduction

Until the 1950s, the Rio Grande silvery minnow (*Hybognathus amarus*) was distributed throughout many of the larger order streams of the Rio Grande Basin upstream of Brownsville, Texas to points in northern New Mexico primarily below 5,500 ft elevation (1,676 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, Rio Grande silvery minnow is restricted to a variably perennial reach of the Rio Grande in New Mexico, from the vicinity of Algodones 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 river miles (241 km).

Rio Grande 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 the State of 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 Rio Grande silvery minnow as a Federal endangered species with proposed critical habitat (Federal Register, 1994). In 2003, the Service designated critical habitat for Rio Grande silvery minnow in the Middle Rio Grande. The critical habitat designation extends from Cochiti Dam downstream about 157 mi (252 km) to the utility line crossing the Rio Grande in Socorro County. This location is at 4,450 feet of elevation (1,356 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 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 the Pueblos 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,” (U.S. Fish and Wildlife 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 Rio Grande silvery minnow along with the southwestern willow flycatcher (*Empidonax traillii extimus*; flycatcher) and adversely modify critical habitat of Rio Grande silvery minnow (U.S. Fish and Wildlife Service, 2003). The March 17, 2003 BO describes a Reasonable and Prudent Alternative, Reasonable and Prudent Measures, and Conservation Measures that serve in part to secure baseline conditions for Rio Grande silvery minnow and flycatcher. As part of the March 17, 2003 BO, the Service established the annual incidental take limit for Rio Grande silvery minnow for water operations in the Middle Rio Grande. That limit was amended on August 15, 2005 (U.S. Fish and Wildlife Service, 2005a), June 15, 2006 (U.S. Fish and Wildlife Service, 2006a), and April 2, 2007 (U.S. Fish and Wildlife Service, 2007) incorporating a formula that includes October standard monitoring data, habitat conditions during the spawn (spring runoff),

and augmentation. Action agencies are apprised of the limit for incidental take by April 1 each year. Estimates of incidental take in the field 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. This value was an estimated value determined by USFWS Biologists. The August 15, 2005 amendment also specified that the incidental take statement applies to Rio Grande silvery minnow greater than 30 mm standard length. The amended incidental take limit for the 2007 irrigation season was 1,112,109 and is equivalent to 22,242 Rio Grande silvery minnow that are observed dead.

This report documents efforts during 2007 to reduce the mortality of post-larval Rio Grande silvery minnow when flow in the Middle Rio Grande became intermittent. This report also discusses the effectiveness of those efforts using the permitted limit of incidental take defined in the March 17, 2003 BO (U. S. Fish and Wildlife Service, 2003) and subsequently amended on August 15, 2005 (U. S. Fish and Wildlife Service, 2005a), June 15, 2006 (U. S. Fish and Wildlife Service, 2006a), and April 2, 2007 (U. S. Fish and Wildlife Service, 2007) as the standard of performance.

Methods

The Middle Rio Grande below Cochiti Dam is designated by four divisions/reaches defined by locations of mainstream irrigation diversion dams. The Cochiti Reach extends from Cochiti Dam to Angostura Diversion Dam. The reach from Angostura Diversion Dam to Isleta Diversion Dam is called the Angostura Reach. The Isleta Reach is bounded upstream by Isleta Diversion Dam and downstream by San Acacia Diversion Dam. Finally, the reach below San Acacia Diversion Dam to the headwaters of Elephant Butte Reservoir is the San Acacia Reach.

Determination of Incidental Take

Rio Grande silvery minnow mortality can occur with channel drying resulting from excessive drought conditions, and conditions resulting from federal mediated water operations. In the recent past, intermittent conditions have existed in significant portions (e.g., up to 68.0 miles – approximately 45 percent of the Rio Grande silvery minnow’s contemporary range) of the river between Isleta Diversion Dam and Elephant Butte Reservoir. Efforts to salvage Rio Grande silvery minnow from intermittent reaches of river are intended to reduce Rio Grande silvery minnow mortality that can occur with channel drying resulting from water operations and drought conditions. In addition, salvage is meant to reduce the probability that the mortality associated with water operations will exceed the limit for incidental take.

Rio Grande silvery minnow rescue operations progressed in synchrony with river recession, with priority given to river reaches in which the death of Rio Grande silvery minnow due to federal water operations would be considered incidental take. Incidental take of post embryonic Rio Grande silvery minnow is defined for two size classes, i.e., for those shorter than or equal to 30 mm SL and those longer than 30 mm SL. All smaller sized post embryonic Rio Grande silvery minnow (≤ 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 incidental take is calculated.

Determination of incidental take of the larger size class of post embryonic Rio Grande silvery minnow (> 30 mm SL) was conditional. Mortality of the larger sized post embryonic Rio

Grande silvery minnow that occurs in portions of the river that are rewetted due to forces that are not directly or indirectly related to the operations of the Action Agencies was not considered to be incidental take under the March 17, 2003 BO (U. S. Fish and Wildlife Service, 2003). In contrast, rewetting of river reaches that were previously dried in violation of the BO and was directly or indirectly related to the operations of the Action Agencies was regarded as incidental take. Rio Grande silvery minnow mortality, involving the larger sized individuals, that occurred outside of the active river channel was generally not considered to be incidental take under the March 17, 2003 BO (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 Rio Grande silvery minnow that are “rescued” and that die in transit to relocation sites were not considered to be incidental take. Likewise Rio Grande silvery minnow that exhibited advanced clinical signs of poor health were deemed not salvageable and also (e.g., lethargy and hemorrhagic lesions) were not considered incidental take.

Rescue of Rio Grande silvery minnow

Transport tanks equipped with water-tight lids were filled with water to near capacity with water from flowing sections prior to the day's salvage. Salt (NaCl) was added to water in hauling vessels at the rate of 1.0 % NaCl solution, and Stress Coat was added at the rate of 0.26 ml/liter (1 ml/gallon) (Appendix A).

Using seines of various sizes, fish were collected from isolated pools that formed as flow in the Middle Rio Grande becomes discontinuous. Prior to handling Rio Grande silvery minnow, personnel washed their hands to remove the residue of lotions (e.g., suntan lotions and mosquito repellent). Fish were handled with care using wetted hands. Rio Grande silvery minnow that exhibited advanced clinical signs of poor health (e.g., lethargy and hemorrhagic lesions) were not salvaged. Captured Rio Grande silvery minnow were immediately placed into five-gallon buckets previously filled with transport tank water and subsequently transferred to 30-gallon transport tanks attached to utility terrain vehicles.

Pure oxygen was supplied to transport tanks through micro-bubble oxygen diffusers. The flow of oxygen was adjusted with varying water temperatures and loading rates of fish to maintain dissolved oxygen levels at or above 100% saturation. Rescued Rio Grande silvery minnow were transported to the nearest section of perennial flow within their reach of origin where live fish were released to the river. Prior to releasing Rio Grande silvery minnow into the river, water in the transport tanks was tempered (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. For each day that rescue operations were conducted, counts of the number of Rio Grande silvery minnow rescued were made.

