United States Department of the Interior

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September 23, 2008

Cons. # 22420-2008-F-145

Memorandum

To: Area Manager, Albuquerque Area Office, U.S. Bureau of Reclamation, Albuquerque, New Mexico

From: Field Supervisor, U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, Albuquerque, New Mexico

Subject: U.S. Fish and Wildlife Service's Biological Opinion on the Effects of Actions Associated with the Rio Grande Sediment Plug Removal Project at Bosque del Apache National Wildlife Refuge

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion on the effects of the proposed sediment plug removal project (project) at Bosque del Apache National Wildlife Refuge (BdA). The project area begins at river mile (RM) 81 and continues upstream approximately 2 miles. This biological opinion concerns the effects of the proposed action on the endangered Rio Grande silvery minnow (*Hybognathus amarus*) (silvery minnow), and its designated critical habitat, and the endangered southwestern willow flycatcher (*Empidonax traillii extimus*) (flycatcher). Your request for formal consultation, in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 531 *et seq.*) was received on August 20, 2008.

This biological opinion is based on determinations made in your cover letter for the Biological Assessment for the project, information submitted in the August, 2008, "Rio Grande Sediment Plug Removal at Bosque del Apache National Wildlife Refuge Biological Assessment" (BA), meetings between Reclamation and the Service, supplemental information provided via e-mail, and other sources of information available to the Service. A complete administrative record of this consultation is on file at the Service's New Mexico Ecological Services Field Office (NMESFO).

Flycatcher

You have determined that the proposed project may affect, is not likely to adversely affect, the southwestern willow flycatcher. We concur with this determination for the following reasons:

- Vegetation clearing and construction of the access road will occur outside the nesting season (May to September 15) and will be located such that the smallest amount of potentially-suitable flycatcher habitat will be affected.
- The access road will be located >1/4 mile south of the existing flycatcher nests from the existing levee to the plugged river.
- Clearing of a narrow linear strip of vegetation, 25 to 40 feet wide, along the levee, to the west of the river, will occur at least 500 feet from the flycatcher nest on the west side of the Rio Grande.

Diversion of water to the western floodplain in the area of the sediment plug may indirectly affect flycatcher habitat. In the short term, it may temporarily improve the health of the riparian vegetation and allow for seedling dispersal and recruitment of new vegetation. Over time, however, once the sediment plug is removed, this area may receive less frequent and shorter duration overbanking events than it did while the plug was in place. These effects are considered insignificant (unlikely to cause take) for the following reasons:

- The immediate action area does not currently support flycatcher territories
- Reclamation does not anticipate channel degradation in this reach
- We anticipate that groundwater connectivity will be sufficient to support riparian vegetation
- Overbanking is expected to occur at flows similar to those that caused overbanking pre-plug

Additionally, in their BA, Reclamation has made a commitment to long-term solutions to sediment plug formation and associated effects of removing the plug (Phase III, Reclamation, 2008). The Service has every expectation that protection and restoration of flycatcher habitat will occur as a result of Phase III.

Consultation History
The Service, Reclamation and other interested parties met on August 6, 2008, to discuss the proposed action, implementation strategies, and opportunities for long-term solutions in the Socorro reach. A final BA was received on August 20, 2008. A draft BO was provided to Bosque del Apache and Reclamation on September 12, 2008. This BO is tiered off the 2003 Biological and Conference Opinions on the Effects of the Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande (March 2003 BO).

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION
The BA contains a comprehensive description of the purpose and need for the proposed action, details on the project, a description of the environmental commitments, and effects determination for listed species and critical habitat. The following description of the proposed action is a summary of the material in the biological assessment and should not be considered the complete description.

Overview
During the 2008 spring runoff a sediment plug formed in the main channel of the Rio Grande at River Mile 81, within the BdA, forcing flows in the river to the east and west floodplain. The plug was first identified during a river flight on May 17, and growth of the plug continued during the remainder of the runoff, with the length requiring removal now estimated at more than 2 miles.

Review of available data indicates that current conditions throughout the general reach of river through BdA are conducive to sediment plug formation, and that the problem is not confined to the location where this plug formed. Therefore, a thorough analysis of conditions and alternatives is warranted and a multi-phase approach will be taken with the project, starting with a short-term solution that will focus on removal of the plug and which can be implemented quickly. Work will also begin on a long-term solution for addressing sediment plugs within this general reach of the river. The following project phasing is anticipated:

The proposed project has four distinct phases:

1. Phase I(a) – Pilot Channel: Excavation of a 25-foot wide pilot channel through approximately 2 to 3.5 miles of sediment plug. Work is expected to be conducted between September 15, 2008 and October 31, 2008 due to BdA migratory bird restrictions beginning on November 1, 2008.

2. Phase I(b) – Hauling & Levee Improvements: Hauling of material excavated for the pilot channel to the levee and construction of embankment for widening and raising 1 to 2 miles of levee. Work is anticipated to begin at the end of BdA migratory bird restrictions (March 1, 2009), and must be completed prior to the start of the spring runoff or by May 1, 2009 due to flycatcher restrictions.

3. Phase II – Pilot Channel Monitoring: Each year, after the spring runoff, Reclamation will conduct an inspection of the pilot channel to assess the progress that the river has made toward widening the channel to the original (pre-sediment plug) width. If, after at least two runoffs, the progress made by the river in widening the pilot channel is unacceptable, then Reclamation will perform additional excavation to remove the remaining sediment plug material and haul the material to the levee.

4. Phase III – Long-term Solution: Complete analysis of conditions that may contribute to sediment plug formation within the general reach of river within the BdA, development of several potential alternatives, and implementation of the selected alternative. Realignment of the river to the east will be given consideration as a potential alternative.

This consultation focuses only on the Phase I work. For Phases II and III, Reclamation will consult with the Service as appropriate.

Project Description
Excavation of the pilot channel is viewed as a short-term solution. The extent of the Phase I work is difficult to predict because of the potential for additional sediment plug growth in the

upstream direction prior to the start of the work. The current best estimate of the length of pilot channel required to reconnect the river is 2.2 miles, but it is possible that estimates of the upstream growth may prove to be low and the required length of pilot channel could be up to 3.5 miles. For this consultation, discussions generally assume a length of 2.2 miles, unless otherwise noted, and this length is used for "anticipated" quantities. The length of 3.5 miles is used for "maximum" quantities.

The general concept for Phase I is to excavate a pilot channel through the sediment plug as Phase I(a). The pilot channel will be located on the far east side of the plugged river channel and excavated material will be placed in a spoil berm along the west side of the pilot channel. Several months after completion of Phase I(a), material from the spoil berms will be hauled to the levee to the west of the river (Low Flow Conveyance Channel levee) and used to raise and widen 1 to 2 miles of the levee. This levee work will be Phase I(b), and waiting several months between pilot channel excavation and levee improvements will allow drying of the western floodplain, which will minimize the need for haul road improvements. Although unlikely, it is also possible that floodplain conditions will permit hauling some or all of the excavated pilot channel material to the levee in conjunction with the Phase I(a) work.

Vegetation Removal

Phase I(a) work will require clearing of vegetation to provide an access route for the amphibious excavators. The access route will be approximately 1,500 feet south of rangeline SO-1539. The alignment was selected to minimize removal of mature native trees. The location may be adjusted by approximately 100 feet, to the north or south, for the purpose of avoiding native trees. The width of clearing will be 30 feet and the length approximately 875 feet.

Diversion of River and Pilot Channel Excavation

The pilot channel will be excavated through the eastern portion of the sediment plug and excavated material spoiled to the west of the channel. The proposed pilot channel configuration is a channel with a bottom width of 25 feet and top width of 35 to 50 feet. The top width will be based on the depth of excavation and stable slope of the excavated material. A deeper 10-foot wide channel may also be excavated within the 25-foot wide channel. The average depth of the pilot channel is anticipated to be 2 to 4 feet, with a maximum depth of up to 6 feet.

The pilot channel will be excavated using amphibious excavators, which will be walked in from the levee along the cleared access route. There will likely be flowing water in the western floodplain at the time that the pilot channel excavation takes place, and the amphibious excavators will be traveling through this water to access the river, as will the amphibious fuel carrier. Prior to beginning excavation of the pilot channel, flows remaining in the river channel at the upstream end of the pilot channel will be diverted to either the western or eastern floodplain. Based on July 2008 surveys, it appeared that diversion to the western floodplain at SO-1539 would be feasible because a natural channel had formed at this location. However, conditions at the time that the pilot channel excavation begins may result in selection of a different location for the diversion. The diversion location will be selected based upon the following criteria: to minimize in-water excavation; create a diversion that can withstand higher flows; minimize permanent changes to overbanking patterns. BDANWR personnel will be invited to participate in development of the final diversion plan.

Excavation of the pilot channel will begin some distance upstream of the solid sediment plug, in a portion of the river that is not completely dry, but where significant sediment deposition has occurred. Therefore, in-water work with the amphibious excavators will likely be required in order to divert the remaining flows in the river to either the western or eastern floodplain. The maximum area of disturbance, in wet conditions, is estimated at 7.3 acres. This is the best estimate of the starting point at this time, but the actual starting point may vary depending on actual conditions at the time work begins.

