United States Department of the Interior

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Cons. # 2-22-03-F-171

Memorandum

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

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

Subject: Final Biological Opinion for the Bureau of Reclamation's Proposed Pecos River Dam Operations, March 1, 2003 through February 28, 2006.

This document transmits the U.S. Fish and Wildlife Service's (Service) final biological opinion (BO) on the effects of the Bureau of Reclamation's (Reclamation) proposed Pecos River dam operations from the date of this opinion through February 28, 2006, on the Pecos bluntnose shiner (*Notropis simus pecosensis*)(shiner) and its designated critical habitat in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.). The Service received Reclamation's transmittal memo requesting formal consultation and the biological assessment (BA) for Pecos River water operations on December 13, 2002, and received supplemental information on January 10, January 30, May 20, and May 23, 2003.

The Service determined that Reclamation had provided information necessary to initiate formal consultation, as outlined in the regulations governing interagency consultation (50 CFR § 402.14) in a memorandum to Reclamation dated February 4, 2003. All information required for consultation was either included with your letter and BA, was provided in subsequent memorandums and meetings, or was otherwise accessible for our consideration and reference. You determined that the proposed block releases on the Pecos River "may affect, is likely to adversely affect" the shiner but that they "will not destroy or adversely modify its critical habitat" and that all other operations "may affect, but is not likely to adversely affect the shiner, and will not destroy or adversely modify its critical habitat." A complete administrative record of this consultation is on file in the Service's New Mexico Ecological Services Field Office.

CONSULTATION HISTORY

Reclamation initiated formal consultation with the Service in 1991 to address operations on the Pecos River (Reclamation 1991). The consultation concluded in August 1991 with the issuance of a biological opinion (BO)(Cons. #2-22-91-F-198). In that BO (Service 1991), the Service found that the timing of releases of water from upstream storage facilities (large blocks of water for expedient delivery down the channel followed by extensive drying of the river channel) was likely to jeopardize the continued existence of the shiner. A Reasonable and Prudent Alternative (RPA) was formulated by the Service and accepted by Reclamation that removed the likelihood of jeopardy to the shiner.

The Reasonable and Prudent Alternative consisted of the following:

1. Reclamation, Carlsbad Irrigation District (CID), and the Service would develop a memorandum of understanding (MOU) for the purpose of formulating annual plans of operation for Reclamation Pecos River facilities. The MOU would be in effect by September 1991 and remain in force for five years. During the five year period, Reclamation operated the system similarly to pre-Brantley Dam operations except that flow releases were gradually ramped on the ascending and descending limbs of the releases to determine the effect that this more natural release method has upon the shiner. It also included how studies could be conducted to determine the effects of Reclamation projects on listed species.

2. For the 1991 season, releases from Santa Rosa Reservoir were scheduled to provide gradual increases of flow (ramping) at the beginning of the release periods and similarly, gradual ramping of releases at the end. Mid-summer releases were made to avoid long-term dewatering of the river channel.

3. Reclamation funded five years of research activities designed to determine biologic and hydrologic needs of the shiner and operational guidelines for Reclamation that would protect, maintain, and assist in recovery of the species. During the first year of this study, a microhabitat/community structure study in relation to native and non-native species was initiated. Additionally, basic life history information concerning spawning periodicity, duration, fecundity, flow effects, and temperature preferences would be gathered, and a larval fish series of the Pecos River shiner guild would be preserved for future larval fish research.

4. Reclamation would provide color infrared aerial photographs and video imagery of the Pecos River from Santa Rosa Dam downstream to the Brantley Reservoir inflow during winter low flows. Video imagery would also be conducted during the late spring maximum flow release and the summer low flow. The imagery and photographs would be used to determine the amounts of riverine and sandbar habitat available at these flows.

5. Reclamation's Albuquerque Projects Office staff would conduct those hydrological studies necessary to develop a flow model that would investigate the downstream effect of various releases upon water delivery and habitat conditions for listed species. This model would serve as the basis for future negotiations with Pecos River water users.

6. Bioassay studies would be conducted on a fish species acting as surrogate for the shiner to determine if inorganic compounds are causing reproductive impairment. Residue analysis for the shiner's prey items in the Pecos River would be conducted for mercury, lead, and selenium.

In that consultation, the Service found that the implementation of this RPA also removed the likelihood of take. Therefore, no incidental take for the shiner was provided in the BO.

The five-year interagency research effort guided by the MOU which resulted from the consultation had as its basic goal to develop management options that conserve and restore the shiner and the associated native fish community, and efficiently deliver water for consumptive uses. Overall objectives of the research program were:

1. Determine the distribution and abundance of fishes.
2. Characterize life history of shiner.
3. Evaluate the relationship between flow and native and non-native larval fishes.
4. Prepare description of early life history developmental series of Pecos River larval fishes.
5. Determine the effects of riverine habitat intermittency on resident fishes.
6. Determine the effect of non-native fish species on the native fish community.
7. Identify spatial and temporal habitat use patterns for fishes at varying flows.
8. Quantify available aquatic macrohabitats at varying flows.
9. Identification, verification, and curation of adult and larval fish samples.
10. Quantify stream channel characteristics using aerial photography and videography.
11. Develop an operations model to evaluate the effects of various operational schedules on surface flows in downstream habitats.
12. Characterize water quality seasonally and at varying flows.
13. Determine the presence/extent of contaminants and effects on resident fishes.
14. Develop and maintain a computerized database.
15. Develop management recommendations.

Within the scope of the MOU, annual meetings of both the signatory parties and the researchers were held to review the findings of the investigations and apply new information to the annual or seasonal operation plans for the river. Typically, the participants have met prior to both the irrigation and winter seasons to review available water supplies and current information on the shiner, and determine recommendations for the operations of the upcoming season. Over the past ten years, a variety of water operation scenarios have been implemented on the Pecos River. Monitoring of both biological resources and hydrologic dynamics resulting from those scenarios has occurred each season. The information gathered during the monitoring efforts has been reviewed annually by the researchers and the signatory parties. Additional informal and formal consultations have been completed with Reclamation addressing specific impacts within the operations or research conducted during the five-year period.

Formal consultation with the Service was requested by the U. S. Army Corps of Engineers (Corps) in April 1992 concerning operations of Santa Rosa Dam and Reservoir and the potential of that operation to mobilize and transport environmental contaminants to downstream habitats occupied by the endangered interior least tern (*Sterna antillarum*) and the shiner. The BO issued for that consultation (Cons. #2-22-92-F-240) found that the Corps' ongoing and proposed operations of Santa Rosa Dam were likely to jeopardize the continued existence of the shiner and adversely modify its designated critical habitat on the Pecos River. An RPA was proffered by the Service and accepted by the Corps to remove the likelihood of jeopardy /adverse modification. That RPA consisted of the following elements:

1. The Corps would become a signatory to the MOU executed between the Service, Reclamation, New Mexico Department of Game and Fish (NMDGF), and CID. The Corps, in conjunction with Reclamation and CID, would develop annual plans of operation for Santa Rosa Dam and Reservoir that would provide for the survival and recovery of the shiner. These plans were coordinated with those developed by Reclamation and took into account Reclamation's and CID's commitment to provide various experimental flow regimes for a five-year period.