New Criteria Salvage Protocol (2007)

Adjustments to salvage protocol and new criteria for qualifying pools for salvage were implemented in 2007 to increase the efficiency of salvage efforts and improve the effects of releasing salvaged fish on the remaining Rio Grande silvery minnow population. Interim results from recent research indicates that cumulative effects of intermittency, capture, and transport of salvaged fish result in greater physiological stress responses and lower survival compared to fish

collected from perennial areas (Caldwell et al. 2007). Therefore, the priority for salvage activities concentrated on newly (on an annual basis) intermittent stretches of river where salvage would minimize incidental take and survival of salvaged fish would be highest. The cumulative effects of intermittency may increase Rio Grande silvery minnow's susceptibility to disease as well as increase the chances of exposure to opportunistic pathogens (Caldwell et al. 2006).

Once a location was identified as a potential for salvage, a set of primary and secondary biological criteria were applied to determine whether salvage should occur. These criteria were defined using field experience (air temperature and secondary fish health) and after reviewing tolerances of Rio Grande silvery minnow to environmental variables (secondary water quality, K. Buhl, unpublished data). Documentation of conditions, incidental take (if appropriate), and preservation of individuals followed. We initially instituted a primary criterion of ambient air temperature > 34°C. We soon realized that water temperatures alone would provide a better criterion for determining salvageability and removed that criterion. The secondary (water quality and fish health observation) criteria were applied to individual isolated pools as differences in water quality and fish health vary, but if any one of these secondary criteria was exceeded for a particular isolated pool, then salvage did not occur from that pool.

Criteria for Not Salvaging

Primary	1. Ambient air temperature > 34°C (REMOVED)
Secondary (Water Quality)	1. Water temperature > 34°C 2. Dissolved Oxygen < 2.0 mg/liter 3. pH < 9.0
Secondary (Fish Health)	1. Dead fish (any species) in pool 2. Lethargy and/or hemorrhagic lesions noticed from fish (any species) in pool

In the instances where salvage was deemed necessary and feasible, every effort was made to ensure that any fish to be moved had the highest probability of survival.

Monitoring Activities

During salvage, a variety of data were collected to document the conditions at the pools, including those data necessary to determine whether or not salvage would occur. These parameters included estimated size of pool, species composition, water quality parameters, documentation of FWS permit take, and the presence of VIE-marked hatchery fish. These activities included the documentation and preservation of mortalities and/or salvaged when these pools otherwise met the criteria. Preserved specimens were returned to the lab for verification. Preserved specimens were processed similar to methods described for enumeration of incidental take.

Results

Documentation of Incidental Take of Rio Grande silvery minnow

Incidental take of Rio Grande silvery minnow (larger than 30 mm SL) that occurred as a result of water operations in the Middle Rio Grande was documented and evaluated under limitations established in the March 17, 2003 BO (U. S. Fish and Wildlife Service, 2003) and as modified on August 15, 2005 (U. S. Fish and Wildlife Service, 2005a) and June 15, 2006 (U. S. Fish and Wildlife Service, 2006a).

Channel drying resulted in the incidental take of 92 Rio Grande silvery minnow (Tables 1,2,3). This level of incidental take was below the limit established in the March 17, 2003 BO (U. S. Fish and Wildlife Service, 2003), as modified on August 15, 2005 (U. S. Fish and Wildlife Service, 2005a), June 15, 2006 (U. S. Fish and Wildlife Service, 2006a), and April 2, 2007 (U. S. Fish and Wildlife Service, 2007). Of the total amount of incidental take, 64 Rio Grande silvery minnow deaths occurred in the Isleta Reach and 28 occurred in the San Acacia Reach.

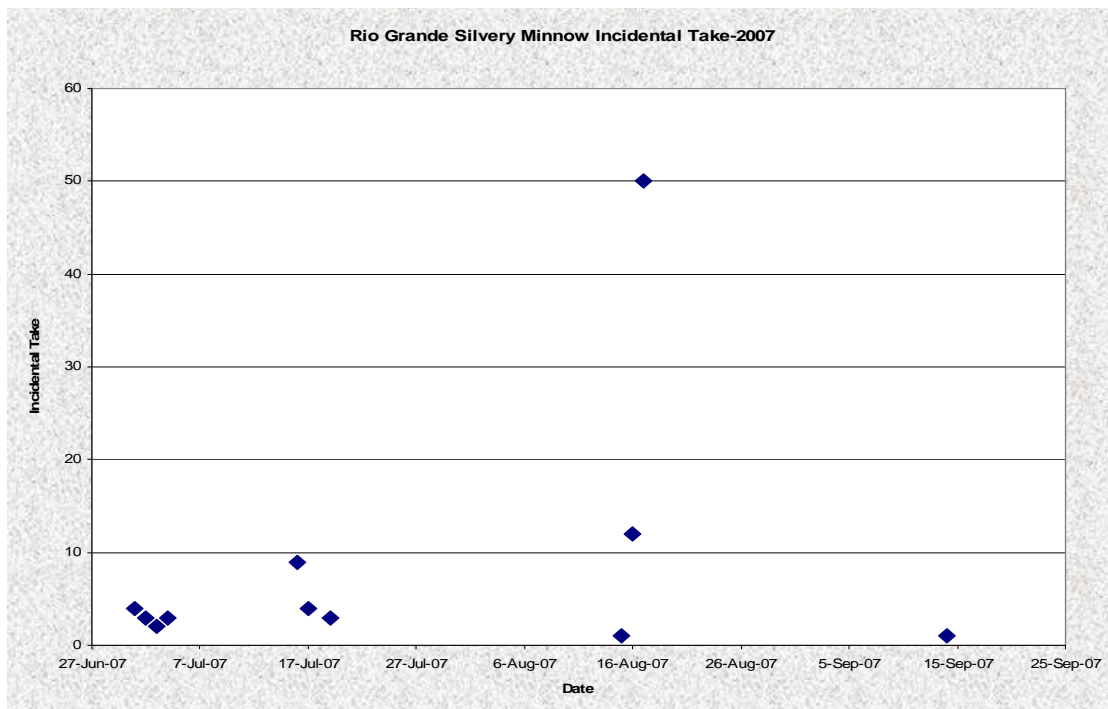


Figure 1. Chronology of Rio Grande silvery minnow incidental take during 2007.

Rescue of Rio Grande silvery minnow

Rio Grande silvery minnow rescue operations generally progressed in synchrony with river recession over the course of the 2007 irrigation season in main channel habitats. Ultimately, 30.0 miles of the main channel of the Middle Rio Grande were dried. Discontinuous main channel segments of the San Acacia Reach of the Middle Rio Grande, totaled 20.5 miles between Socorro (approximately 8.0 miles upstream of U. S. 380) and the south boundary of Bosque Del Apache Wildlife Refuge during the 2007 irrigation season. Discontinuous main channel

segments of the Isleta Reach of the Middle Rio Grande totaled 9.5 miles between points approximately 0.5 miles upstream of N. M. Highway 49 (at Los Lunas) and the Peralta Wasteway (approximately 3.0 miles upstream of N. M. Highway 6 (at Belen) during the 2007 irrigation season.