It is anticipated that when the pilot channel work is performed, flows in the river will be less than 500 cfs and that all, or nearly all, of this flow will be leaving the river channel before or at rangeline SO-1539 (Sta. 42+32) and flowing to the western floodplain. Therefore, the plan is to divert the remaining flows in the river somewhere between SO-1536 (Sta. 25+42) and SO-1539. If there is a small amount of water below the point of diversion, that reach of river may require seining for minnows after the diversion has been made. Seining should not be required farther south than Sta. 72+44, as the river channel downstream of that point was completely plugged and dry in July 2008 and will almost certainly be so at the time work is performed.

The process of temporarily diverting river flows will be as described below, based on assumed conditions for the time when work will begin. If the size of the sediment plug has increased more than what was assumed, the diversion will be moved farther upstream.

- A location such as SO-1539 will be selected for diversion of remaining flows in the river channel to the western or eastern floodplain. The location selected will be one where flows are already leaving the river channel, and some additional excavation of the natural berm on the west side of the river channel may be performed to increase the flows to the floodplain. A diversion berm will also be constructed across the western portion of the river channel, so that all flows leave the river channel to the west floodplain at this point.

- If the river thalweg is not along the western side of the channel from Sta. 0 to the diversion point, excavation will be performed in that segment to establish the river thalweg along the west bank. This excavation will be performed in wet conditions, but will be done in a manner so as to ensure that fish are not trapped in pools.

- A berm will be constructed at Sta. 0 to protect the pilot channel excavation area from high flows.

Excavation of the pilot channel will be performed by three or four amphibious excavators, which will each work a segment of the pilot channel excavation. Approximately 100 feet of sediment plug will be left in place at the start and end of the pilot channel excavation, and between the excavated segments. Leaving these areas in place until the pilot channel excavation is complete will isolate excavation areas in the event that river water enters the pilot channel and will help lessen the extent of excavation that may need to be seined.

When the entire length of pilot channel excavation is complete, the bottom 100 feet of channel will be excavated, then the top 100 feet of channel, at which time the river flows will enter the pilot channel. The area excavated to form a diversion channel (example SO-1539) will then be filled to the original condition.

If additional pilot channel excavation is required under Phase I(b), a diversion channel will be reestablished in the same general manner as described above, so that river flows do not enter the pilot channel excavation.

Levee Improvements
Material excavated to form the pilot channel will be hauled and used to widen and raise 1 to 2 miles of levee. Hauling will be accomplished utilizing trucks or scrapers. This work will likely be completed several months after excavation of the pilot channel, to allow drying of the floodplain.

The haul road will be located on the same line that was cleared for access by the amphibious excavators for Phase I(a) work. The road alignment will be cleared of vegetation for the Phase I(a) work and will then be improved with fill material for the Phase I(b) work, to provide a suitable surface for the hauling equipment. It is estimated that approximately 1,000 cubic yards of fill material will need to be imported from Valverde Pit to allow trucks initial access the river, and the remaining fill will be obtained from the pilot channel spoil berms. The majority of road fill will be used to form the ramp to the levee and to cross a natural channel within the floodplain that has formed at the toe of the levee. Fill required over the remainder of the floodplain should average a depth of 1 to 2 feet. At the natural channel near the levee, two or more culverts will be installed to allow water in the floodplain to pass through the access road embankment. There should be no overbanking of river flows at the time of the hauling, but the culverts will be installed as a precaution. The majority of fill material placed on the floodplain will be removed at the end of the hauling work so as to minimize impacts to flow patterns within the floodplain. To the extent possible, the road surface will be left so as to match adjacent floodplain topography with particular attention given to maintaining the existing flow paths within the floodplain. To the extent possible, the road surface will be left so as to match adjacent floodplain topography with particular attention given to maintaining the existing flow paths within the floodplain. No more than 1 foot of fill (above adjacent floodplain) will be left in any location.

Widening of the levee will be performed on both the east and west sides, but with the majority of widening to the west side. Some portions of the levee will be raised up to 2 feet.

Areas of Disturbance
In-water disturbance areas are detailed in Tables 1 and 2 below:

Table 1: Wetted Floodplain Disturbance Area

Equipment	Max #	Disturbance Width	# of Trips (each)	Total Wet Area of Disturbance (acres)
Phase 1(a)				
Amphibious Excavators	4	30	2	6
Amphibious Fuel Carrier	1	22	48	24
Phase 1(b)				
Amphibious Excavators	4	30	2	6
Amphibious Fuel Carrier	1	22	24	12
			TOTAL	**48**

Notes for Table 1:
1. For computing the above disturbance area, a maximum performance time for the pilot channel excavation is assumed at 6 weeks for Phase 1(a), between September 15, 2008, and October 31, 2008, and Phase 1(b) will occur between March and May 2009. It is anticipated that the floodplain will be dry for Phase I(b), provided that the Phase 1(a) pilot channel is successful. If Phase 1(a) is not successful, then more pilot channel excavation would be required in Phase 1(b).

2. Disturbance width was computed as follows:
Amphibious excavators: The largest excavator has pontoons that measure 6 feet in width, with a distance from outside to outside of the pontoons of 23.5 feet. A total disturbance width of 30 feet was used.

Amphibious fuel carrier: Pontoons measure 4 feet in width, with a distance from outside to outside of the pontoons of 16 feet. A total disturbance width of 22 feet was used.

3. "Number of Trips" is the number of round trips that each piece of equipment could make from the levee to the river and back. The length of the access road (levee to river) is assumed to be a maximum of 1,000 feet and it is assumed that only 50% of this length (500 feet) will be wet at the time of the work, so the round trip wetted length is 1,000 feet. The amphibious excavators will generally use the access road only for mobilization and demobilization, but additional trips were added for maintenance. The amphibious fuel carrier will average 1 trip per work day.

Table 2: Total Area for Potential Incidental Take of Minnow		
Activity	Phase 1(a) Area (acres)	Phase 1(b) Area (acres)
Crossing wetted floodplain:		
Amphibious excavators	6	6
Amphibious fuel carrier	24	12
Diversion of river:		
Equipment working in river channel	7	7
Isolated pools of water below diversion (to be seined)	7	7
Pilot channel excavation (in wet conditions)	0	5
Isolated river water in pilot channel excavation (to be seined)	4	4
TOTALS	**48**	**41**

Action Area
The Service has defined the Action Area to include the area from the San Acacia Diversion Dam to Elephant Butte Reservoir, and the entire width of the 100 year Rio Grande floodplain within that reach.

STATUS OF THE SPECIES

RIO GRANDE SILVERY MINNOW

Description
The silvery minnow currently occupies a 170-mile reach of the Middle Rio Grande, New Mexico, from Cochiti Dam, Sandoval County, to the headwaters of Elephant Butte Reservoir, Socorro County (U.S. Fish and Wildlife Service 1994). The silvery minnow is a stout minnow, with moderately small eyes, a small, sub-terminal mouth, and a pointed snout that projects beyond the upper lip (Sublette *et al.* 1990). The back and upper sides of the silvery minnow are silvery to olive, the broad mid-dorsal stripe is greenish, and the lower sides and abdomen are silver. Maximum length attained is about 3.5 inches (in). The only readily apparent sexual dimorphism is the expanded body cavity of ripe females during spawning (Bestgen and Propst 1994).

In the past, the silvery minnow was included with other species of the genus *Hybognathus* due to morphological similarities. Phenetic and phylogenetic analyses corroborate the hypothesis that it is a valid taxon, distinctive from other species of *Hybognathus* (Cook *et al.* 1992, Bestgen and Propst 1994). It is now recognized as one of seven species in the genus *Hybognathus* in the United States and was formerly one of the most widespread and abundant minnow species in the

Rio Grande basin of New Mexico, Texas, and Mexico (Pflieger 1980, Bestgen and Platania 1991). Currently, *Hybognathus amarus* is the only remaining endemic pelagic spawning minnow in the Middle Rio Grande. The speckled chub (*Extrarius aestivalus*), Rio Grande shiner (*Notropis jemezanus*), phantom shiner (*Notropis orca*), and bluntnose shiner (*Notropis simus simus*) are either extinct or have been extirpated from the Middle Rio Grande (Bestgen and Platania 1991).

Legal Status

The silvery minnow was federally listed as endangered under the ESA on July 20, 1994 (U.S. Fish and Wildlife Service 1994). The species is also listed as an endangered species by the State of New Mexico. Primary reasons for listing the silvery minnow are described below in the Reasons for Listing section.

Critical habitat for the silvery minnow was designated on February 19, 2003, (68 FR 8088). The critical habitat designation extends approximately 157 miles from Cochiti Dam, Sandoval County, New Mexico downstream to the utility line crossing the Rio Grande, a permanent identified landmark in Socorro County, New Mexico. The critical habitat designation defines the lateral extent (width) as those areas bounded by existing levees or, in areas without levees, 300 feet (ft) or riparian zone adjacent to each side of the bank full stage of the Middle Rio Grande. Some developed lands within the 300 ft lateral extent are not considered designated critical habitat because they do not contain the primary constituent elements of critical habitat and are not essential to the conservation of the silvery minnow. Lands located within the lateral boundaries of the critical habitat designation, but not considered critical habitat include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the Low Flow Conveyance Channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. The Pueblo lands of Santo Domingo, Santa Ana, Sandia, and Isleta within this area are not included in the critical habitat designation. Except for these Pueblo lands, the remaining portion of the silvery minnow's occupied range in the Middle Rio Grande in New Mexico is designated as critical habitat (68 FR 8088).