2. During the research period, releases from Santa Rosa Reservoir would be scheduled to provide gradual increases of flow (ramping) at the beginning of release periods and similarly gradual decreasing of releases at the end.

3. The Corps, in conjunction with Reclamation and CID, would at the end of the five-year research effort use the research data to initiate a reservoir water management plan that would provide for the continued survival and recovery of the shiner throughout the life of the project.

4. The Corps would fund and implement a study to evaluate the downstream transport of mercury into shiner critical habitat. The study would determine if transport was occurring, and if it was, what impact it was having on the shiner. If transported mercury was a problem to the continued existence of the shiner, the Corps, in concert with the signatories to the MOU, would initiate remedial action.

With implementation of the RPA, the Service did not anticipate that continued operation of Santa Rosa Dam and Reservoir would result in incidental take of the shiner. Accordingly, no incidental take was authorized. The participation of the Corps in the existing MOU was found infeasible.

Thus, a separate MOU was signed by the Corps, Service, Reclamation, NMDGF, and CID. In order to avoid duplication, joint meetings of the signatories to the two MOUs have been held.

Following the expiration of the 1992 MOU for Reclamation's Pecos operations, a second MOU was signed by the original participants and the New Mexico Office of the State Engineer (OSE) to facilitate analysis of existing data, produce reports and management recommendations, and develop water operational plans that are not detrimental to the shiner or its habitat. The process of interagency meetings and review of available data on water conditions and the status of the shiner for recommendations of seasonal water operations continued under the new MOU. The new MOU marked a crossover from the completion of the study phase to the beginning of the decision making process through the National Environmental Policy Act (NEPA) phase. The NEPA process is ongoing and no long-term operational decisions have yet been made. As part of the NEPA process, Reclamation plans to continue consultation with the Service over interim operations until the completion of the Carlsbad Project Water Operations and Water supply Conservation Environmental Impact Statement.

Winter Water Operations, 1998 to 2003

At the October 9, 1998, interagency research meeting, it was recommended that a target flow of 35 cubic feet per second (cfs) (1 cubic meter per second [m^3/s]) be provided at the Acme Gage for the 4 month span of the 1998 to 1999 winter season for the protection of the shiner. On November 9, 1998, Reclamation provided its proposed plan for the winter operations to the Service for review. The proposed action consisted of flow management that would produce a range of flows at the Acme Gage from an anticipated minimum of approximately 26 cfs (0.7 m^3/s) to a maximum of 41 cfs (1.2 m^3/s) in order to target 35 cfs (1 m^3/s). Based on the preliminary analysis of "worst case conditions" arising from the low flows of 26 cfs (0.7 m^3/s), the Service, by memorandum dated November 10, 1998, recommended that Reclamation initiate consultation under section 7 of the Act.

Reclamation reinitiated consultation in the fall of 1998 for the 1998 to 1999 winter operations after the completion of the five-year MOU study. The "Pecos River Winter Operations Plan/Biological Assessment" was submitted to the Service on November 17, 1998. Reclamation determined that the winter operations "may adversely affect" the shiner, but would "not adversely modify or destroy" its critical habitat. The Service found that, based on Reclamation's findings, its operations would not likely jeopardize the shiner (Cons. # 2-22-99-F-59).

Reclamation submitted a BA for the 1999 to 2000 winter operations on January 10, 2000. Reclamation determined that the proposed winter operations "may affect, is not likely to adversely affect," the shiner. The Service concurred in a letter to Reclamation on April 5, 2000 (Cons. # 2-22-00-I-136).

On January 11, 2001, Reclamation submitted a BA for the 2000 to 2001 winter operations. The effects determination was "may affect, is not likely to adversely affect" the shiner and "not likely to adversely modify or destroy" critical habitat. The Service concurred on February 2, 2001 (Cons. # 2-22-01-I-038).

Reclamation submitted the 2001 to 2002 Winter Operations BA on November 19, 2001. The effects determination for the shiner was "may affect, is not likely to adversely affect," and "not likely to adversely modify or destroy" critical habitat. Several consultation meetings occurred and a supplement to the BA was provided to the Service on February 21, 2002. The Service concurred with the determinations on March 18, 2002 (Cons. # 2-22-02-I-120).

Reclamation submitted a 2002-2003 Winter Operations BA fo the Service on October 16, 2002. We responded with a concurrence letter (Cons. #2-22-03-I-044) on November 13, 2002, agreeing with Reclamation's determinations of "may affect, but is not likely to adversely affect" the shiner and will not "destroy or adversely modify" the shiner's critical habitat.

Irrigation Season Water Operations, 1999 to 2001

On June 24, 1999, Reclamation submitted a "Biological Assessment of the Pecos Operation Plan for the 1999 Irrigation Season for the Pecos Bluntnose Shiner" (Cons. # 2-22-99-I-347). The effects determination was "may adversely affect" the shiner, but "will not destroy or adversely modify" its critical habitat. On July 19, 1999, the Service responded to Reclamation with a memorandum stating that more information was required before formal consultation could begin. Reclamation never provided the additional information and the consultation was never completed.

In 2000, Reclamation submitted the "Interim Programmatic Biological Assessment of proposed Pecos River Operations on the listed species of the Pecos River Basin," to the Service on March 31, 2000. The effects determination was "may adversely affect" the shiner, but was "not likely to destroy or adversely modify" its critical habitat. In May 2000, the Service met with Reclamation to discuss possible actions to reduce incidental take of the shiner and to provide additional information in the draft BA. Reclamation did not finalize the BA for formal consultation in 2000 (Cons. # 2-22-99-F-347b) and no BO was written.

The 2001 Irrigation Season Operations Biological Assessment was submitted on February 14, 2001, and formal consultation was initiated on March 6, 2001. Reclamation determined that the proposed action "may adversely affect" the shiner, but was "not likely to adversely modify or destroy" its critical habitat. The Service transmitted a BO (Cons. #2-22-01-F-221) on May 21, 2001, indicating that the action was "not likely to jeopardize the continued existence" of the shiner and "will not adversely modify or destroy" its critical habitat.