Rescue operations were conducted on 50 days during the 2007 irrigation season. Rescue operations were restricted to main channel pools during the period of 1 July 2007 to 29 October 2007 (Figure 1). In the Isleta Reach, salvage occurred between 12 August and 29 October, 2007 (Figure 2). In the San Acacia Reach, salvage occurred between 29 June and 3 October 2007 (Figure 3). Within both reaches, salvage activities occurred multiple times over the same areas. In total, 119.2 river miles were salvaged in the San Acacia and Isleta reaches from July to October (Table 4).

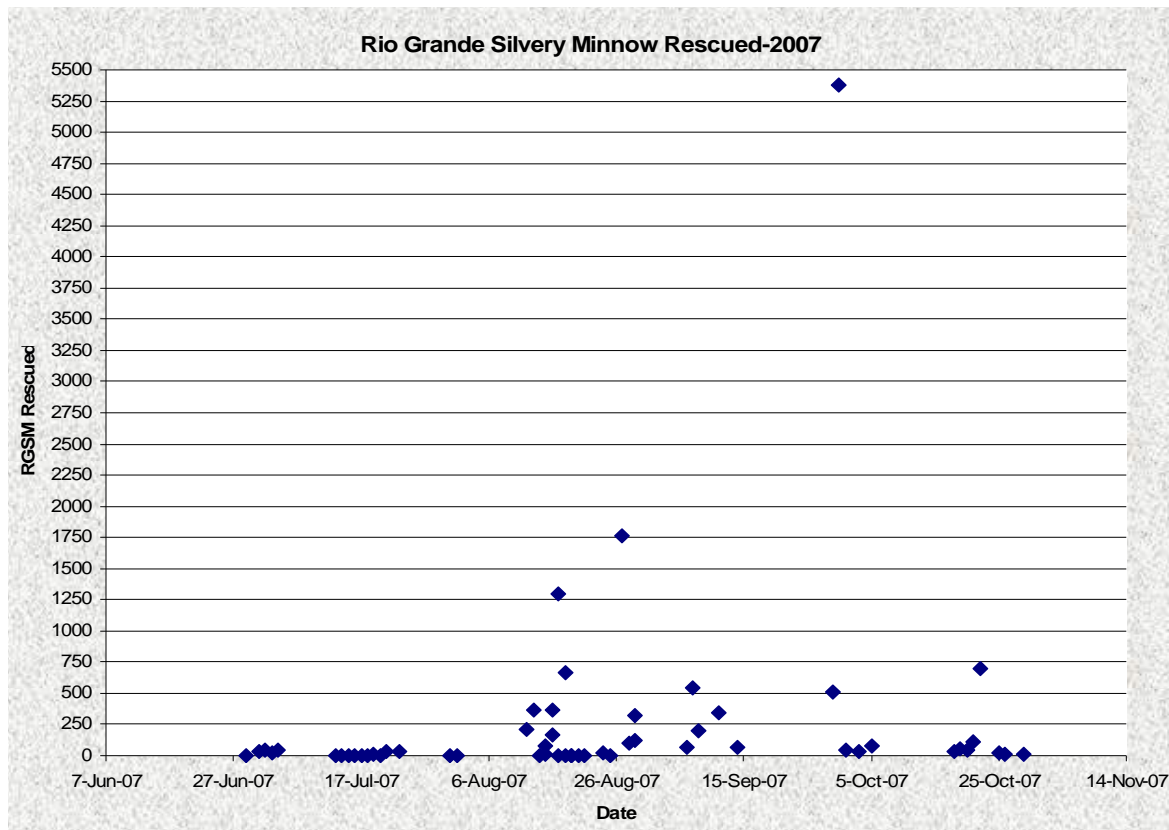


Figure 2. Chronology of Rio Grande silvery minnow rescued during 2007.

A total of 13,953 Rio Grande silvery minnow were captured in the isolated pools of the river, transported to flowing sections within the same reach and released alive. Although vastly fewer than the number of Rio Grande silvery minnow rescued during the 2005 and 2006 irrigation season (U. S. Fish and Wildlife Service 2005, 2006b), the number of rescued Rio Grande silvery minnow greatly exceeds that rescued before 2005: 12,865 during 2004, 713 during 2003, 3,662 during 2002, and 240 during 2001 (U. S. Fish and Wildlife Service, 2005b; Smith and Basham 2003; Smith and Munoz 2002; Smith 2001). The average daily longitudinal extent of aquatic habitat involved in rescue operations per day was at or below the 8.0 miles/day rate allowed in the March 17, 2003 BO; U. S. Fish and Wildlife Service, 2003), as modified on June 15, 2006 (U. S. Fish and Wildlife Service, 2006b).

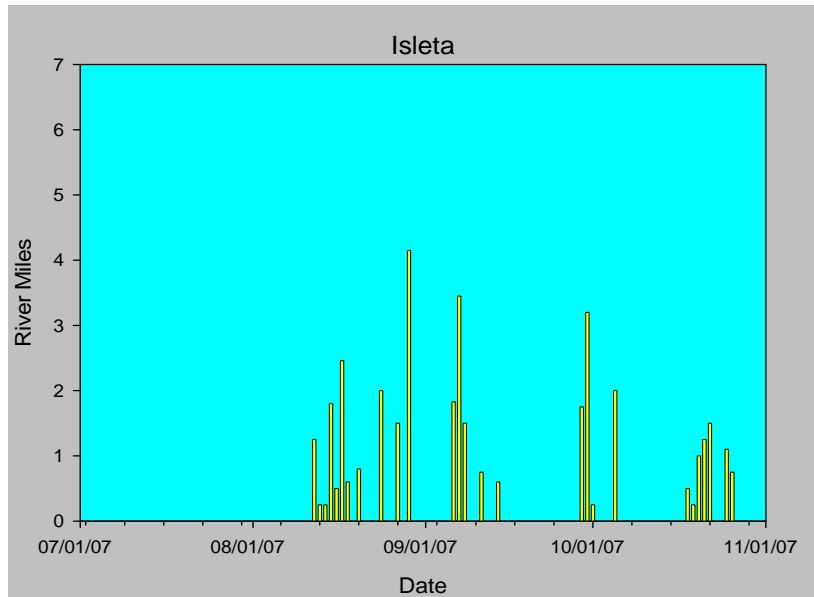


Figure 3. Daily total of river miles salvaged in Isleta Reach in 2007.