Habitat

The silvery minnow travels in schools and tolerates a wide range of habitats (Sublette *et al.* 1990); yet, generally prefers low velocity (<0.33 ft per second) areas over silt or sand substrate that are associated with shallow [< 15.8 inch (in)] braided runs, backwaters or pools (Dudley and Platania 1997). Habitat for the silvery minnow includes stream margins, side channels, and off-channel pools where water velocities are low or reduced from main-channel velocities. Stream reaches dominated by straight, narrow, incised channels with rapid flows are not typically occupied by silvery minnow (Sublette *et al.* 1990, Bestgen and Platania 1991).

Adult silvery minnow are most commonly found in backwaters, pools, and habitats associated with debris piles; whereas, young of year (YOY) occupy shallow, low velocity backwaters with silt substrates (Dudley and Platania 1997). A study conducted between 1994 and 1996 characterized habitat availability and use at two sites in the Middle Rio Grande at Rio Rancho and Socorro. From this study Dudley and Platania (1997) reported that the silvery minnow was most commonly found in habitats with depths less than 19.7 in. Over 85 percent were collected from low-velocity habitats (<0.33 ft/sec) (Dudley and Platania 1997, Watts *et al.* 2002).

Designated Critical Habitat

The Service has determined the primary constituent elements (PCEs) of silvery minnow designated critical habitat based on studies on silvery minnow habitat and population biology (68 FR 8088). They include:

1. A hydrologic regime that provides sufficient flowing water with low to moderate currents capable of forming and maintaining a diversity of aquatic habitats, such as, but not limited to the following: backwaters (a body of water connected to the main channel, but with no appreciable flow), shallow side channels, pools (that portion of the river that is deep with relatively little velocity compared to the rest of the channel), and runs (flowing water in the river channel without obstructions) of varying depth and velocity – all of which are necessary for each of the particular silvery minnow life-history stages in appropriate seasons (e.g., the silvery minnow requires habitat with sufficient flows from early spring (March) to early summer (June) to trigger spawning, flows in the summer (June) and fall (October) that do not increase prolonged periods of low- or no flow, and relatively constant winter flow (November through February));

2. The presence of eddies created by debris piles, pools, or backwaters, or other refuge habitat within unimpounded stretches of flowing water of sufficient length (i.e., river miles) that provide a variation of habitats with a wide range of depth and velocities;

3. Substrates of predominantly sand or silt; and

4. Water of sufficient quality to maintain natural, daily, and seasonally variable water temperatures in the approximate range of greater than 1°C (35°F) and less than 30°C (85°F) and reduce degraded conditions (e.g., decreased dissolved oxygen, increased pH).

These PCEs provide for the physiological, behavioral, and ecological requirements essential to the conservation of the silvery minnow.

Life History

The species is a pelagic spawner that produces 3,000 to 6,000 semi-buoyant, non-adhesive eggs during a spawning event (Platania 1995, Platania and Altenbach 1998). The majority of adults spawn in about a one-month period in late spring to early summer (May to June) in association with spring runoff. Platania and Dudley (2000, 2001) found that the highest collections of silvery minnow eggs occurred in mid- to late May. In 1997, Smith (1999) collected the highest number of eggs in mid-May, with lower frequency of eggs being collected in late May and June. These data suggest multiple silvery minnow spawning events during the spring and summer, perhaps concurrent with flow spikes. Artificial spikes have apparently induced silvery minnow to spawn (Platania and Hoagstrom 1996). It is unknown if individual silvery minnow spawn more than once a year or if some spawn earlier and some later in the year.

The spawning strategy of releasing semi-bouyant eggs can result in the downstream displacement of eggs, especially in years or locations where overbank opportunities are limited.

The presence of diversion dams (Angostura, Isleta, and San Acacia Diversion Dams) prevents the recolonization of upstream habitats (Platania 1995) and has reduced the species' effective population size (Ne) to critically low levels (Alo and Turner 2005, Osborne et al. 2005). Adults, eggs and larvae are also transported downstream to Elephant Butte Reservoir. It is believed that none of these fish survive because of poor habitat and predation from reservoir fishes (U.S. Fish and Wildlife Service 1999).

Platania (2000) found that development and hatching of eggs are correlated with water temperature. Eggs of the silvery minnow raised in 30°C water hatched in approximately 24 hours while eggs reared in 20-24°C water hatched within 50 hours. Eggs were 0.06 in in size upon fertilization, but quickly swelled to 0.12 in. Recently hatched larval fish are about 0.15 in in standard length and grow about 0.005 in in size per day during the larval stages. Eggs and larvae have been estimated to remain in the drift for 3-5 days, and could be transported from 134 to 223 mi downstream depending on river flows (Platania 2000). Approximately three days after hatching the larvae move to low velocity habitats where food (mainly phytoplankton and zooplankton) is abundant and predators are scarce. YOY attain lengths of 1.5 to 1.6 in by late autumn (U.S. Fish and Wildlife Service 1999). Age-1 fish are 1.8 to 1.9 in by the start of the spawning season. Most growth occurs between June (post spawning) and October, but there is some growth in the winter months. In the wild, maximum longevity is about 25 months, but very few survive more than 13 months (U.S. Fish and Wildlife Service 1999). Captive fish have lived up to four years (C. Altenbach, City of Albuquerque, *pers. comm.* 2003).

The silvery minnow is herbivorous (feeding primarily on algae); this is indicated indirectly by the elongated and coiled gastrointestinal tract (Sublette *et al.* 1990). Additionally, detritus, including sand and silt, is filtered from the bottom (Sublette *et al.* 1990, U.S. Fish and Wildlife Service 1999).

Population Dynamics

Generally, a population of silvery minnow consists of only two age classes: YOY and Age-1 (U.S. Fish and Wildlife Service 1999). The majority of spawning silvery minnow is one year old. Two year old and older fish comprise less than 10 percent of the spawning population. High silvery minnow mortality occurs during or subsequent to spawning, consequently very few adults are found in late summer. By December, the majority (greater than 98 percent) of individuals are YOY (Age 0). This population ratio does not change appreciably between January and June, as Age 1 fish usually constitute over 95 percent of the population just prior to spawning.

Platania (1995) found that a single female in captivity could broadcast 3,000 eggs in eight hours. Females produce 3 to 18 clutches of eggs in a 12-hour period. The mean number of eggs in a clutch is approximately 270 (Platania and Altenbach 1998). In captivity, silvery minnow have been induced to spawn as many as four times in a year (C. Altenbach, City of Albuquerque, *pers. comm.* 2000). It is not known if they spawn multiple times in the wild. The high reproductive potential of this fish appears to be one of the primary reasons that it has not been extirpated from the Middle Rio Grande. However, the short life span of the silvery minnow increases the population instability. When two below-average flow years occur consecutively, a short-lived species such as the silvery minnow can be impacted, if not completely eliminated from dry reaches of the river (U.S. Fish and Wildlife Service 1999).

Distribution and Abundance

Historically, the silvery minnow occurred in 2,465 mi of rivers in New Mexico and Texas. They were known to have occurred from Española upstream from Cochiti Lake; in the downstream portions of the Chama and Jemez Rivers; throughout the Middle and Lower Rio Grande to the Gulf of Mexico; and in the Pecos River from Sumner Reservoir downstream to the confluence with the Rio Grande (Sublette *et al.* 1990, Bestgen and Platania 1991). The current distribution of the silvery minnow is limited to the Rio Grande between Cochiti Dam and Elephant Butte Reservoir, which amounts to approximately 5 percent of its historic range.

The construction of mainstem dams, such as Cochiti Dam and irrigation diversion dams have contributed to the decline of the silvery minnow. The construction of Cochiti Dam in particular has affected the silvery minnow by reducing the magnitude and frequency of flooding events that help to create and maintain habitat for the species. In addition, the construction of Cochiti Dam has resulted in degradation of silvery minnow habitat within the Cochiti Reach. Flow in the river at Cochiti Dam is now generally clear, cool, and free of sediment. There is relatively little channel braiding, and areas with reduced velocity and sand or silt substrates are uncommon. Substrate immediately downstream of the dam is often armored cobble (rounded rock fragments generally 3 to 12 in in diameter). Further downstream the riverbed is gravel with some sand material. Ephemeral tributaries including Galisteo Creek and Tonque Arroyo introduce sediment to the lower sections of this reach, and some of this is transported downstream with higher flows (U.S. Fish and Wildlife Service 2001, 1999). The Rio Grande below Angostura Dam becomes a predominately sand bed river with low, sandy banks in the downstream portion of the reach. The construction of Cochiti Dam also created a barrier between silvery minnow populations (U.S. Fish and Wildlife Service 1999). As recently as 1978, the silvery minnow was collected upstream of Cochiti Lake; however surveys since 1983 suggest that the fish is now extirpated from this area (U.S. Fish and Wildlife Service 1999; Torres et al. 2008).