For the 2002 irrigation season (March 1 to October 31), the Service received Reclamation's transmittal memo requesting formal consultation and the BA for Pecos River water operations on April 5, 2002. The Service accepted the submission as complete on April 5, 2002. From March 6 to March 15 there was a block release of water that virtually emptied Santa Rosa and Sumner

Reservoirs. Pecos River intermittency began in early May 2002, and a meeting between the Service and Reclamation occurred on May 7, 2002. At the conclusion of the meeting, Reclamation and the Service agreed that a supplement to the BA was appropriate. Reclamation provided an amendment to the BA to the Service on June 3, 2002. On September 19, 2002, the Service was informed by its Regional Solicitor that a BO for the 2002 irrigation season was no longer needed.

The Service received Reclamation's transmittal memo requesting formal consultation and the BA for Pecos River Dam Operations, March 1, 2003 through February 28, 2006, on December 13, 2002 and received supplemental information on January 10 and January 30, 2003. Formal consultation was initiated on January 30, 2003.

BIOLOGICAL OPINION

I. Description of the Proposed Action

Reclamation's proposed action includes operating Sumner Dam in a manner that not only seeks to avoid jeopardizing the shiner, but also to conserve and protect the species under section 7(a)(1). Reclamation's proposed action is storing and releasing water. The activities of Fort Sumner Irrigation District (FSID) are not part of the proposed action. Under its state water right permit, Reclamation cannot store natural flow water that FSID is entitled to receive under its senior state water rights permit. Thus, Reclamation must pass through Santa Rosa and Sumner Dams, without storing (bypass), sufficient natural flow water to meet the FSID water right. Reclamation will not store any natural inflow that is needed to target a downstream objective flow of 35 cfs as stated below. Therefore, Reclamation will only store natural flow water when such storage is allowed by state permit and when it is not needed to meet the 35 cfs target.

The Sumner Dam authorization, which added flood control purposes, specifies that the dam shall be operated first for irrigation (33 U.S.C. § 707). Reclamation plans to release water in the form of block releases under the criteria identified below. The block releases are used to maximize the efficiency of the water delivery.

Consistent with these goals, Reclamation proposes the following:

A) Criteria for Diverting Water to Storage

1) Water needed to satisfy FSID's senior water right cannot be stored at Sumner or Santa Rosa Reservoirs.

2) When FSID requests water, as allowed under its water right, water needed to meet the downstream target flow of 35 cfs at the Pecos River near Acme Gage (Acme) will not be stored at Sumner or Santa Rosa Reservoirs if there is water available under the two-week flow calculation.

3) At all other times than those listed above, water will not be stored at Sumner or Santa Rosa Reservoirs if there is water available on a real-time basis as determined at the Puerto de Luna gage (PDL), and that water is needed to meet the downstream target flow of 35 cfs at Acme.

B) Releasing Water from Storage

1) Releasing stored water for the beneficial purpose of irrigation in CID in a manner that does not constitute a wasteful use due to excessive losses through seepage and evaporation.

2) Restricting the duration of block releases from Sumner to a maximum of 15 days.

3) Restricting the cumulative duration of block releases from Sumner in a calendar year to a maximum of 65 days.

4) Targeting a minimum of 14 days between block releases from Sumner.

5) When the Pecos River is anticipated to have significant intermittency and there is only enough water in storage for one block release under historical operations, Reclamation will attempt to schedule multiple block releases by reducing the volume of each release to the extent possible within beneficial use constraints.

C) Supplemental Water

1) Reclamation will enter into a lease agreement with FSID. Optimally, a minimum of 20 percent of the irrigated acres in FSID will be leased. If 20 percent of the irrigated acres were leased, it is anticipated that approximately 16 cfs of water would be bypassed for the shiner (assuming that FSID’s total diversion is 80 cfs; 20 cfs if the diversion were 100 cfs).

2) Reclamation will exchange artesian ground water (250-375 acre feet [af]) for surface water. Reclamation holds water rights in the Seven Rivers area near Brantley Reservoir. Reclamation has previously pumped water from these wells into Brantley Reservoir to replace net depletions due to modified operations at Sumner. Once Reclamation obtains a permit from the state, an equivalent amount of water (approximately 500 af accounting for delivery losses) could be stored at Sumner Dam and released downstream to maintain instream flows.

3) Reclamation will lease water rights from groundwater pumpers above the upper critical habitat and pump the water to the Pecos River. One lease (for 900 af/year) is in place. Other leases are being pursued.

4) Reclamation will discuss with FSID the cessation of the pumpback operation when the below Taiban gage is less than 35 cfs.

The first two sources of supplemental water (leasing from FSID and groundwater/surface water exchange) will be in place by July 1, 2003. The third source of water (leasing of groundwater above critical habitat) will be in place by December 2003. Although cessation of the pumpback operation would provide immediate water to the river, it is not known when or if an agreement can be reached on this source of water.

II. Status of the Species/Critical Habitat

A. Species/Critical Habitat Description

Description of the Species

Historically, bluntnose shiner, *Notropis simus* (Cope), was found in main channel habitats of the Rio Grande, Rio Chama, and Pecos River, New Mexico and Texas (Cope and Yarrow 1875, Evermann and Kendall 1894, Koster 1957, Chernoff et al. 1982, Hatch et al. 1985, Bestgen and Platania 1990). The total range of the species, based on collected specimens, was 827 river miles (mi) (1,332 kilometers [km]) (C. Hoagstrom, Service, pers. comm. 2002). Concern for the species began in the 1970's, when it was listed as endangered by the American Fisheries Society (Deacon et al. 1979, Williams et al. 1989), and by the Texas Organization for Endangered Species (Anonymous 1987). Concern proved valid for the Rio Grande subspecies (*Notropis simus simus*) which was last collected in 1964 and determined to be extinct during the 1970's (Chernoff et al. 1982, Williams et al. 1985, Miller et al. 1989, Bestgen and Platania 1990, Sublette et al. 1990, Hubbs et al. 1991). As a result, the Pecos River subspecies (*Notropis simus pecosensis* Gilbert and Chernoff), was given formal protection by the state of New Mexico in 1976 (listed as endangered, Group 2) and the state of Texas in 1987 (chapter 68 of the Texas Parks and Wildlife Code). In 1987, the shiner was listed as threatened with critical habitat by the Service (1987).

The shiner is a true minnow (family Cyprinidae) in the genus *Notropis* (Chernoff et al. 1982), and the subgenus *Alburnops* (Etnier and Starnes 1993). Members of the genus *Notropis* are commonly referred to as 'the true shiners' (Jenkins and Burkhead 1994). The shiner shares the typical characteristics of the genus in that they do not have a frenum (a bridge of skin-covered tissue binding snout to the upper lip) and lack a barbel (a slender fleshy protuberance, found on lip, jaw, or elsewhere on the head of some fishes) (Sublette et al. 1990, Jenkins and Burkhead 1994). Members of the subgenus *Alburnops* lack bright breeding coloration, are found in big rivers, have small tubercles on dorsal surfaces of the head, and have pectoral fin rays 1 or 2 through 7 to 9 (Chernoff et al. 1982). The shiner is distinguished from other members of the subgenus *Alburnops* because it commonly possesses as many as 9 anal rays (soft, segmented support structures in the anal fin) (Chernoff et al. 1982, Sublette et al. 1990).