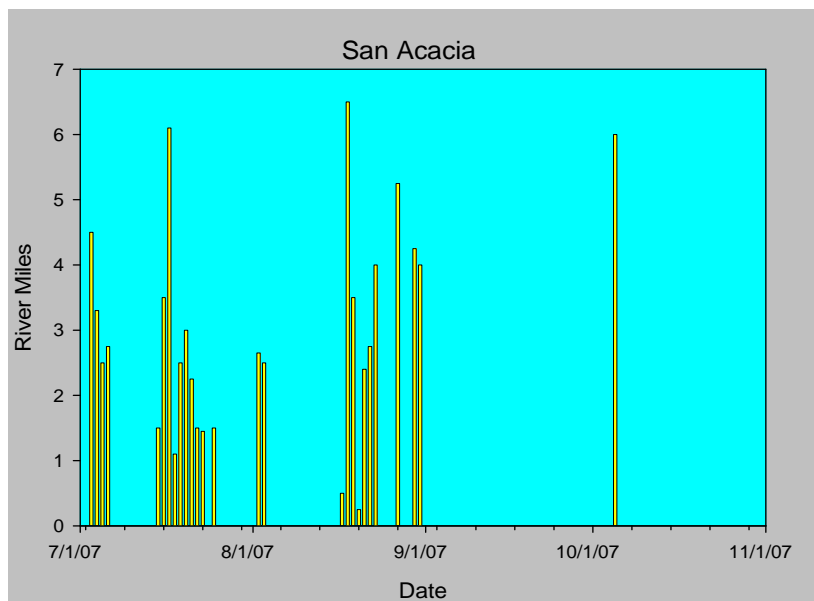


Figure 4. Daily total of river miles salvaged in San Acacia Reach in 2007.

Of the Rio Grande silvery minnow rescued during the 2007 irrigation season, 3.9% (546) Rio Grande silvery minnow were captured in the San Acacia Reach. This relates to an estimated 57.5 salvaged Rio Grande silvery minnow/ river mile dried. A total of 13,407 (96.1% of total) Rio Grande silvery minnow were captured in the Isleta Reach. This relates to an estimated 654.0 salvaged Rio Grande silvery minnow/ river mile dried, a tenfold increase over the amount observed for the San Acacia Reach. Age 1 fish represented the majority of salvaged fish in the San Acacia Reach, especially before August, afterwards Age 0 fish (3-6 months old) represented the most abundant year class in both reaches. Although densities of Rio Grande silvery minnow were likely higher in the Isleta Reach, the “difference” between reaches can further be explained by the fact that by the time we were salvaging the fish from the Isleta Reach (after 12 August

2007), the majority of Rio Grande silvery minnow had grown to over 30 mm SL and were subject to being counted. Presence of juvenile Rio Grande silvery minnow (14-25 mm SL) was documented in isolated lateral pools during initial drying on 25 June 2008. The reality is that many fish in the San Acacia Reach likely perished when drying occurred during July before reaching the minimum size of 30 mm SL to be salvaged or counted towards incidental take.

Monitoring Activities

A total of 1,053 isolated pools were surveyed during salvage. Of the isolated pools surveyed (1,053), 706 (68.2%) were actively searched for Rio Grande silvery minnow to be salvaged and 347 were not salvaged. Mean size of isolated pools was 156 m² (Min. 0.5 m², Max. 3000 m²). Mean dissolved oxygen in isolated pools was 6.5 mg/liter (Min. 0.5 mg/liter, Max. 15.5 mg/liter). Of the 347 (33.0%) not salvaged, 12 (1.1%) failed for not meeting the criterion for dissolved oxygen (> 2.0 mg/liter). Variation in dissolved oxygen in isolated pools was predictable and inversely related to the estimated size of the isolated pool (Figure 5). Low critical levels of dissolved oxygen were rarely observed and these instances were all in pools less than 800 m². Mean water temperature of isolated pools was 23.0 ° C (Min. 2.4, Max. 41.9). There were 20 (1.9%) isolated pools that exceeded the criterion for water temperature (> 34.0 °C). Mean pH values in isolated pools was 8.7 (Min. 6.5, Max. 10.8). There were 100 (9.5%) isolated pools that exceeded the criterion for pH (> 9.0) and these pools typically were less than 1000 m² (Figure 7).

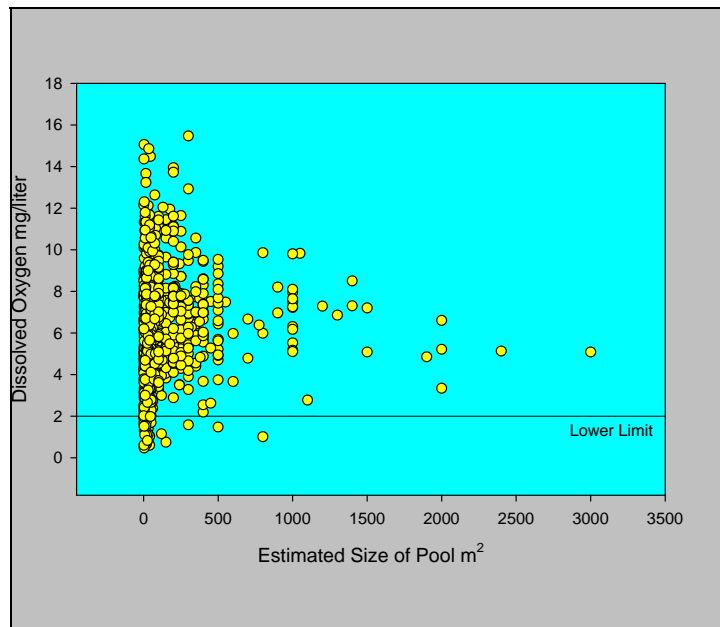


Figure 5. Dissolved oxygen of isolated pools by pool size.

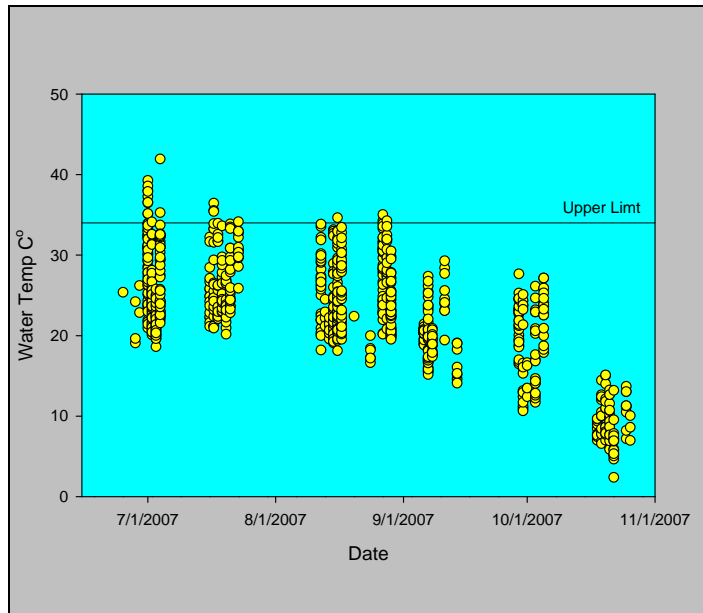


Figure 6. Water temperature of isolated pools by date salvaged.