Long-term monitoring for the Rio Grande silvery minnow and fish communities in the Middle Rio Grande began in 1993 and has continued annually, with the exception of 1998. This monitoring has recorded substantial (order of magnitude increases and decreases) fluctuations in the population. Rio Grande silvery minnow catch rates declined two to three orders of magnitude between 1993 and 2004, but then increased three to four orders of magnitude in 2005 (Figure 1). Population size is highly correlated with hydrologic conditions, particularly the magnitude and duration of the spring runoff (Dudley and Platania 2007). The capacity of the species to respond to good hydrologic years (e.g. 2005) is dependent on a variety of factors including the previous year's survivorship and number of adults available to reproduce.

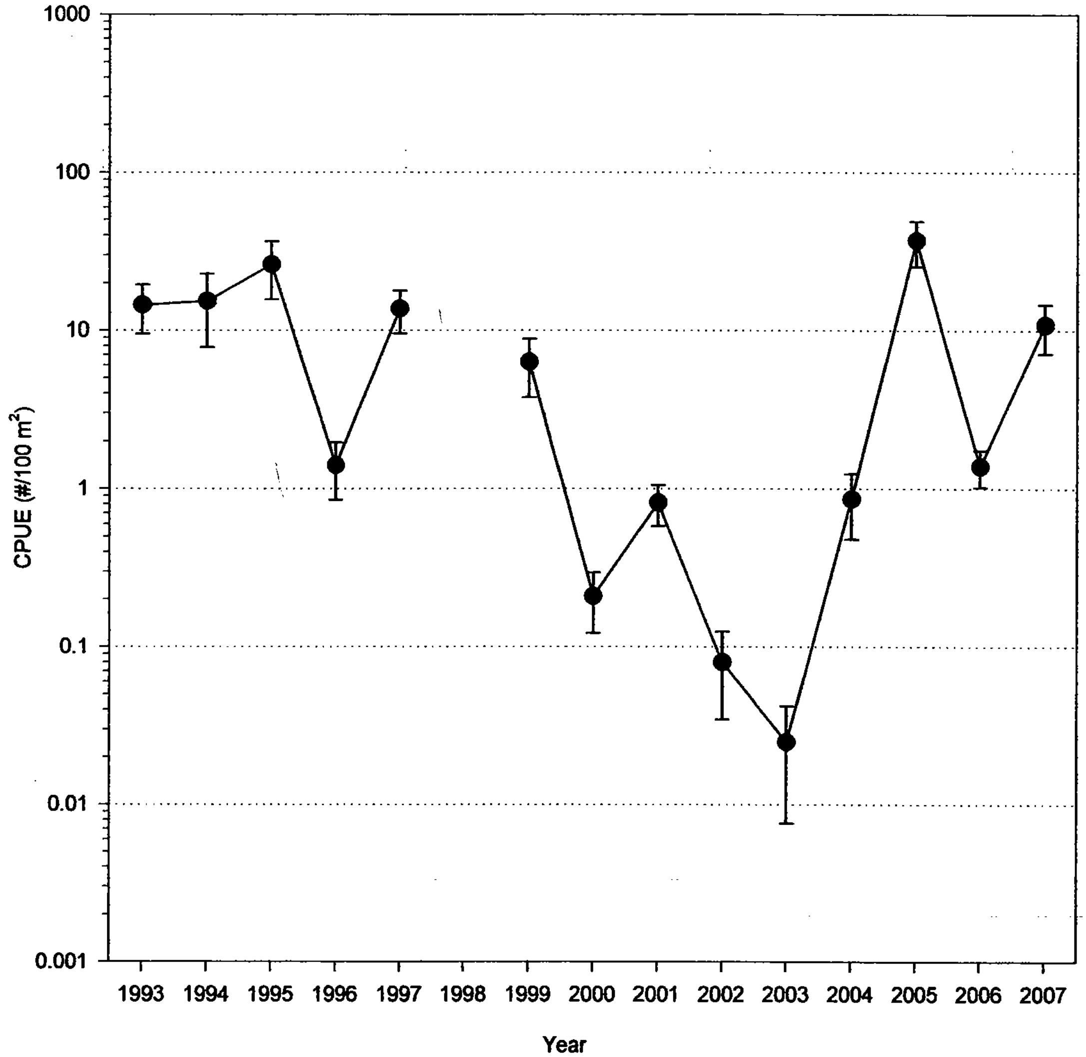

Figure 1. Rio Grande Silvery Minnow Population Trends 1993-2007 based on October CPUE data.

Augmentation, throughout this period, likely sustained the silvery minnow population. Over 1,000,000 silvery minnow have been released (primarily in the Angostura Reach) since 2000 (see Environmental Baseline). Captively propagated and released fish supplemented the native adult population and most likely prevented extinction during the extremely low water years of 2002 and 2003.

Middle Rio Grande Distribution

During the early 1990s, the density of silvery minnow generally increased from upstream (Angostura Reach) to downstream (San Acacia Reach). During surveys in 1999, over 98 percent of the silvery minnow captured were downstream of San Acacia Diversion Dam (Dudley and Platania 2002). This distributional pattern can be attributed to downstream drift of eggs and larvae and the inability of adults to repopulate upstream reaches because of diversion dams.

This pattern has changed in recent years. In 2004, 2005, and 2007, catch rates were highest in the Angostura Reach and lower the Isleta and San Acacia reaches. Routine augmentation of silvery minnow in the Angostura Reach (nearly 1,000,000 since 2000), and the transplanting of silvery minnow rescued from drying reaches (approximately 770,000 since 2003) may partially explain this pattern. Good recruitment conditions (i.e., high and sustained spring runoff) throughout the Middle Rio Grande during April and May followed by wide-scale drying in the Isleta and San Acacia reaches from June-September in these years, may also explain the shift. High spring runoff (>3,000 cfs for 7-10 days) and perennial flow, leads to increased availability of nursery habitat and increased survivorship in the Angostura Reach. In contrast, south of Isleta and San Acacia Diversion Dams, large stretches of river (30+ miles) have been routinely dewatered and young silvery minnow in these areas were either subjected to poor recruitment conditions (i.e., lack of nursery habitats during low-flows) or were trapped in drying pools where they perished.

In 2006, the largest numbers of silvery minnow were again highest downstream of San Acacia. Spring runoff volumes were exceedingly low in 2006. Flows at the Albuquerque gage never exceeded 3,000 cfs in 2006 (Porter, pers com.) and likely very little nursery habitat was inundated during critical recruitment times.

Reasons for Listing/Threats to Survival

The silvery minnow was federally listed as endangered for the following reasons:

1. Regulation of stream waters, which has led to severe flow reductions, often to the point of dewatering extended lengths of stream channel;

2. Alteration of the natural hydrograph, which impacts the species by disrupting the environmental cues the fish receives for a variety of life functions, including spawning;

3. Both the stream flow reductions and other alterations of the natural hydrograph throughout the year can severely impact habitat availability and quality, including the temporal availability of habitats;

4. Actions such as channelization, bank stabilization, levee construction, and dredging result in both direct and indirect impacts to the silvery minnow and its habitat by severely disrupting natural fluvial processes throughout the floodplain;

5. Construction of diversion dams fragment the habitat and prevent upstream migration;

6. Introduction of nonnative fishes that directly compete with, and can totally replace the silvery minnow, as was the case in the Pecos River, where the species was totally replaced in a time frame of 10 years by its congener the plains minnow (*Hybognathus placitus*); and

7. Discharge of contaminants into the stream system from industrial, municipal, and agricultural sources (U.S. Fish and Wildlife Service 1993b, 1994).

These reasons for listing continue to threaten the species throughout its currently occupied range in the Middle Rio Grande.

Recovery Efforts
The final recovery plan for the silvery minnow was released in July 1999 (U.S. Fish and Wildlife Service 1999). The Recovery Plan has been updated and revised and a draft revised Recovery Plan (U.S. Fish and Wildlife Service 2007) was released for public comment on January 18, 2007 (72 FR 2301).

The draft revised Recovery Plan describes recovery goals for the Rio Grande silvery minnow and actions to complete these (U.S. Fish and Wildlife Service 2007). The three goals identified for the recovery and delisting of the Rio Grande silvery minnow are:

1. Prevent the extinction of the Rio Grande silvery minnow in the middle Rio Grande of New Mexico.

2. Recover the Rio Grande silvery minnow to an extent sufficient to change its status on the List of Endangered and Threatened Wildlife from endangered to threatened (downlisting).

3. Recover the Rio Grande silvery minnow to an extent sufficient to remove it from the List of Endangered and Threatened Wildlife (delisting).

Downlisting (Goal 2) for the Rio Grande silvery minnow may be considered when three populations (including at least two that are self-sustaining) of the species have been established within the historic range of the species and have been maintained for at least five years.

Delisting (Goal 3) of the species may be considered when three self-sustaining populations have been established within the historic range of the species and they have been maintained for at least ten years (U.S. Fish and Wildlife Service 2007).