The shiner is a relatively small, moderately deep-bodied minnow, rarely exceeding 3.1 inches (80 mm) total length (Propst 1999). It has a deep, spindle-shaped silvery body and a fairly large mouth that is overhung by a bluntly rounded snout and a large subterminal mouth. The fish is pallid gray to greenish brown dorsally and whitish ventrally. A wide silvery lateral stripe extends from the pectoral girdle to the base of the caudal fin. Pelvic and anal fins lack pigmentation, dorsal and pectoral fins have small black flecks along the fin rays, and the caudal fin is variably pigmented. Adults exhibit little sexual dimorphism except during the reproductive period when the females's abdomen becomes noticeably distended and males develop fine tubercles on the head and pectoral fin rays.

The historical range of the shiner was 392 river mi (631 km) from Santa Rosa, New Mexico to the New Mexico-Texas border (Delaware River confluence). At the time of listing (1987), the shiner was confined to the mainstem Pecos River from the town of Fort Sumner to Major Johnson Springs, New Mexico (roughly 202 mi [325 river km]) (Hatch et al. 1985, Service 1987). The current range of the shiner is from Old Fort Sumner State Park to Brantley Reservoir (194 mi, 318 km), or about 23 percent of the historical range of the species. The river reach from the FSID Diversion Dam to Bitter Lake National Wildlife Refuge Middle Tract (BLNWRMT) (110 mi, 177 km) is considered the "stronghold" for the shiner, and comprises 13 percent of the historical range of the species (C. Hoagstrom, Service, pers. comm. 2002). This reach is considered a stronghold because habitat availability and suitability is the best within the overall range, all size classes of shiner are found in this reach, and population numbers are relatively stable in this reach (Hoagstrom 2003).

Critical Habitat

Shiner critical habitat is divided into 2 separate reaches (Figure 1) and includes a 64 mile (mi) (103 kilometer [km] reach (upper critical habitat) extending from 0.6 mi (1 km) upstream from the confluence of Taiban Creek (river mile 668.9) downstream to the Crockett Draw confluence (river mile 610.4). The lower critical habitat reach is 37 mi (60 km) from Hagerman to Artesia (Service 1987). These two areas were chosen for critical habitat designation because both sections contained permanent flow and had relatively abundant, self-perpetuating populations of shiner. However, these two areas vary greatly in their habitat characteristics. The upper critical habitat has a wide sandy river channel with only moderately incised banks, and provides habitat suitable for all age classes. The lower critical habitat is deeply incised, has a narrow channel, and has a compacted bed (Tashjian 1993). Although the lower critical habitat has permanent flow, the habitat is less suitable for shiners and only smaller size classes are common in this reach (Hatch et al. 1985, Brooks et al. 1991).

At the time of critical habitat designation, the 114 mi (184 km) middle reach between the two critical habitat reaches was subject to frequent drying and therefore was not designated. However, when flow is maintained in the middle reach, as it was between 1991 and 2001, this area contains excellent habitat and supports large numbers of shiners (Hoagstrom 1997, 1999, 2000). The middle reach is also important to the recovery of the shiner.

Primary constituent elements of the critical habitat are clean, permanent water; a main river channel with sandy substrate; and low water velocity (Service 1987). At the time of listing, sporadic water flow in the river was identified as the greatest threat to the shiner and its habitat. Water diversions, ground and river water pumping, and water storage had reduced the amount of water in the channel and altered the hydrograph with which the shiner evolved. Although block releases maintain the current channel morphology (Tetra Tech 2003), since the construction of Sumner Dam, the peak flow that can be released is much less than the historical peak flows (U.S. Geological Survey historical surface flow data). The altered hydrograph encourages the proliferation of non-native vegetation, such as salt cedar, which armors the banks and causes channel narrowing. Channel narrowing increases water velocity, reduces backwater areas, and leads to the removal of fine sediments such as sand. Consequently, in areas dominated by salt cedar, the habitat becomes much less suitable or unsuitable for shiners. Lack of permanent flow and an altered hydrograph continue to be the greatest threats to the shiner and its habitat.

B. Life History

Habitat

Typical of other members of the subgenus *Alburnops* (Etnier and Starnes, 1993), the shiner inhabits big rivers (Chernoff et al. 1982, Bestgen and Platania 1990). It has survived only within perennial stretches of the Middle Pecos River, New Mexico (Hatch et al. 1985, Service 1987). In conjunction with perennial flow, the shiner is found in wide river channels with a shifting sand-bed and erosive banks (Tashjian 1993, 1994, 1995, 1997; Hoagstrom 2000, 2001, 2002). The highly erosive bed and banks allow channel configurations to change in response to flow events (Tashjian 1997, Tetra Tech 2000).

Flood inflows from numerous uncontrolled tributaries contribute to favorable river channel conditions in the Pecos River between Taiban Creek confluence and BLNWRMT. Although flood flows from uncontrolled tributaries occur too infrequently to maintain a wide channel, the combination of sediment and floodwater inflows are important for the maintenance of a sand-bed. Throughout the remainder of the historical bluntnose shiner range, closely spaced impoundments that control floods and block sediment transport have virtually eliminated these features (Lawson 1925, Lane 1934, Woodson and Martin 1965, Lagasse 1980, Hufstetler and Johnson 1993, Collier et al. 1996).

Although the shiner is found in the deeply incised lower river stretch from BLNWRMT downstream to Brantley Reservoir, the population there is dominated by small young-of-the-year (YOY) (Hatch et al. 1985, Brooks et al. 1991, Brooks et al. 1994, Brooks and Allan 1995, Hoagstrom et al. 1995, Hoagstrom 1997, 1999, 2000, 2001). Lack of growth, reduced survival, and reduced recruitment in this reach is attributed to poor habitat conditions related to the narrow, incised river channel and silt-armored bed. The predominance of YOY shiner in this reach is explained by periodic downstream displacement of eggs, larvae, and small juveniles (Brooks and Allan 1995, Hoagstrom et al. 1995, 1997, 1999, 2000; Platania and Altenbach 1998).