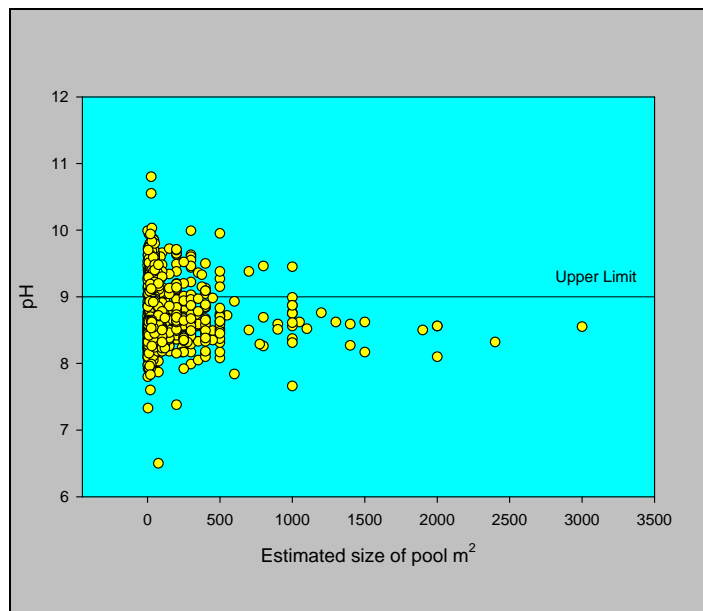


Figure 7. pH of isolated pools by estimated pool size

A total of 2,902 Rio Grande silvery minnow were counted towards the FWS permit (Tables 1,2). These individuals included those that perished between the act of salvage and when they were to be released back to the river, were preserved for salvage research, and those that were deemed not salvageable based on the criteria mentioned previously.

One hatchery-produced Rio Grande silvery minnow was encountered during salvage. This fish was distinguished by a unique visible implant elastomer mark that signified the location, date and size of the fish at the time of stocking. This fish was introduced into the Rio Grande as a

part of the Rio Grande silvery minnow augmentation program being conducted by New Mexico Fish and Wildlife Conservation Office. On August 16, 2007, one Rio Grande silvery minnow, with a yellow left dorsal mark, was captured in the Isleta Reach near Los Lunas (Collection # WJR07-681). It was recaptured at RM 156.7, 304 days after the original release (RM 126.5) 30.2 river miles upstream.

Discussion

Additionally, we were able to identify pool characteristics and seasonal timeframe that equated to better water quality conditions. Generally speaking, after September 1, in pools that maintained surface areas of over 1000 m², water quality conditions remained favorable. Unfortunately, the critical time for intermittency occurs prior to this, occasionally as early as June 15. This critical period also coincides with the early life stages of Rio Grande silvery minnow, when fish less than 30 mm SL can be present, sometimes in large numbers. These individuals are more susceptible to extreme water quality conditions and have little chance of survival if salvage is attempted and are generally left to perish.

In 2007, the adoption of a new rescue and salvage protocol allowed us to more effectively manage Rio Grande silvery minnow that are affected by intermittency. The total number of salvaged Rio Grande silvery minnow was likely lower than would have been estimated in previous years but we feel that the 2007 salvage numbers more accurately reflect the number of fish that could and were rescued. By prioritizing our efforts and the quality of fish that could be salvaged, we were able to ensure higher survival rates after fish were released back in secure sections of the river. In addition to the higher survival rates and benefit to the species achieved by our efforts, we also were able to cut down on workforce needs and expenses.

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. There were in excess of 20 people that contributed directly to the rescue effort, notably including personnel associated with the U.S. Fish and Wildlife Service, the U. S. Bureau of Reclamation, and the U.S. Army Corps of Engineers. The contributions of everyone are greatly appreciated. Success in Rio Grande silvery minnow operations during 2007 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 rescue operations, and represented the core of the rescue workforce, including LeeAnna Torres, Thomas Archdeacon, Tammy Knecht, Weston Furr, Stephanie Coleman, James Sandoval, Casey Smith, Evan Anderson, Dustin Myers, Jeanette Grode, Andrew Farwick, and Bethany Gray. We would also like to acknowledge personnel from the New Mexico Ecological Services Field Office including Michelle Cummer, Maseo Martinet, and Jennifer Parody for field assistance and support. Field assistance was provided by Army Corps of Engineers staff including Champe Green, Don Gallegos, Sarah Gallegos, Justin Reale, and Phillip Alarcon. Others volunteering and assisting included Tristan Austring, Zachary Simpson, Dr. Colleen Caldwell, SungJin Cho and Gregory Pargas. Special thanks to personnel from Bosque Del Apache National Wildlife Refuge for providing housing and logistical support.

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Table 1. Results from Rio Grande silvery minnow rescue operations in 2007.

Rio Grande silvery minnow

Summary of 2007 Rescue Operations

(Perspective Emphasizing Longitudinal Position)

<i>Date</i>	<i>Lateral Position</i>	<i>Distance Worked (River Mi.)</i>	<i>Rescued</i>	<i>RGSM FATES</i>	
				<i>FWS Permit</i>	<i>Main Channel Mortality (Incidental Take)</i>
<i>Isleta Reach</i>					
<i>Isleta-Peralta Wasteway</i>					
<i>(Approx. 9.5 River Miles Dried) 0.5 miles North of NM Highway 49 (Los Lunas) to 3.0 miles North of NM Highway 6 (Belen)</i>					
12-Aug-2007	Main Channel		215	18	0
13-Aug-2007	Main Channel		369	50	0
14-Aug-2007	Main Channel		0	4	0
15-Aug-2007	Main Channel		81	40	1
16-Aug-2007	Main Channel		368	28	12
17-Aug-2007	Main Channel		1295	7	50
18-Aug-2007	Main Channel		663	1	0
19-Aug-2007	Main Channel		3	11	0
20-Aug-2007	Main Channel		0	25	0
21-Aug-2007	Main Channel		0	146	0
24-Aug-2007	Main Channel		20	4	0
27-Aug-2007	Main Channel		1765	757	0
28-Aug-2007	Main Channel		99	10	0
29-Aug-2007	Main Channel		321	2	0
6-Sept-2007	Main Channel		72	4	0
7-Sept-2007	Main Channel		545	12	0
8-Sept-2007	Main Channel		198	14	0
11-Sept-2007	Main Channel		344	0	0
14-Sept-2007	Main Channel		61	0	1
29-Sept-2007	Main Channel		511	0	0

30-Sept-2007	Main Channel	5376	1074	0
1-Oct-2007	Main Channel	39	0	0
5-Oct-2007	Main Channel	81	1	0
18-Oct-2007	Main Channel	35	35	0
19-Oct-2007	Main Channel	59	6	0
20-Oct-2007	Main Channel	47	2	0
21-Oct-2007	Main Channel	106	0	0
22-Oct-2007	Main Channel	695	5	0
25-Oct-2007	Main Channel	23	0	0
26-Oct-2007	Main Channel	7	0	0
29-Oct-2007	Main Channel	9	0	0

Descriptive Statistics for the Isleta Reach (9.5 River Miles):

Subtotals:	9.5	13407	2256	64
Rescued RGSM / River Mile Worked:		1411.26		

RGSM FATES

<i>Date</i>	<i>Lateral Position</i>	<i>Distance Worked (River Mi.)</i>	<i>Rescued</i>	<i>FWS Permit</i>	<i>Main Channel Mortality (Incidental Take)</i>
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San Acacia Reach

San Acacia – South Boundary Reach

(Approx. 20.5 River Miles Dried) 8.0 miles north of US 380 (near Socorro) to the South Boundary of Bosque Del Apache Wildlife Refuge