ENVIRONMENTAL BASELINE
Under section 7(a)(2) of the ESA, when considering the effects of the action on federally listed species, we are required to take into consideration the environmental baseline. Regulations implementing the ESA (50 FR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area; the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation; and the impacts of State and private actions that are contemporaneous with the consultation in progress. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

SILVERY MINNOW

Status of the Species within the Action Area
The average density of silvery minnow in the Action Area, based on the most recent data (July 2008) is estimated to be 16.08/100 m^2. In most cases, this estimate is likely to exceed the

number of fish distributed throughout the river since sampling is directed toward areas where silvery minnows are likely to be found. Nevertheless, it represents our best estimate of the number of silvery minnows in any given locality.

Past actions have eliminated and severely altered habitat conditions for the silvery minnow. These actions can be broadly categorized as changes to the natural hydrology of the Rio Grande and changes to the morphology of the channel and floodplain. Other factors that influence the environmental baseline are water quality, the release of captively propagated silvery minnow; silvery minnow rescue efforts, on-going research efforts, and past projects in the Middle Rio Grande. Also of importance is the current drought, the expected weather pattern for the near future, and how it may affect flow in the Rio Grande. Each of these topics is discussed below.

Changes in Hydrology

There have been two primary changes in hydrology as a result of the construction of dams on the Rio Chama and Rio Grande that affect the silvery minnow: Loss of water and changes to the magnitude and duration of peak flows.

Loss of Water

Prior to measurable human influence on the system, up to the fourteenth century, the Rio Grande was a perennially flowing, aggrading river with a shifting sand substrate (Biella and Chapman 1977). There is now strong evidence that the Middle Rio Grande first began drying up periodically after the development of Colorado's San Luis Valley in the mid to late 1800s (Scurlock 1998). After humans began exerting more influence on the river, there are two documented occasions when the river became intermittent; during prolonged, severe droughts in 1752 and 1861 (Scurlock 1998). The silvery minnow historically survived low-flow periods because such events were infrequent and of lesser magnitude than they are today. There were also no diversion dams to block repopulation of upstream areas, the fish had a much greater geographical distribution, and there were oxbow lakes, cienegas, and sloughs associated with the Rio Grande that supported fish until the river became connected again.

Water management and use has resulted in a large reduction of suitable habitat for the silvery minnow. Agriculture accounts for 90 percent of surface water consumption in the Middle Rio Grande (Bullard and Wells 1992). The average annual diversion of water in the Middle Rio Grande by the Middle Rio Grande Conservation District (MRGCD) was 535,280 af for the period from 1975 to 1989 (Reclamation 1993). In 1990, total water withdrawal (groundwater and surface water) from the Rio Grande Basin in New Mexico was 1,830,628 af, significantly exceeding a sustainable rate (Schmandt 1993). Water withdrawals have not only reduced overall flow quantities, but also caused the river to become locally intermittent and/or dry for extended reaches. Irrigation diversions and drains significantly reduce water volumes in the river. However, the total water use (surface and groundwater) in the Middle Rio Grande by the MRGCD may range from 28 – 37 percent (S.S. Papadopulos & Associates, Inc. 2000; U.S. Geological Survey 2002). A portion of the water diverted by the MRGCD returns to the river and may be re-diverted (in some cases more than once) (Bullard and Wells 1992; MRGCD, *in litt.* 2003).

River reaches particularly susceptible to drying are immediately downstream of the Isleta Diversion Dam (river mile 169), a 5-mi reach near Tome (river miles 150-155), a 5-mi reach near the U.S. Highway 60 Bridge (river miles 127-132), and an extended 36-mi reach from near Brown's Arroyo (downstream of Socorro) to Elephant Butte Reservoir. Extensive fish kills, including silvery minnow, have occurred in these lower reaches when the river has dried. Since 1996, an average of 32 mi of the Rio Grande has dried, mostly in the San Acacia Reach. The most extensive drying occurred in 2003 and 2004 when 60 and 68.7 mi, respectively, were dewatered. Most documented drying events lasted an average of two weeks, before flows returned.

Changes to Size and Duration of Peak Flows

Water management has also resulted in a loss of peak flows that historically initiated spawning. The reproductive cycle of the silvery minnow is tied to the natural river hydrograph. A reduction in peak flows and/or altered timing of flows may inhibit reproduction. Since completion of Elephant Butte Dam in 1916, four additional dams have been constructed on the Middle Rio Grande, and two have been constructed on one of its major tributaries, the Rio Chama (Scurlock 1998). Construction and operation of these dams, which are either irrigation diversion dams (Angostura, Isleta, San Acacia) or flood control and water storage dams (Elephant Butte, Cochiti, Abiquiu, El Vado), have modified the natural flow of the river. Mainstem dams store spring runoff and summer inflow, which would normally cause flooding, and release this water back into the river channel over a prolonged period of time. These releases are often made during the winter months, when low-flows would normally occur. The releases depart significantly from natural conditions, and can substantially alter the habitat. In spring and summer, artificially low-flows may limit the amount of habitat available to the species and may also limit dispersal of the species (U.S. Fish and Wildlife Service 1999).

Mainstem dams and the altered flows they create can affect habitat by preventing overbank flooding, trapping nutrients, altering sediment transport regimes, prolonging summer base flows, modifying or eliminating native riparian vegetation, and creating reservoirs that favor non-native fish species. These changes may affect the silvery minnow by reducing its food supply; altering its preferred habitat, preventing dispersal, and providing a continual supply of non-native fish that may compete with or prey upon them. Altered flow regimes may also result in improved conditions for other native fish species that occupy the same habitat, causing those populations to expand at the expense of the silvery minnow (U.S. Fish and Wildlife Service 1999).

In addition to providing a cue for spawning, flood flows also maintain a channel morphology to which the silvery minnow is adapted. The changes in channel morphology that have occurred from the loss of flood flows are discussed below.

Changes in Channel Morphology

Historically, the Rio Grande was sinuous, braided, and freely migrated across the floodplain. Changes in natural flow regimes, narrowing and deepening of the channel, and restraints to lateral channel migration (i.e., jetty jacks) adversely affected the silvery minnow. These effects result directly from constraints placed on channel capacity by structures built in the floodplain. These anthropogenic changes have and continue to degrade and eliminate spawning, nursery, feeding, resting, and refugia areas required for species' survival and recovery (U.S. Fish and Wildlife Service 1993a).

The active river channel within occupied habitat is being narrowed by the encroachment of vegetation, resulting from continued low-flows and the lack of overbank flooding. The lack of flood flows has allowed non-native riparian vegetation such as salt cedar and Russian olive to encroach on the river channel (Reclamation 2001). These non-native plants are very resistant to erosion, resulting in narrowing of the channel. When water is confined to a narrower cross-section, its velocity increases and the ability to carry sediments is enhanced. Fine sediments such as silt and sand are carried away leaving coarser bed materials such as gravel and cobble. Habitat studies during the winter of 1995 and 1996 (Dudley and Platania 1996), demonstrated that a wide, braided river channel with low velocities resulted in higher catch rates of silvery minnow, and narrower channels resulted in fewer fish captured. The availability of wide, shallow habitats that are important to the silvery minnow is decreasing. Narrow channels have few backwater habitats with low velocities that are important for silvery minnow fry and YOY.

Within the current range of the silvery minnow, human development and use of the floodplain have greatly restricted the width available to the active river channel. A comparison of river area between 1935 and 1989 shows a 52 percent reduction, from 26,598 acres (10,764 ha) to 13,901 acres (5,626 ha) (Crawford *et al.* 1993). These data refer to the Rio Grande from Cochiti Dam downstream to the "Narrows" in Elephant Butte Reservoir. Within the same stretch, 234.6 mi of levees occur, including levees on both sides of the river. Analysis of aerial photography taken by Reclamation in February 1992, for the same river reach, shows that of the 180 mi of river, only 1 mi, or 0.6 percent of the floodplain has remained undeveloped.

Development in the floodplain, makes it difficult, if not impossible, to send large quantities of water downstream that would create low velocity side channels that the silvery minnow prefers. As a result, reduced releases have decreased available habitat for the silvery minnow and allowed encroachment of non-native species into the floodplain.

Water Quality

Many natural and anthropogenic factors affect the quality of the middle Rio Grande. The water quality of the Rio Grande varies spatially and temporally throughout its course primarily because of inflows of ground water and from surface water discharges and tributary delivery to the river. Both point sources (pollution discharged from a pipe) and non-point sources (diffuse sources of pollution) affect the Middle Rio Grande. Major point sources are wastewater treatment plants (WWTPs) and feedlots. Major non-point sources include urban storm water run off, agricultural activities (e.g., fertilizer and pesticide application, livestock grazing), and mining (Ellis *et al.* 1993).

Large precipitation events wash sediment and pollutants into the river from surrounding lands through storm drains and intermittent tributaries. Contaminants of concern to the silvery minnow that are frequently found in storm water include the metals aluminum, cadmium, lead, mercury, and zinc, organics such as oils, the industrial solvents trichloroethene and tetracholoroethene (TCE), and the gasoline additive methyl tert-butyl ether (U.S. Geological Survey 2001).