Velocity and Depth Preference

A habitat preference study was conducted from 1992 to 1999, to determine the effects of dam operations and variable flows on habitat availability. Velocity association varies with shiner size; larger fish are found in higher velocities (Hoagstrom 1997, 1999, 2000, 2002). Adults most frequently utilize velocities between 0.33 and 1.4 feet/second (ft/s) (10 and 42 centimeters/s [cm/s]). These velocities are typically found in open-water runs, riffles, and shallow pools (Hoagstrom 2002). Juveniles most frequently utilize velocities between 0.03 and 0.91 ft/s (1.0 and 28 cm/s), which are most commonly associated with shoreline areas (Hoagstrom 2002). Larvae presumably utilize backwater habitats with negligible velocity, relatively high water temperature, and high water clarity (Platania and Altenbach, 1998). Thus, a range of velocities is necessary to support all shiner life stages.

Adult shiners most frequently utilize depths between 5.1 and 13 inches (in) (13 and 34 cm) (Hoagstrom, 2002). Juvenile shiners utilize a variety of depths from 2 to 17 in (6 to 42 cm) (Hoagstrom 2002). Such depths are generally associated with run, riffle, and shallow pool habitat. Use of a variety of depths may be caused by the need to avoid high velocity areas, regardless of depth. However, shallow, low-velocity habitat may be most favorable (Platania and Altenbach 1998). Depths used most often by larvae is unknown.

The habitat preference study found that habitat availability varied between study sites (Hoagstrom 1999, 2000, 2002). Suitable depths and velocities were least abundant downstream from BLNWRMT (Hoagstrom 2002). The uniformity of the channel creates nearly constant depths and velocities across the channel at a given discharge. This lack of variability at all flows and lack of shallow depths and low velocity areas at high discharge, greatly reduces the suitability of habitat in this lower reach. Between the Taiban Creek confluence and Gasline, the wide, mobile, sand-bed channel meanders from side to side. Because a variety of depths and velocities are present over a wide range of discharges, the availability of suitable habitat is much greater in this reach.

Reproduction (Spawning)

The shiner is a member of the pelagic spawning minnow guild found in large plains rivers (Platania 1995a, Platania and Altenbach 1998). These minnows release non-adhesive, semi-buoyant eggs (Platania and Altenbach 1998). Because these minnow inhabit large sand bed rivers where the substrate is constantly moving, semi-buoyant eggs are a unique adaptation to prevent burial (and subsequent suffocation) and abrasion by the sand (Bestgen et al. 1989). Shiners begin spawning as one-year-olds, once they reach 1.6 in (41 mm) standard length (SL) (Hatch 1982). The spawning season extends from late April through September, with the primary period occurring from June to August (Platania 1993, 1995a). Throughout the reproductive season, spawning is associated with substantial increases in discharge, including flash floods and block releases of water (Platania 1993, S. Platania, University of New Mexico, pers. comm. 2002).

Fecundity varies among individuals. Platania (1993) found that females released an average of 370 eggs with each spawning event and spawn multiple times during the spawning season. Eggs hatch in 24 to 48 hours (Platania 1993). Because the eggs are semi-buoyant, they are carried downstream in the current (Platania 1993, 1995a, Platania and Altenbach 1998). Newly-hatched larvae float downstream for another 2 to 4 days. During this time, blood circulation begins, the yolk sac is absorbed, and the swim bladder, mouth, and fins develop (Moore 1944, Bottrell 1964, Sliger 1967, Platania 1993). As the larvae drift, they "swim up", a behavior in which they repeat a cycle of swimming towards the surface perpendicular to the current, sink to the bottom, and upon touching substrate, propel themselves back toward the surface (Platania 1993). This behavior allows larvae to remain within the water column and avoid burial by mobile substrate (Platania and Altenbach 1998). Small juveniles are also susceptible to downstream displacement (Harvey 1987), but are better able to seek low-velocity habitats. Channel conditions that reduce downstream displacement and provide low-velocity habitats are favorable for successful shiner recruitment.

Historically the Pecos River had low, erosive banks, large inputs of sediment from tributaries, and uncontrolled floods. However, downstream displacement of eggs and larvae was minimal because flood peaks were of short duration and back water, low velocity habitat remained abundant at high discharge (Dudley and Platania 1999). In contrast, transport of water in block releases sustains high flows for many days instead of several hours (Dudley and Platania 1999). In addition, where the channel is narrow and incised, back water, low velocity areas are much reduced. Block releases of water stimulate the shiner to spawn (S. Platania, University of New Mexico, pers. comm. 2002), but the eggs, larvae, and small juveniles are then displaced downstream because of the lack of low velocity habitats and the sustained high discharge. Massive downstream displacement accounts for dramatic population fluctuation in the deeply incised stretch between BLNWRMT and Brantley Reservoir (Brooks et al. 1994, Brooks and Allan 1995, Hoagstrom et al. 1995, Hoagstrom 1997, 1999, 2000; Platania and Altenbach 1998). Eggs, larvae, and small juveniles that are transported to Brantley Reservoir likely perish (Dudley and Platania 1999).

Food Habits

A short intestine, large terminal mouth, silvery peritoneum, and pointed, hooked pharyngeal teeth indicate that the shiner is carnivorous (Hubbs and Cooper 1936, Bestgen and Platania 1990). Although Platania (1993) found both animal and vegetable matter within shiner intestines, it is possible that vegetation is ingested incidental to prey capture. It is uncertain whether vegetation can be digested in such a short intestine (Hubbs and Cooper 1936, Marshall 1947). Young shiners likely consume zooplankton primarily, while shiners of increasing size rely upon terrestrial and aquatic insects (Platania 1993, Propst 1999). In a cursory analysis of 655 shiner stomachs, Platania (1993) found terrestrial insects (ants and wasps), aquatic invertebrates (mainly dipteran fly larvae and pupae), larval fish, and plant seeds (salt cedar). Other studies have also documented *Notropis* species consuming seeds during winter (Minckley 1963, Whitaker 1977) and it could be that shiners are primarily carnivorous, but utilize less favorable forage such as seeds when animal prey is scarce, or that they indiscriminately ingest anything that is of the appropriate size.

The shiner diet is indicative of drift foraging (a feeding strategy where individuals wait in a favorable position and capture potential food items as they float by) (Starrett 1950, Griffith 1974, Mendelson 1975). Drift foragers depend upon frequent delivery of food to offset the energy required to maintain a position in the current (Fausch and White 1981). Water velocity must be adequate to deliver drift (Mundie 1969, Chapman and Bjornn 1969) but low velocity refugia where the fish can rest within striking distance of target items is also necessary (Fausch and White 1981, Fausch 1984). Habitat structure that creates adjacent areas of high and low velocity (e.g., bank projections, debris, bedforms) may be important for shiner feeding. Alluvial bed forms may be the most abundant form of habitat structure in sand-bed rivers (Cross 1967) and these bedforms require a certain velocity for formation and maintenance (Simons and Richardson 1962, Task Force on Bed Forms in Alluvial Channels 1966). Thus, foraging shiners rely upon flow both for delivering food items and for maintaining favorable habitat.