29-Jun-2007	Main Channel	2	0	0
1-July-2007	Main Channel	30	0	4
2-July-2007	Main Channel	42	1	3
3-July-2007	Main Channel	23	2	3
4-July-2007	Main Channel	42	36	2
13-July-2007	Main Channel	3	0	3
14-July-2007	Main Channel	0	34	0
15-July-2007	Main Channel	0	3	0

16-July-2007	Main Channel	0	33	9
17-July-2007	Main Channel	0	14	4
18-July-2007	Main Channel	0	25	0
19-July-2007	Main Channel	7	42	3
20-July-2007	Main Channel	0	30	0
21-July-2007	Main Channel	33	1	0
23-July-2007	Main Channel	33	1	0
31-July-2007	Main Channel	0	1	0
1-Aug-2007	Main Channel	0	15	0
15-Aug-2007	Main Channel	15	0	0
16-Aug-2007	Main Channel	161	3	0
17-Aug-2007	Main Channel	0	92	0
18-Aug-2007	Main Channel	0	31	0
19-Aug-2007	Main Channel	0	97	0
25-Aug-2007	Main Channel	0	172	0
29-Aug-2007	Main Channel	127	7	0
3-Oct-2007	Main Channel	28	6	0

Descriptive Statistics for the San Acacia-South

Boundary Bosque Del Apache Reach (20.5 River Miles):

Subtotals: 20.5 546 646 28

Rescued RGSM / River Mile Worked: 26.6

Descriptive Statistics for All Areas:

Grand Totals: 30.0 13953 2902 92

Rescued RGSM / River Mile Worked: 465.1

Table 2. Chronological Order of Rio Grande silvery minnow Salvage 2007

Note: FWS permit includes those found dead that could not be attributed to Incidental Take including fish not salvaged due to health criteria, those sacrificed for research, or died prior to release.

29 June 2007	San Acacia Reach	WJR07-669
Rio Grande silvery minnow – Salvaged		2
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		0
1 July 2007	San Acacia Reach	WJR07-670
Rio Grande silvery minnow – Salvaged		30
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		4
2 July 2007	San Acacia Reach	WJR07-671
Rio Grande silvery minnow – Salvaged		42
Rio Grande silvery minnow – FWS permit		1
Rio Grande silvery minnow – Incidental Take		3
3 July 2007	San Acacia Reach	WJR07-672
Rio Grande silvery minnow – Salvaged		23
Rio Grande silvery minnow – FWS permit		2
Rio Grande silvery minnow – Incidental Take		2
4 July 2007	San Acacia Reach	TPA07-001
Rio Grande silvery minnow – Salvaged		42
Rio Grande silvery minnow – FWS permit		36
Rio Grande silvery minnow – Incidental Take		3
13 July 2007	San Acacia Reach	FRO07-001
Rio Grande silvery minnow – Salvaged		3
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		0
14 July 2007	San Acacia Reach	FRO07-002
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		34
Rio Grande silvery minnow – Incidental Take		0
15 July 2007	San Acacia Reach	FRO07-003
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		3
Rio Grande silvery minnow – Incidental Take		0

16 July 2007	San Acacia Reach	WJR07-675
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		33
Rio Grande silvery minnow – Incidental Take		9
17 July 2007	San Acacia Reach	FRO07-004
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		14
Rio Grande silvery minnow – Incidental Take		4
18 July 2007	San Acacia Reach	FRO07-005
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		25
Rio Grande silvery minnow – Incidental Take		0
19 July 2007	San Acacia Reach	WJR07-676
Rio Grande silvery minnow – Salvaged		7
Rio Grande silvery minnow – FWS permit		42
Rio Grande silvery minnow – Incidental Take		3
20 July 2007	San Acacia Reach	FRO07-006
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		30
Rio Grande silvery minnow – Incidental Take		0
21 July 2007	San Acacia Reach	FRO07-007
Rio Grande silvery minnow – Salvaged		33
Rio Grande silvery minnow – FWS permit		1
Rio Grande silvery minnow – Incidental Take		0
23 July 2007	San Acacia Reach	FRO07-008
Rio Grande silvery minnow – Salvaged		33
Rio Grande silvery minnow – FWS permit		1
Rio Grande silvery minnow – Incidental Take		0
31 July 2007	San Acacia Reach	FRO07-009
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		1
Rio Grande silvery minnow – Incidental Take		0
1 August 2007	San Acacia Reach	FRO07-010
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		15
Rio Grande silvery minnow – Incidental Take		0

12 August 2007	Isleta Reach	WJR07-677
Rio Grande silvery minnow – Salvaged		215
Rio Grande silvery minnow – FWS permit		18
Rio Grande silvery minnow – Incidental Take		0
13 August 2007	Isleta Reach	WJR07-678
Rio Grande silvery minnow – Salvaged		369
Rio Grande silvery minnow – FWS permit		50
Rio Grande silvery minnow – Incidental Take		0
14 August 2007	Isleta Reach	WJR07-678
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		4
Rio Grande silvery minnow – Incidental Take		0
15 August 2007	Isleta Reach	WJR07-679
Rio Grande silvery minnow – Salvaged		81
Rio Grande silvery minnow – FWS permit		40
Rio Grande silvery minnow – Incidental Take		1
15 August 2007	San Acacia Reach	BAG07-001
Rio Grande silvery minnow – Salvaged		15
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		0
16 August 2007	Isleta Reach	WJR07-680
Rio Grande silvery minnow – Salvaged		368
Rio Grande silvery minnow – FWS permit		28
Rio Grande silvery minnow – Incidental Take		12
16 August 2007	San Acacia Reach	BAG07-001
Rio Grande silvery minnow – Salvaged		161
Rio Grande silvery minnow – FWS permit		3
Rio Grande silvery minnow – Incidental Take		0
17 August 2007	San Acacia Reach	BAG07-003
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		92
Rio Grande silvery minnow – Incidental Take		0
17 August 2007	Isleta Reach	WJR07-681
Rio Grande silvery minnow – Salvaged		1295
Rio Grande silvery minnow – FWS permit		7
Rio Grande silvery minnow – Incidental Take		50

18 August 2007	San Acacia Reach	WJR07-682
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		31
Rio Grande silvery minnow – Incidental Take		0
18 August 2007	Isleta Reach	WJR07-682
Rio Grande silvery minnow – Salvaged		663
Rio Grande silvery minnow – FWS permit		1
Rio Grande silvery minnow – Incidental Take		0
19 August 2007	Socorro Reach	FRO07-011
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		97
Rio Grande silvery minnow – Incidental Take		0
20 August 2007	Isleta Reach	FRO07-012
Rio Grande silvery minnow – Salvaged		3
Rio Grande silvery minnow – FWS permit		11
Rio Grande silvery minnow – Incidental Take		0
20 August 2007	Isleta Reach	FRO07-013
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		25
Rio Grande silvery minnow – Incidental Take		0
21 August 2007	Isleta Reach	FRO07-014
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		146
Rio Grande silvery minnow – Incidental Take		0
24 August 2007	Isleta Reach	FRO07-015
Rio Grande silvery minnow – Salvaged		20
Rio Grande silvery minnow – FWS permit		4
Rio Grande silvery minnow – Incidental Take		0
25 August 2007	Socorro Reach	FRO07-016
Rio Grande silvery minnow – Salvaged		0
Rio Grande silvery minnow – FWS permit		172
Rio Grande silvery minnow – Incidental Take		0
27 August 2007	Isleta Reach	FRO07-017
Rio Grande silvery minnow – Salvaged		1765
Rio Grande silvery minnow – FWS permit		757
Rio Grande silvery minnow – Incidental Take		0