Sediment is the sand, silt, organic matter, and clay portion of the river bed, or the same material suspended in the water column. Ong *et al.* (1991) recorded the concentrations of trace elements and organochlorine pesticides in suspended sediment and bed sediment samples collected from the Middle Rio Grande between 1978 and 1988. These data were compared to numerical sediment quality criteria (Probable Effects Criteria [PEC]) proposed by MacDonald *et al.* (2000). According to MacDonald *et al.* (2000) most of the PEC provide an accurate basis for predicting sediment toxicity to aquatic life and a reliable basis for assessing sediment quality in freshwater ecosystems. Although the PEC were developed to assess bed (bottom) sediments, they also provide some indication of the potential adverse effects to organisms consuming these same sediments when suspended in the water column.

Semi-volatile organic compounds are a large group of environmentally important organic compounds. Three groups of compounds, polycyclic aromatic hydrocarbons (PAHs), phenols, and phthalate esters, were included in the analysis of bed sediment collected by the USGS (Levings *et al.* 1998). These compounds were abundant in the environment, are toxic and often carcinogenic to organisms, and could represent a long-term source of contamination. The analysis of the PAH data by Levings *et al.* (1998) show one or more PAH compounds were detected at 14 sites along the Rio Grande with the highest concentrations found below Albuquerque and Santa Fe. Polycyclic aromatic hydrocarbons and other semi-volatile compounds affect the sediment quality of the Rio Grande and may affect silvery minnow behavior, habitat, feeding, and health.

Pesticide contamination occurs from agricultural activities, as well as from the cumulative impact of residential and commercial landscaping activities. The presence of pesticides in surface water depends on the amount applied, timing, location, and method of application. Water quality standards have not been set for many pesticides, and existing standards do not consider cumulative effects of several pesticides in the water at the same time. Roy *et al.* (1992) reported that DDE, a degradation product of DDT, was detected most frequently in whole body fish collected throughout the Rio Grande. He suggested that fish in the lower Rio Grande may be accumulating DDE in concentrations that may be harmful to fish and their predators.

In addition to the compounds discussed above, several other constituents are present and affect the water quality of the Rio Grande. These include nutrients such as nitrates and phosphorus, total dissolved solids (salinity), and radionuclides. Each of these also has the potential to affect the aquatic ecosystem and health of the silvery minnow. As the river dries, pollutants will be concentrated in the isolated pools. Even though these pollutants do not cause the immediate death of silvery minnow, the evidence suggests that the amount and variety of pollutants present in the Rio Grande, could compromise their health and fitness (Post 1987). Factors that are known to cause poor fish habitat include temperature changes, sedimentation, runoff, erosion, organic loading, reduced oxygen content, pesticides, and an array of other toxic and hazardous substance addition or alterations in the physical or biological integrity.

Silvery Minnow Propagation and Augmentation

In 2000, the Service identified captive propagation as an appropriate strategy to assist in the recovery of the silvery minnow. Captive propagation is conducted in a manner that will, to the maximum extent possible, preserve the genetic and ecological distinctiveness of the silvery minnow and minimize risks to existing wild populations.

Silvery minnow are currently housed at four facilities in New Mexico including: the Dexter Fish Hatchery; New Mexico State University Coop Unit (Las Cruces); the Service's New Mexico

Fishery Resources Office (NMFRO), and the City of Albuquerque's propagation facilities. These facilities are actively propagating and rearing silvery minnow. Silvery minnow are also held in South Dakota at the U.S. Geological Survey, Biological Resources Division Lab, but there is no active spawning program at this facility.

Since 2000 approximately 1,000,000 silvery minnow have been propagated using both adult wild silvery minnow and wild caught eggs and then released into the wild. Wild gravid adults are successfully spawned in captivity at the City of Albuquerque's propagation facilities. Eggs are raised and released as larval fish. Marked fish have been released by the NMFRO since 2002 under a formal augmentation effort funded by the Collaborative Program. Silvery minnow are released into the Angostura Reach of the river near Alameda Bridge to ensure downstream repopulation. Eggs left in the wild have a very low survivorship and this ensures that an adequate number of spawning adults are present to repopulate the river each year. While hatcheries continue to successfully spawn silvery minnow, wild eggs are collected to ensure genetic diversity within the remaining population.

Ongoing Research

There is ongoing research by the NMFRO and University of New Mexico (UNM) to examine the movement of silvery minnow. Augmented fish are marked with a visible fluorescent elastomer tag and released in large numbers in a few locations. Crews sample upstream and downstream from the release site in an attempt to capture the marked fish. Preliminary results indicate that the majority of silvery minnow disperse a few miles downstream. One individual was captured 15.7 mi upstream from its release site (Platania *et al.* 2003). Monitoring within 48 hours after the release of the 41,500 silvery minnow resulted in the capture of 937 fish. Of these, 928 were marked and 927 were collected downstream of the release point. The farthest downstream point of recapture was 9.4 mi.

In 2002, a hybridization study involving the plains minnow and silvery minnow was conducted to determine the genetic viability of hybrids. Plains minnow are found in the Pecos River where reintroduction of silvery minnow is being considered. The results are preliminary because the number of trials was low and because there is some question about the fitness of the females used in the experiments. The plains minnow and silvery minnow did spawn with each other and the hybrid eggs hatched. However, none of the larvae lived longer than 96 hours. The control larvae (non-hybrids) for both the plains minnow and silvery minnow lived until the end of the study (24 days) (Caldwell 2002).

Due to the increased efforts in captive propagation, recent studies by UNM have focused on the genetic composition of the silvery minnow. This research indicates that the net effective population size (Ne) (the number of individuals that contribute to maintaining the genetic variation of a population) of the silvery minnow in the wild is between 60-250 fish (T. Turner, UNM, *pers. comm.* 2003). It has been suggested that a Ne of 500 fish is needed to retain the long-term adaptive potential of a population (Franklin 1980). No significant genetic differences have been found in populations isolated in the different reaches of the Rio Grande (D. Alo UNM, *pers. comm.* 2002). Because the number of wild fish in the river appears to be low, the addition of thousands of silvery minnow raised in captivity could impact the genetic structure of the population. The propagation effort should be sufficient to maintain 100,000 to 1,000,000 fish in the wild (T. Turner, UNM, *pers. comm.* 2003). For instance if it were determined that 50,000 silvery minnow were in the wild, a minimum of 50,000 adult fish should be in propagation facilities. We do not know how many fish are in the wild so it is difficult at this time to determine the exact number needed in propagation facilities. However, to insure against a catastrophic event where most wild fish are lost, it is suggested that 100,000 to 1,000,000 silvery minnow should be kept in propagation facilities to maintain a sufficient amount of genetic variability for propagation efforts (T. Turner, UNM, *pers. comm.* 2003). Approximately 150,000 silvery minnow are currently being maintained in captivity (M. Ulibarri, Service, *pers. comm.* 2007).

Permitted and/or Authorized Take

Take is authorized by section 10, and incidental take is permitted under section 7. These permits and/or authorizations are issued by the Service. Applicants for section 10 permits must also acquire a permit from the State to "take" or collect silvery minnow. Many of the permits issued under section 10 allow take for the purpose of collection and salvage of silvery minnow and eggs for captive propagation. Eggs, larvae, and adults are also collected for scientific studies to further our knowledge about the species and how best to conserve the silvery minnow. Because of the population decline from 2002-2004, the Service has reduced the amount of take permitted for voucher specimens in the wild.

Incidental take of silvery minnow in the Action Area is authorized through section 7 consultation associated with the 2003 BO, the Tiffany Plug Removal Project and various Federal government projects. In 2005 the Service revised the ITS for the 2003 BO using a formula that incorporates October monitoring data, habitat conditions during the spawn (spring runoff), and augmentation. Annual estimated take due to river drying and flood control operations now fluctuates relative to the total number of RGSM found in October across 20 population monitoring locations.

Factors Affecting Species Environment within the Action Area

On the Middle Rio Grande in the Action Area, the following past and present federal, state, private, and other human activities, in addition to those discussed above, have affected the silvery minnow and its designated critical habitat:

1. Release of Carryover Storage from Abiquiu Reservoir to Elephant Butte Reservoir: The Army Corps of Engineers (Corps) consulted with the Service on the release of water during the winter of 1995. Ninety-eight thousand af of water was released from November 1, 1995 to March 31, 1996, at a rate of 325 cfs. This discharge is above the historic winter flow rate. Substantial changes in the flow regime that do not mimic the historic hydrograph can be detrimental to the silvery minnow.

2. Creation of a Conservation Pool for Storage of Native Water in Abiquiu and Jemez Canyon Reservoirs and Release of a Spike Flow: The City created space (100,000 af) in Abiquiu Reservoir and the Corps created space in Jemez Canyon Reservoir to store Rio Grande Compact credit water for use in 2001, 2002, and 2003 for the benefit of listed species. The conservation pool was created with the understanding that the management of this water would be decided in later settlement meetings or during water operations conference calls. In addition, a supplemental release (spike) occurred in May 2001 to

accommodate movement of sediment as a part of habitat restoration and construction on the Rio Grande and Jemez River on the Santa Ana Pueblo.