Age and Growth

First year and second year individuals dominate the shiner population (97 percent); third year individuals are much less prevalent (Hatch et al. 1985). First year individuals grow rapidly, reaching 26 to 30 mm SL within 60 days (S. Platania, University of New Mexico pers. comm. 2002). Hatch et al. (1985) reported that age-0 (first year) shiners ranged from 0.75 to 1.3 in (19.0 to 32.5 mm) SL, age-1 (second year) individuals ranged from1.28 to 1.77 in (32.6 to 45.0 mm) SL, and that age-2 (third year) individuals ranged from 1.77 to 2.22 in (45.1 to 56.5 mm) SL.

Mean length of the shiners is significantly different between the upstream reaches (Taiban Creek confluence down to BLNWRMT) and the downstream area (downstream of the BLNWRMT). In the upper reach the mean length of shiners is 1.3 in (34.2 mm), with a standard deviation (SD) of 0.36 in (9.3 mm) (N=7477). Downstream the mean length is 0.91 in (23.2 mm) with a SD of 0.28 in (7.1 mm) (N=8876) (C. Hoagstrom, Service, pers. comm. 2002). Most likely the difference in size is related to habitat quality (the downstream reach provides less suitable habitat for the growth and survival of the shiner) and the influx of small shiners into this lower reach during high flows.

Data from 1992 to 1999 (years of high precipitation and experimental base-flow supplementation) suggest that favorable flow conditions produced larger shiners (Hoagstrom 2001). Numerous individuals captured during that period were larger than previously recorded. Abundance of record-length shiners peaked between April and July 1999 when the 16 largest shiners, ranging in size from 2.58 to 3.01 inches (65.5 to 76.4 mm) SL were captured (C. Hoagstrom, Service, pers. comm. 2002). Twenty-five percent of the longest shiners caught over a 11-year period (1992 to 2002) were caught in 1999. The longest individual captured in 1999 was 3 inches SL (76.4 mm). This specimen was 0.4 in (11.2 mm) longer than any other shiner caught during the 10-year study, 0.3 inches (7.5 mm) longer than the longest reported by Platania (1993), 0.8 inches (19.9 mm) longer than any reported by Hatch (1982), and 0.9 inches (23 mm) longer than the longest from the historical record (Chernoff et al. 1982). Dryer weather has prevailed since 1999, and shiners greater than 2.4 in (60.0 mm) SL have again become uncommon (C. Hoagstrom, Service, pers. comm. 2002).

Competition and Predation

Non-native species, including the plains minnow (*Hybognathus placitus*) and the Arkansas River shiner (*Notropis girardi*), are now established members of the Pecos River fish community. They are also part of the guild defined as broadcast spawners to which the shiner belongs (Platania 1995a). Members of this guild spawn during high flow events in the Pecos River and have semi-buoyant eggs that are distributed downstream to colonize new areas (Bestgen et al. 1989). As a result of the non-native introductions, interspecific competition may be a factor in the reduction in shiner abundance and distribution. Young fishes of these species that also use low velocity back water areas may compete directly with young shiner for space and food (if food is limited); however, competitive interactions among Pecos River fishes have not been studied.

Juvenile and adult shiners generally occupy flowing water of low depth (see Velocity and Depth Section). At the same time, flowing water is important for supplying food and creating habitat structure (see Food Habits). Thus, a significant reduction of velocity impacts feeding position and food availability. Under such circumstances, shiners are forced to occupy habitats with lower velocity and more variable depth, but these habitats are commonly occupied by other fish species (Hoagstrom 1999, 2000). At low discharge, competition for space and forage is likely increased (Hoagstrom 1999). Concentration of species is most severe during interrmittency because fishes must congregate in remnant pools. In such cases, it is likely that fishes that commonly inhabit still and stagnant waters (e.g., red shiner [*Cyprinella lutrensis*], western mosquitofish [*Gambusia affinis*]) gain a competitive advantage over fluvial species (Cross 1967, Summerfelt and Minckley, 1969). In addition, without flows to deliver food items, species dependent upon drift, such as the shiner, are at a disadvantage (Mundie 1969).

Large bodied piscivorous fishes in the Pecos River are uncommon between the Taiban Creek confluence and Brantley Reservoir (Hoagstrom 2000, Larson and Propst 2000). This is primarily because the majority of available habitat is shallow. High turbidity likely inhibits sight-oriented predators such as the sunfishes (Centrarchidae). Predators that occupy the most suitable shiner habitat include the native longnose gar (*Lepisosteus osseus*), flathead catfish (*Pylodictis olivaris*), and green sunfish (*Lepomis cyanellus*), and the non-native channel catfish (*Ictalurus punctatus*), white bass (*Morone chrysops*), and spotted bass (*Micropterus punctulatus*) (Larson and Propst, 2000, C. Hoagstrom, Service, pers. comm. 2002). When captured during surveys, the majority of these predators have been small (Larson and Propst 2000, Valdez et al. 2003). Thus, low abundance and small size suggest fish predation is not a major threat to the shiner (Larson and Propst 2000). However, the impacts of predaceous fishes within intermittent pools have not been studied and it is possible that they feed on shiners (Larson and Propst 2000).

Aerial and terrestrial piscivores may also threaten the shiner. Although neither group appears especially abundant along the Pecos River (C. Hoagstrom, Service, pers. comm. 2002), many piscivorous birds are seasonally found at BLNWRMT and piscivorous mammals and reptiles are present along the river. Least terns are known to prey on shiner species in other rivers (Wilson et al. 1993, Schweitzer and Leslie 1996), but this has not been documented on the Pecos River. As with piscivorous fishes, impacts of non-aquatic predators (e.g. racoons, skunks, coyotes) on the shiner are likely most significant during surface flow intermittence, when fishes are confined and crowded in shallow water (Larimore et al. 1959)

C. Population Dynamics

Based on seine collections (0.12 in, 3.0 mm mesh), shiner population structure is bimodal (two distinct length classes) from May through August (Hoagstrom 2003). The smaller size class includes YOY and juveniles; the larger size class, adults. In the spring (January through April) the population is unimodal (one size class) as first year individuals complete a growth spurt and third year individuals decline in abundance (Hoagstrom 2003). Large juveniles and adults dominate the population at this time. Young-of-the-year present in May and June are not collected with the seine because they are small enough to pass through the mesh.