28 August 2007	Isleta Reach	FRO07-018
Rio Grande silvery minnow – Salvaged		99
Rio Grande silvery minnow – FWS permit		10
Rio Grande silvery minnow – Incidental Take		0
29 August 2007	Isleta Reach	FRO07-019
Rio Grande silvery minnow – Salvaged		321
Rio Grande silvery minnow – FWS permit		2
Rio Grande silvery minnow – Incidental Take		0
29 August 2007	San Acacia Reach	FRO07-020
Rio Grande silvery minnow – Salvaged		127
Rio Grande silvery minnow – FWS permit		7
Rio Grande silvery minnow – Incidental Take		0
6 September 2007	Isleta Reach	FRO07-021
Rio Grande silvery minnow – Salvaged		72
Rio Grande silvery minnow – FWS permit		4
Rio Grande silvery minnow – Incidental Take		0
7 September 2007	Isleta Reach	FRO07-022
Rio Grande silvery minnow – Salvaged		545
Rio Grande silvery minnow – FWS permit		12
Rio Grande silvery minnow – Incidental Take		0
8 September 2007	Isleta Reach	FRO07-023
Rio Grande silvery minnow – Salvaged		198
Rio Grande silvery minnow – FWS permit		14
Rio Grande silvery minnow – Incidental Take		0
11 September 2007	Isleta Reach	FRO07-024
Rio Grande silvery minnow – Salvaged		344
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		0
14 September 2007	Isleta Reach	FRO07-025
Rio Grande silvery minnow – Salvaged		61
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		1
29 September 2007	Isleta Reach	FRO07-026
Rio Grande silvery minnow – Salvaged		511
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		0

30 September 2007	Isleta Reach	FRO07-027
Rio Grande silvery minnow – Salvaged		5376
Rio Grande silvery minnow – FWS permit		1074
Rio Grande silvery minnow – Incidental Take		0
1 October 2007	Isleta Reach	FRO07-028
Rio Grande silvery minnow – Salvaged		39
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		0
3 October 2007	San Acacia Reach	FRO07-029
Rio Grande silvery minnow – Salvaged		28
Rio Grande silvery minnow – FWS permit		6
Rio Grande silvery minnow – Incidental Take		0
5 October 2007	Isleta Reach	FRO07-030
Rio Grande silvery minnow – Salvaged		81
Rio Grande silvery minnow – FWS permit		1
Rio Grande silvery minnow – Incidental Take		0
18 October 2007	Isleta Reach	FRO07-031
Rio Grande silvery minnow – Salvaged		35
Rio Grande silvery minnow – FWS permit		35
Rio Grande silvery minnow – Incidental Take		0
19 October 2007	Isleta Reach	FRO07-032
Rio Grande silvery minnow – Salvaged		59
Rio Grande silvery minnow – FWS permit		6
Rio Grande silvery minnow – Incidental Take		0
20 October 2007	Isleta Reach	FRO07-033
Rio Grande silvery minnow – Salvaged		47
Rio Grande silvery minnow – FWS permit		2
Rio Grande silvery minnow – Incidental Take		0
21 October 2007	Isleta Reach	FRO07-034
Rio Grande silvery minnow – Salvaged		106
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		0
22 October 2007	Isleta Reach	FRO07-035
Rio Grande silvery minnow – Salvaged		695
Rio Grande silvery minnow – FWS permit		5
Rio Grande silvery minnow – Incidental Take		0

25 October 2007	Isleta Reach	FRO07-036
Rio Grande silvery minnow – Salvaged		23
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		0
26 October 2007	Isleta Reach	FRO07-037
Rio Grande silvery minnow – Salvaged		7
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		0
29 October 2007	Isleta Reach	FRO07-038
Rio Grande silvery minnow – Salvaged		9
Rio Grande silvery minnow – FWS permit		0
Rio Grande silvery minnow – Incidental Take		0
29 June – 29 October	Rio Grande	2007 Totals
Rio Grande silvery minnow – Salvaged		13,953
Rio Grande silvery minnow – FWS permit		2,902
Rio Grande silvery minnow – Incidental Take		92

Table 3. Summary of Rio Grande silvery minnow Incidental Take in 2007.

Rio Grande silvery minnow

Summary of 2007 Incidental Take

<i>Date</i>	<i>Reach</i>	<i>Main Channel Mortality (Incidental Take)</i>	<i>Percent of Total</i>	<i>Incidental Take Running Sum Over Time</i>	<i>Percent of Total</i>
01-Jul-2007	San Acacia	4	4.34	4	4.3
02-Jul-2007	San Acacia	3	3.26	7	7.6
03-Jul-2007	San Acacia	2	2.17	9	9.7
04-Jul-2007	San Acacia	3	3.26	12	13.0
16-Jul-2007	San Acacia	9	9.78	21	22.8
17-Jul-2007	San Acacia	4	4.34	25	27.2
19-Jul-2007	San Acacia	3	3.26	28	30.4
15-Aug-2007	Isleta	1	1.08	29	31.5
16-Aug-2007	Isleta	12	13.0	41	44.6
17-Aug-2007	Isleta	50	54.3	91	98.9
14-Sept-2007	Isleta	1	1.08	92	100

Total incidental take = 92

Table 4. Summary of River Miles worked by month in 2007.

<i>Date</i>	<i>Reach</i>	<i>Way Points</i>	<i>River Miles Worked</i>	<i>Distance Worked (Riv. Mi.)</i>	<i>Total River Miles</i>
<i>July-Salvage</i>					
01-Jul-2007	San Acacia	816-871	74.00-78.50	4.5	4.50
02-Jul-2007	San Acacia	873-918	78.50-81.80	3.3	7.80
03-Jul-2007	San Acacia	919-950	82.00-84.50	2.5	10.30
04-Jul-2007	San Acacia	952-996	84.50-87.25	2.75	13.05
13-Jul-2007	San Acacia	004-013	74.75-76.25	1.50	14.55
14-Jul-2007	San Acacia	014-071	76.25-79.75	3.50	18.05
15-Jul-2007	San Acacia	072-101	81.00-87.10	6.1	24.15
16-Jul-2007	San Acacia	103-118	87.30-88.40	1.10	25.25
17-Jul-2007	San Acacia	119-134	89.00-91.50	2.5	27.75
18-Jul-2007	San Acacia	135-145	90.25-93.25	3.0	30.75
19-Jul-2007	San Acacia	146-161	91.00-93.25	2.25	33.00
20-Jul-2007	San Acacia	162-178	93.50-95.00	1.50	34.50
21-Jul-2007	San Acacia	179-199	96.75-95.30	1.45	35.95
23-Jul-2007	San Acacia	200-213	96.80-98.30	1.50	37.45
31-Jul-2007	San Acacia	214-223	74.75-77.40	2.65	40.10