3. Programmatic Biological Opinions on the Effects of Actions Associated with the U.S. Bureau of Reclamation's, U.S. Army Corps of Engineers', and non-federal Entities' Discretionary Actions Related to Water Management on the Middle Rio Grande: In 2001 and 2003, the Service issued jeopardy biological opinions on the effects of water operations and management activities in the Middle Rio Grande on the silvery minnow and flycatcher. In 2002, the Service issued a jeopardy biological opinion for the silvery minnow. The current opinion, issued on March 17, 2003, contains a Reasonable and Prudent Alternative to jeopardy with multiple elements. These elements set forth a flow regime in the Middle Rio Grande and describe habitat improvements necessary to alleviate jeopardy to both the silvery minnow and flycatcher. For example, the elements require augmentation in the Rio Grande of silvery minnow and 1,600 acres of habitat restoration.

4. Temporary Channel to Elephant Butte: This project began in 1997 and involved the construction of a temporary channel through the delta area of Elephant Butte Reservoir to increase the efficiency of sediment and water conveyance. An additional project goal was to initiate some degradation of the river bed through the San Marcial Reach to increase overall channel capacity and potentially allow for higher peak releases from Cochiti dam during subsequent spring runoff periods. At the time the channel was constructed, habitat ranged from a dry channel to a broad expanse of sheet flows. The area was effectively an extension of the reservoir and did not provide suitable habitat for silvery minnow. Surveys conducted prior to the first phase of temporary channel construction did not detect silvery minnow in the headwaters of Elephant Butte (Reclamation 1996). The temporary channel created a riverine environment that supports silvery minnows. Surveys in 2005 detected silvery minnows throughout the temporary channel (Remshardt, Service, *pers. comm.* 2008). At the same time, the headcut and streambed degradation associated with the temporary channel has increased channel incision and prevented the formation of backwaters and slackwaters.

5. Silvery minnow salvage and relocation: During river drying, the Service's silvery minnow salvage crew captures and relocates silvery minnow. Since 1996, approximately 770,000 silvery minnow have been rescued and relocated to wet reaches Prior to 2007, he majority of salvaged fish were released in the Angostura Reach. Beginning in 2007. Salvaged fish are now relocated to wet sections of the reach from which they were rescued. Studies are being conducted to determine survival rates for salvaged fish.

6. Middle Rio Grande Conservation District: Improvements to physical and operational components of the irrigation system since 2001 have contributed to a reduction in the total diversion of water from the Rio Grande by the MRGCD. Prior to 2001, average diversions were 630,000 afy and now average 370,000 afy. The change was possible because of the considerable efforts of MRGCD to install new gages, automated gates at diversions, and scheduling and rotation of diversions among water users. The new operations reduce the amount of water diverted; however, this also reduces return flows

that previously supported flow in the river. The river below Isleta Diversion Dam may be drier than in the past, but small inflows may contribute to maintaining flows.

7. Pilot Water Leasing Project: The City of Albuquerque and Albuquerque Bernalillo County Water Utility Authority with six conservation groups established a fund in February 2007 that will provide the opportunity to lease water from Rio Grande farmers and have that water remain in the river channel to support the silvery minnow. This program supports the need for reliable sources of water to support conservation programs as identified by the Middle Rio Grande Endangered Species Collaborative Program (MRGESCP, 2004).

8. Tiffany Plug Removal: Reclamation has, on a recurring basis, cut a pilot channel through an instream sediment plug in the Rio Grande upstream of the bridge at San Marcial. The purpose of this project is to protect the levee from failure by directing water and sediment through the main channel rather than allow it to overbank into the adjacent floodplain. This action reduced the amount of overbank flooded habitat for the minnow.

Summary

The remaining population of the silvery minnow is restricted to approximately 7 percent of its historic range. Every year since 1996, there has been at least one drying event in the river that has negatively affected the silvery minnow population. The population is unable to expand its distribution because poor habitat quality and Cochiti Dam prevent upstream movement and Elephant Butte Reservoir blocks downstream movement (U.S. Fish and Wildlife Service 1999). Augmentation of silvery minnow with captive-reared fish will continue; however, continued monitoring and evaluation of these fish is necessary to obtain information regarding the survival and movement of individuals.

Water withdrawals from the river and water releases from dams severely limit the survival of silvery minnow. The consumption of shallow groundwater and surface water for municipal, industrial, and irrigation uses continues to reduce the amount of flow in the Rio Grande and eliminate habitat for the silvery minnow (Reclamation 2003). However, under state law, the municipal and industrial users are required to offset the effects of groundwater pumping on the surface water system. The City of Albuquerque, for example, has been offsetting their surface water depletions with 60,000 afy returning to the river from the WWTP (U.S. Bureau of Reclamation 2003). The effect of water withdrawals means that discharge from WWTPs and irrigation return flows will have greater importance to the silvery minnow and a greater impact on water quality. Lethal levels of chlorine and ammonia have been released from the WWTPs in the last several years. In addition, a variety of organic chemicals, heavy metals, nutrients, and pesticides have been documented in storm water channels feeding into the river and contribute to the overall degradation of water quality.

Various conservation efforts have been undertaken in the past and others are currently being carried out in the middle Rio Grande. Silvery minnow abundance has increased since lows observed in 2002-2003. However, the threat of extinction for the silvery minnow continues because of increased reliance on captive propagation, the fragmented and isolated nature of currently occupied habitat, and the absence of silvery minnow in other parts of the historic range.

EFFECTS OF THE ACTION

Effects of the action refer to the direct and indirect effects of an action on the species or designated critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

Direct Effects

The proposed action is likely to result in short-term adverse effects on silvery minnow. Silvery minnow in the area will be displaced or disturbed during excavation of the diversion channel and as soil is deposited to create the diversion berm. Any equipment crossing wetting floodplain or river channel will also cause silvery minnow in the area to flee. Fleeing from the disturbance will result in stress and energy expenditures that the fish will not experience without the project. This stress could depress survivorship and future reproductive ability.

Additional effects to the silvery minnow are likely to occur during pilot channel excavation within the upstream zone. Silvery minnows may be crushed or removed from the water by the amphibious excavator at the northern end of sediment plug segments where the pilot channel meets the main river channel or any pools containing silvery minnows. Also, silvery minnows may also be crushed or removed from the water during the berm removal process, as the excavator removes sediment below flowing water.

Equipment working in the wetted channel may affect water quality. During channel excavation and berm construction, localized increases in turbidity and suspended sediments will likely occur. Direct effects from excess suspended sediments to a variety of fish include: alarm reaction, abandonment of cover, avoidance response, reduction in feeding rates, increased respiration, physiological stress, poor condition, reduced growth, delayed reproduction and mortality (Newcombe and Jensen 1996).

The effects of sediment mobilization due to the use of heavy equipment in the channel, and placement of material into the wetted channel include the potential smothering and mortality of algae and aquatic invertebrates, depressed rates of growth, reproduction, and recruitment or reduced physiological function of invertebrates. Decreases in primary production are associated with increases in sedimentation and turbidity and produce negative cascading effects through depleted food availability to zooplankton, insects, mollusks, and fish.

Adverse effects can also be expected should silvery minnow become stranded in isolated pools either downstream of the diversion point, or in the pilot channel following temporarily increased flows. When fish are trapped in isolated pools, water quality may deteriorate causing fish to become stressed. The Service has agreed to assist in salvaging silvery minnows from isolated pools should they develop. However, seining, handling, and transporting fish to new locations causes stress, and may only minimally increase survivorship.

Indirect Effects
Indirect effects to the silvery minnow include loss of and alteration of suitable habitat. Removal of the sediment plug will reduce backwater habitat, eliminating nursery and wintering habitat for the silvery minnow in this reach of the river. As a result, there will be a reduction in the quality of habitat for eggs and larvae. Most eggs and larvae will not be retained in this portion of the river, but disperse downstream where both suitable and unsuitable habitat exists.

Effects to Designated Critical Habitat
This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of designated critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to designated critical habitat for the silvery minnow.

Some of the primary constituent elements of silvery minnow critical habitat will be adversely affected by the proposed action. Specifically, the proposed action creates a steep bankline which confines the channel, increases water velocities, and prevents the formation of backwaters, embayments and other slow velocity habitat. This habitat is necessary for development and hatching of eggs and the survival of the species from larvae to adult. Low-velocity habitat provides food, shelter, and sites for reproduction, which are essential for the survival and reproduction of Rio Grande silvery minnow. Additionally, the action would reduce the opportunity for sustained low-velocity nursery habitat in the overbank area. This habitat is necessary for development and hatching of eggs and the survival of the species from larvae to adult. Low-velocity habitat provides food, shelter, and sites for reproduction, which are essential for the survival and reproduction of Rio Grande silvery minnow.

However, the effects to the function and conservation role of critical habitat relative to the entire designation are not significant because the impacts occur in a very small area relative to the overall critical habitat designation. Therefore, we conclude that the primary constituent elements of silvery minnow critical habitat will serve the intended conservation role for species with implementation of the proposed action.

Cumulative Effects
Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area considered in this draft biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Act. Cumulative effects include:

- Increases in development and urbanization in the historic floodplain that result in reduced peak flows because of the flooding threat. Development in the floodplain makes it more difficult, if not impossible, to transport large quantities of water that will overbank and create low velocity habitats that silvery minnow.