Within the Pecos River, two population trends are exhibited. Upstream of BLNWRMT, all age groups are present and adults dominate the population. In contrast, downstream of BLNWRMT, adults are rare and YOY dominate (Hatch et al. 1985, Brooks et al. 1991, Brooks and Allan 1995, Hoagstrom et al. 1995, Hoagstrom 1997, 1999, 2000, 2001). Upstream, fish community composition is stable among years and seasons (Hoagstrom 2000). Shiner abundance varies among years, but is relatively stable within years (seasonally) (Hoagstrom 2000, 2001). In contrast, downstream of BLNWRMT, fish community composition is unstable among years and seasons and shiner abundance fluctuates widely both within and among years (Hoagstrom 2000, 2001).

Early studies showed that shiners avoid (or perish within) areas subjected to frequent surface flow intermittence (Hatch et al. 1985, Brooks et al. 1991). Subsequent studies found that shiners proliferated in areas that were formerly intermittent when they remained perennially wet (e.g. the middle reach of the Pecos River between the two critical habitat segments) (Hoagstrom 1997, 1999, 2000, 2001). Favorable flow conditions between 1992 and 1999 corresponded with increased shiner density in the middle reach (Hoagstrom 2000, 2001) and large individual size (see Age and Growth).

In 1992, New Mexico Fishery Resources Office (NMFRO) began a 5-year study on the shiner and its habitat. Research on the shiner population has continued, resulting in an 11-year record of population trends. Because of the differences in habitat type and quality, the river was divided into reaches similar in character (Figure 2). The 'Tailwaters' reach is from Sumner Dam down to the confluence of Taiban Creek. The 'Rangelands' reach is from the Taiban Creek confluence down to BLNWRMT, and the 'Farmlands' reach is from BLNWRMT down to Brantley Reservoir. From February 1992 through August 2002, 803 fish collections were made, capturing 19,525 shiners (density = 0.09 shiner/m^2) (C. Hoagstrom, Service, pers. comm. 2002). Over the 11-year period, only 23 shiners have been caught in the Tailwaters reach. Although at the time of listing (1987) shiners were relatively common from the FSID Diversion Dam down to Taiban Creek, they have become more rare in this part of the river and now are infrequently collected (Hoagstrom 2003). The Tailwaters reach will not be discussed further.

Over the past 11 years, shiner density typically increased from the January-April sampling period to the May-August sampling period in the Rangelands (Figure 3). In only two years prior to 2002 was there a decline between these two sampling periods (1996 and 1998) (Figure 3). In 1996 the decline was 0.03 shiners/ft^2 (0.3 shiners/100 m^2) and in 1998 the decline was 0.28 shiners/ft^2 (2.6 shiners/100 m^2). These values represent 4 and 21 percent declines from the previous sampling period, respectively. In 2002, the decline was 3.6 shiners/ft^2 (33.8 shiners/100 m^2), a drop of 75 percent over the pervious sampling period. Not only is it unusual to see a decline between these two sampling periods but the magnitude of decline seen in 2002 is much greater than has been recorded before. Two factors contribute to the decline. First, there were two periods of stream drying between May and August 2002, which led to the death of shiners (D. Propst NMDG&F, pers.comm. 2002). Second, because stream flow was low during the January-April 2002 sampling period, fish were concentrated and much easier to capture. The very high density recorded in January-April may be in part an artifact of sampling. However, flows were also low during the May-Aug collection. Ease of capture may in part explain the high density values seen in 2001 as well.

The relative abundance of shiners in the fish community in the Rangelands has shown a gradual increase over time, especially since 1995 (Figure 4). This indicates that shiners have become a more abundant component of the fish community over time, reaching a high of 25.6 percent in the January-April 2002, sampling period. The overall trend is likely the result of high precipitation and experimental base-flow supplementation until 2000. The precipitous drop in the May-August 2002 sampling period may indicate that shiners are more susceptible to drying conditions than are other species in the fish community. For instance, red shiners typically occur in harsh, unpredictable environments with temperature extremes and episodes of low oxygen, floods, and drought (Matthews et al. 2001). Data from NMFRO and Valdez et al. (2003) indicate that the percent abundance of shiner decreased to about 5 percent of the shiner guild in October 2002 while the percent abundance of red shiner markedly increased.

Shiner relative abundance and density in the Farmlands reach have not shown any distinct trends over the last 10 years (Figures 5 and 6). Both measures have been highly variable over this time frame. Similar to the Rangelands, shiner density increased in 2001, however, this is very likely due to increased sampling efficiency because of low flows (C. Hoagstrom, Service, pers. comm. 2002). Although shiner density has shown sporadic increases, it is nearly always followed by a decrease in the Farmlands. There has not been an increasing trend in shiner density or relative abundance in the Farmlands

Population fluctuation in the Farmlands is largely attributable to Sumner Dam operations (Hoagstrom 1997, 1999, 2000). After block releases of water (> 15 days in duration) numerous shiner eggs, larvae, and juveniles are displaced downstream (Hoagstrom 1997, 1999, 2000). For example, after a long block release in 1995 (32 days greater than 500 cfs, 14.2 m^3/s), shiner density at the Brantley Reservoir inflow was very high (73 shiners/ft^2, 6.8 shiners/m^2). These fish were all very small (0.6 inch, 15.2 mm). Unfortunately, the high number of shiners is not sustained downstream of BLNWRMT, and shiner abundance is normally low during winter and spring (less than 1.1 shiners/ft^2, 0.1 shiners/m^2) (Hoagstrom 2000). Inability of the shiner to sustain high densities in the Farmlands is the result of low survival, growth, and recruitment attributed to poor habitat conditions (see Velocity and Depth Preference and Reproduction sections).

D. Status and Distribution

The historic trend in shiner abundance indicates a decline since the 1940s (Hatch et al. 1985, Brooks et al. 1991, Propst 1999). For example, Koster (1957) collected 818 shiners on September 3, 1944, at the U.S. Highway 70 bridge (University of New Mexico Museum of Southwestern Biology records). In comparison, at the same site between 1992 and 1999, the NMFRO collected a total of 815 shiners in 39 trips (Hoagstrom 2000). In pre-1950 collections shiner represented 37.5 percent of the shiner guild (Platania 1995 b) but never reached that level subsequently (Platania 1995b, Hoagstrom 2003). Collections between 1986 and 1990 indicate a further decline in abundance and a reduction in range, although the species still existed within the designated critical habitat reaches (Brooks et al. 1991). Brooks et al. (1991) found that the shiner comprised 3.7 percent of the total number of all shiners collected (5 species) from the Pecos River during 1990, compared to 22.4 percent for all collections prior to 1980 (4 species).

From 1992 to 1999 shiner status improved substantially compared to 1991 (Brooks et al. 1991, 1993, Brooks and Allan 1995, Hoagstrom et al. 1995, Hoagstrom 1997, 1999, 2000, 2001). This was due to the combined effects of increased snowpack and spring runoff, frequent local precipitation, and experimental Sumner Dam operations, all of which contributed to sustaining perennial flows from Sumner Dam to Brantley Reservoir (Hoagstrom 1999, 2000). These years included base-flow supplementation and a 15-day maximum peak flow restriction on storage transport release duration. However, 2002 was a very dry year with extensive river drying (at least 38 days) and it appears to have impacted the shiner population.