<i>Date</i>	<i>Reach</i>	<i>Way Points</i>	<i>River Miles</i>		
			<i>River Miles Worked</i>	<i>Distance Worked (Riv. Mi.)</i>	<i>Total River Miles</i>
<i>August-Salvage</i>					
01-Aug-2007	San Acacia	003-033	77.50-80.00	2.50	2.50
12-Aug-2007	Isleta	001-029	152.75-154.0	1.25	3.75
13-Aug-2007	Isleta	030-032	154.0-154.25	0.25	4.00
14-Aug-2007	Isleta	033-036	154.25-155.8	0.25	4.25
15-Aug-2007	San Acacia	M1-M4 (34-36)	90.00-90.50	0.50	4.75
15-Aug-2007	Isleta	037-072	154.0-155.8	1.80	6.55
16-Aug-2007	Isleta	073-112	160.9-161.4	0.50	7.05
16-Aug-2007	San Acacia	087-L39	98.0-104.50	6.50	13.55
17-Aug-2007	San Acacia	M05-M11	91.00-94.50	3.50	17.05
17-Aug-2007	Isleta	115-153	161.4-162.0	2.46	19.51
18-Aug-2007	San Acacia	M12-M15	90.00-89.75	0.25	19.76
18-Aug-2007	Isleta	154-157	161.4-162.0	0.60	20.36
19-Aug-2007	San Acacia	046-054	86.60-89.00	2.40	22.76
20-Aug-2007	Isleta	159-167	160.6-161.40	0.80	23.56
20-Aug-2007	San Acacia	M17-M23	76.76-79.50	2.75	26.31
21-Aug-2007	San Acacia	M24-M32	80.00-84.00	4.00	30.31
24-Aug-2007	Isleta	168-173	152.75-154.75	2.00	32.31
25-Aug-2007	San Acacia	174-201	74.00-79.25	5.25	37.56
27-Aug-2007	Isleta	203-245	152.75-154.25	1.50	39.06
28-Aug-2007	San Acacia	247-265	79.00-83.00	4.00	43.06
29-Aug-2007	Isleta	266-291	154.25-158.4	4.15	47.21
29-Aug-2007	San Acacia	059-075	84.75-89.00	4.25	51.46

<i>Date</i>	<i>Reach</i>	<i>Way Points</i>	<i>River Miles</i>		
			<i>River Miles Worked</i>	<i>Distance Worked (Riv. Mi.)</i>	<i>Total River Miles</i>
September-Salvage					
06-Sept-2007	Isleta	292-318	152.75-154.0	1.83	1.83
07-Sept-2007	Isleta	320-322	154.0-154.25	3.45	5.28
08-Sept-2007	Isleta	061-117	154.25-155.8	1.50	6.78
11-Sept-2007	Isleta	002-019	154.0-155.8	0.75	7.53
14-Sept-2007	Isleta	030-037	160.9-161.4	0.60	8.13
29-Sept-2007	Isleta	038-067	98.0-104.50	1.75	9.88
30-Sept-2007	Isleta	068-085	91.00-94.50	3.20	13.08

<i>Date</i>	<i>Reach</i>	<i>Way Points</i>	<i>River Miles</i>		
			<i>River Miles Worked</i>	<i>Distance Worked (Riv. Mi.)</i>	<i>Total River Miles</i>
September-Salvage					
01-Oct-2007	Isleta	087-091	156.25-156.5	0.25	0.25
03-Oct-2007	San Acacia	076-097	74.00-80.00	6.00	6.25
05-Oct-2007	Isleta	100-118	156.0-158.0	2.00	8.25
18-Oct-2007	Isleta	092-101	155.5-156.0	0.50	8.75
19-Oct-2007	Isleta	102-115	156.5-157.5	1.00	9.75
20-Oct-2007	Isleta	116-129	157.25-158.5	1.25	11.00
21-Oct-2007	Isleta	128-145	158.5-160.0	1.50	12.50
22-Oct-2007	Isleta	146-160	160.1-161.0	1.10	13.60
25-Oct-2007	Isleta	161-171	157.5-158.25	0.75	14.35
26-Oct-2007	Isleta	172-174	158.25-158.5	0.25	14.60

Descriptive Statistics for the Entire San Acacia Reach:

<i>River Mile Subtotals:</i>	<i>July</i>	<i>August</i>	<i>September</i>	<i>October</i>
	40.10	35.90	0.00	6.00
<i>Total River Mile Worked:</i>	82.00			

Descriptive Statistics for the Entire Isleta Reach:

<i>River Mile Subtotals:</i>	<i>July</i>	<i>August</i>	<i>September</i>	<i>October</i>
	0.00	15.56	13.08	8.60
<i>Total River Mile Worked:</i>	37.24			

Descriptive Statistics for All Areas:

<i>Grand Totals:</i>	40.10	51.46	13.08	14.60
<u><i>Total River Mile Worked:</i></u>	119.24			

Appendix A. Water Conditioning Formulations for Transport Tanks

Water Conditioning Formulations for Transport Tanks

Large Transport Tank:

Each half holds 211.2 liters (55.80 gallons) of water.

To render this volume a 1.00 percent salt solution requires 2,112 grams (2.1 kg) of NaCl, which volumetrically equals about 1.50 cups.

The prescribed amount of stress coat is 0.26 ml/liter (1.00 ml/gallon), with 56.00 ml (or approximately 0.25 cups) of stress coat added to each half of the large tank.

Optimal fish density for 211.2 liters @ 10 g/liter = 2,112 g. 4,000 young-of-year (35 mm TL = 0.5 g), or 700 adult (65 mm TL = 3.0 g)

Small Transport Tank:

The tank holds 138.2 liters (36.50 gallons) of water.

To render this volume a 1.00 percent salt solution requires 1,382 grams (1.4 kg) of NaCl, which volumetrically equals about 0.66 cups.

The prescribed amount of stress coat is 0.26 ml/liters (1 ml/gallon) and 36.00 ml (or approximately 0.12 cups) of stress coat will be added to the small tank.

Optimal fish density for 138.2 liters @ 10 grams/liters = 1,382 g. 2750 young-of-year (35 mm TL = 0.5 g), or 450 adult (65 mm TL = 3.0 g)

Bags:

Bags will be filled with river water to approximately 0.66 of bag capacity (approximately 3.00 liters; 0.80 gallons).

To render this volume a 1.00 percent salt solution requires 30.00 grams of NaCl, which volumetrically equals about 2.66 teaspoons.

The prescribed amount of stress coat is 0.26 ml/liter (1.00 ml/gallon) and 1.00 ml of stress coat will be added to each bag.

Optimal fish density for 3 liters @ 10 grams/liter = 30 g. 60 young-of-year (35 mm TL = 0.5 g), or 10 adult (65 mm TL = 3.0 g)