- Increased urban use of water, including municipal and private uses. Further use of surface water from the Rio Grande will reduce river flow and decrease available habitat for the silvery minnow.

- Contamination of the water (i.e., sewage treatment plants, runoff from small feed lots and dairies, and residential, industrial, and commercial development). A decrease in water quality and gradual changes in floodplain vegetation from native riparian species to non-native species (i.e., saltcedar) could adversely affect the silvery minnow and its habitat. Silvery minnow larvae require shallow, low velocity habitats for development. Therefore, encroachment of non-native species results in less habitat available for the silvery minnow.

- Human activities that may adversely impact the silvery minnow by decreasing the amount and suitability of habitat include dewatering the river for irrigation; increased water pollution from non-point sources; habitat disturbance from recreational use, suburban development, and removal of large woody debris.

- Wildfires and wildfire suppression in the riparian areas along the Rio Grande may have an adverse affect on silvery minnow. Wildfires are a fairly common occurrence in the bosque (riparian area) along the Rio Grande. Although fire retardant, which is toxic to aquatic species, is generally not used in close proximity to the Rio Grande, other fire suppression techniques, such as scooping water from the Rio Grande in large buckets, may harm silvery minnow. Silvery minnow could potentially be scooped up along with the water and dropped onto burning areas. In recent time, fire size and frequency has increased within Middle Rio Grande. The increase has been attributed to increasingly dry, fine fuels and ignition sources. The spread of the highly flammable plant, saltcedar, and drying of river areas due to river flow regulation, water diversion, lowering of groundwater tables, and other land practices is largely responsible for these fuels.

- The effect climate change may have on the silvery minnow is still unpredictable. However, mean annual temperature in Arizona increased by 1 degree per decade beginning in 1970 and 0.6 degrees per decade in New Mexico (Lenart 2005). In both New Mexico and Arizona the warming is greatest in the spring (Lenart 2005). Higher temperatures lead to higher evaporation rates which may reduce the amount of runoff, groundwater recharge, and lateral extent of rivers such as the Rio Grande. Increased temperatures may also increase the extent of area influenced by drought (Lenart 2003).

The Service anticipates that these conditions and types of activities will continue to threaten the survival and recovery of the silvery minnow by reducing the quantity and quality of habitat through the continuation and expansion of habitat degrading actions.

CONCLUSION

After reviewing the current status of the silvery minnow and its designated critical habitat, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects; it is the Service's biological opinion that the Bosque del Apache Sediment Plug Removal Project, as proposed in the August 2008, BA is not likely to jeopardize the continued existence of the silvery minnow or result in adverse modification of designated critical habitat. The project area represents a small subset of the occupied range. Sampling data indicate a substantial improvement in numbers of silvery minnow since 2003. The level of take associated with this project is unlikely to appreciably diminish the silvery minnow population in the San Acacia Reach. We find that the effects to the function and conservation role of critical habitat relative to the entire designation are not significant because the impacts occur in a small area relative to the overall critical habitat designation for silvery minnow. Therefore, we conclude that the primary constituent elements of critical habitat will serve the intended conservation role for the species with implementation of the proposed action.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by Reclamation so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. The action agency has a continuing duty to regulate the activity covered by this incidental take statement. If Reclamation (1) fails to assume and implement the terms and conditions or (2) fails to require adherence to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Reclamation must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

AMOUNT OR EXTENT OF TAKE ANTICIPATED

Rio Grande Silvery Minnow

The Service has developed the following incidental take statement based on the premise that the Bosque del Apache Sediment Plug removal project will be implemented as proposed and that acreages disturbed do not exceed those delineated in Tables 1 and 2. Take is expected in the form of harm and harass as excavators push and scoop sediment from the channel, as excavators move along the wetted channel, and fish are stranded in isolated pools. Young-of-year and adult fish are expected to escape channel activity and salvage activities are expected to immediately coincide with isolated pool formation. As a result, no direct mortality is anticipated.

Amount or Extent of Take Anticipated
The Service anticipates that take in the form of harassment may affect up to 57,915 silvery minnow during project construction. We base this figure on the following assumptions. According to the BA, disturbed wetted area will be approximately 89 acres which includes the distance across which equipment will travel to reach the work area and transport sediment. We assume the average density of silvery minnow throughout the project area is 16.08/100 m^2. Therefore, approximately 57,915 silvery minnow will be harassed by river diversion, heavy equipment, and fill placement in the river. The Service does not expect any direct mortality to occur due to sediment plug removal activities.

The Service notes that this number is only a best estimate of the amount of take that is likely under the proposed action. Thus, estimated incidental take may be modified from the above number should population monitoring information, data from silvery minnow rescue operations, or other research indicate substantial deviations from estimated values. In this case, further consultation, may be necessary.

EFFECT OF THE TAKE
The Service has determined that this level of anticipated take is not likely to result in jeopardy to the silvery minnow, because the number that may be taken is small compared to the number currently present within the occupied range. The conservation measures included in Reclamation's 2008 BA will be implemented to minimize or avoid effects to the silvery minnow.

REASONABLE AND PRUDENT MEASURES
The Service believes the following Reasonable and Prudent Measures (RPMs) are necessary and appropriate to minimize impacts of incidental take of the silvery minnow due to activities associated with the proposed project.

1. Minimize take of silvery minnow due to sediment plug removal.
2. Minimize take of silvery minnow in the form of loss of habitat due to channel reconfiguration.
3. Minimize take of silvery minnow due to recurring plug formation and plug removal projects in this reach.

Terms and Conditions
Compliance with the following terms and conditions must be achieved in order to be exempt from the prohibitions of section 9 of the ESA. These terms and conditions implement the Temporary Channel Project described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

To implement RPM 1, Reclamation shall:

1.1 Construct a minimum of 4 embayments on the west side of the pilot channel to promote channel widening to recent pre-plug dimensions. Embayment design will be completed during the winter of 2008. Embayment construction will be completed during Phase I(b).
Dimensions of embayments will be approximately 30 to 50feet in width and 50 to 70 feet in length. Limits of embayments will be limited to the plugged river channel and

will not extend beyond the vegetation line. The depth of the embayments will be such that the invert of the embayments will be above the water surface in the pilot channel at the time of construction, so the excavation can be completed in the dry. If the river has widened the pilot channel to the extent that the majority of the spoil berms have been eroded and it is determined, in conjunction with BdA, that hauling of the remaining spoil berm material to the levee is not warranted, then embayment construction will not be necessary.

To implement RPM 2, Reclamation shall:

2.1 Reclamation will collect the following data for 4 years following excavation of the pilot channel, to monitor channel degradation/aggradation and overbanking patterns:

- Every year, cross-section data of the river channel from the north boundary of BdA to the San Marcial Railroad Bridge.

- At least one time during the 4 years, cross-section data of the river channel and floodplains taken on 25 existing rangelines, between the north boundary of BdA and the San Marcial Railroad Bridge. Cross-sections will extend between existing endpoints for these rangelines.

- Every year, during spring runoff, observations to determine where overbanking is occurring (to the east and west). During each spring runoff, Reclamation will make at least two inspections of the river channel, by boat, during the period of the runoff when overbanking first begins within the reach. Specific locations where there is concentrated flow to the overbank areas will be documented by GPS

2.2 Reclamation will analyze data collected under 2.1 each year, comparing the data to2002 and 2005 cross-section data, to assess changes to the riverbed thalweg and channel geometry, including width/depth ratio. Coordination with the Service (NMESFO and BdA) will occur by Reclamation providing the yearly data and analysis, and through discussions with the Service.

To implement RPM 3, Reclamation shall:

3.1 Complete an in-depth analysis of alternatives to pilot channel construction within the reach of river between Highway 380 and the San Marcial Railroad bridge (Phase III). The alternative analysis should include a minimum of three different strategies to address the following:

- Sediment transport through the reach.
- Maintenance of connected un-vegetated river bars
- Opportunities for river realignment following sand plug formation
- River connectivity during low flows
- River/floodplain surface connectivity
- Surface water supplies to adjacent wetlands.
- Effects on threatened, endangered, or candidate species.

This analysis must be conducted in coordination with the Service (NMESFO and BdA) and initiated within six months of the completion of Phase I(b). The final document must be completed within three years and will be used in all future sediment plug removal or maintenance projects within BdA.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following conservation activities:

1. Encourage adaptive management of flows and conservation of water to benefit listed species.

2. Work to secure long-term water sources to support habitat restoration activities in the Middle Rio Grande.

3. Work to further conduct habitat/ecosystem restoration projects in the Middle Rio Grande to benefit the silvery minnow and flycatcher in the San Acacia Reach.

4. Monitor, maintain, and expand flycatcher habitat restoration areas.

RE-INITIATION NOTICE

This concludes formal consultation on the action(s) described in the September 2007 biological assessment. As provided in 50 CFR § 402.16, re-initiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) The amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or designated critical habitat in a manner or to an extent not considered in this draft biological opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or designated critical habitat not considered in this draft biological opinion; (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

In future correspondence on this project, please refer to consultation number 22420-2008-F-145. If you have any questions or would like to discuss any part of this biological opinion, please contact Jennifer Norris of my staff at (505) 761-4710.

Wally Murphy

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