From the long-term population surveys that have been conducted, it appears that the prolonged and extensive intermittency that occurred in 2002 may have had a negative impact on the shiner population. Both the relative abundance and shiner density dropped precipitously in the Rangelands Reach, where the habitat is the best (Figures 3 & 4). Shiner density had been showing an overall upward trend until the May-August and September-December 2002 sampling dates. Typically (8 out of the 11years), there is an increase in shiner relative abundance from the January-April to May-August sampling dates. In only 3 years (including 2002) was there a decline in this time frame. However in the previous years (1998 and 2001), the decline was small. The same trend is seen in density where there is typically an increase between the January-April to May-August sampling dates. Prior to 2002, there were only 2 years in which the density declined. These declines were very slight (Figure 3). In contrast, the decline in density in 2002 was 75 percent. This magnitude of decline has not been recorded previously. Although more limited in scope, work conducted by Valdez et al. (2003) from May to October, 2002, showed the same pattern. Density of shiner at the 3 sites sampled showed marked declines in the October sampling period. Likewise, the relative abundance of shiner at the three sites declined (as calculated from data presented in Valdez et al. 2003).

Shiner status has remained static or declined since the species was listed as threatened in 1987 under the Act. The range of the species was reduced by inundation of Major Johnson Springs in 1988 and declines have occurred upstream of the Taiban Creek confluence (Hoagstrom 2000, 2003). Restrictions on the duration of block releases and institution of base-flow bypass have benefitted the shiner population at times, but have not reduced the primary threat to the species (intermittency). Bypass flows are most commonly available during the non-irrigation season (November through February), but intermittent flows are most frequent during irrigation season (U.S. Geological Survey historical surface flow data). Avoidance of surface flow intermittency depends on water supply, Sumner Dam operations, FSID Diversion Dam operations, CID operations, antecedent conditions, and monsoons. In the past, water management operations on the Pecos River have not prevented widespread and frequent intermittency (U.S. Geological Survey historical surface flow data). The current drought has resulted in reduced base flow and the advent of surface flow intermittence (U.S. Geological Survey historical surface flow data). Preliminary evidence suggests the shiner population may be in decline (Hoagstrom 2003). Without alleviation of threats, improvements in shiner status cannot be sustained.

E. Analysis of the Species/Critical Habitat Likely to be Affected

The shiner has undergone significant population declines and range contraction in the last 65 years. It is now restricted to about 194 mi (312 km) from Fort Sumner State Park to Brantley Reservoir. The decline is the result of various alterations to the Pecos River, most notably the diversion of water for irrigation and the storage of water in impoundments. Channel drying was recorded at the Acme Gage in 1989 (22 days), 1990 (32 days), 1991 (15 days), 2001 (5 days), and 2002 (at least 38 days). Because the gage at Acme was not operational for at least 20 days in August 2002, the exact number of days of intermittency in 2002 is not known (U.S. Geological Survey surface flow web site http://waterdata.usgs.gov/nm/nwis/discharge).

At the present time, the shiner population is unlikely to expand its distribution, because Santa Rosa and Sumner Reservoirs, FSID Diversion Dam, and Brantley Reservoir fragment river habitat and prevent upstream and downstream migration and colonization. Low base flows and river intermittency also limit movement of the shiner. Although the reach between Taiban Creek upstream to the FSID Diversion Dam (17 miles, 27 km) is almost always wet, shiners do not colonize this area, most likely because the habitat is not suitable (Hoagstrom 2003). Brantley Reservoir is a sink for millions of drifting shiner eggs and larvae and prevents downstream colonization (Dudley and Platania 1999). The possibility of increasing the range of the shiner appears remote.

River channel degradation has also impacted the range of the shiner. River channels below dams often become more stable as a consequence of an altered hydrograph (Polzin and Rood 2000, Shields et al. 2000). Exacerbating this effect is the presence of salt cedar. Salt cedar was first observed near Lake McMillan in 1914 and it expanded its range quickly thereafter (Thomas 1959). Encroachment of salt cedar has narrowed the river channel, especially in the lower critical habitat, leading to a degradation of shiner habitat. Artificial channel geometry was created between BLNWRMT and McMillan Reservoir through channelization efforts that were exacerbated by salt cedar invasion and reservoir operations (Corps 1999). At the same time, bed sediments were scoured from the reach between Sumner Dam and Taiban Creek confluence, leaving a gravel-armored channel (Tetra Tech Inc. 2000). The only reach that has retained an active river channel is between Taiban Creek confluence and BLNWRMT, but channel width and bed mobility progressively decrease downstream (Tashjian 1993, 1994, 1995, 1997; Tetra Tech Inc. 2000).

Decreased peak flows and extended peak flows for block releases have altered the natural hydrograph, to which the shiner is best adapted (Cross et al. 1985). There is increasing interest in oil and gas development near the Pecos River and in its flood plain (S. Belinda, BLM, pers. comm. 2003). This development could lead to more roads, pipelines, and potential sources of pollution into the Pecos River. Sediment entrapment in upstream and tributary reservoirs limit the amount of sediment available for the development of habitat (Sherrard and Erskine 1991).

Although shiner density was greater in 2001 than a decade ago, the intermittency in 2001 and 2002 may significantly reduce the number of shiners in the near future. In the 1990s, shiner numbers increased over a 5-year period (1991 to 1996). The increase in numbers was largely due to favorable flow conditions and absence of river intermittency. Drought conditions have reduced flows and increased river drying. Because the shiner has a short life span (3 years), extended drought conditions and subsequent river drying could severely impact the shiner population.

III. Environmental Baseline

Because this is a 3-year consultation, it is important to discuss the recent drought and how the current climate affects the environmental baseline. As of late January 2003, the state of New Mexico was experiencing drought conditions statewide affecting future spring runoff, soil moisture conditions, and streamflow outlooks. In early fall 2002, it was believed that precipitation events associated with a moderate El Niño would help relieve the drought (National Weather Service 2003). These precipitation events did not occur in January, but February had above normal precipitation (National Weather Service 2003). However, even if the wet weather continues, an above-normal spring runoff is unlikely (National Weather Service 2003).

If we look 3 years back in time, the annual mean runoff for water years 2000, 2001, and 2002, at the Acme gage has been 186 cfs, 105 cfs, and 64.3 cfs respectively (USGS 2001, 2002, http://waterdata.usgs.gov/nm/nwis/rt viewed February 26, 2003). The long term annual mean runoff at this site is 179 cfs (1938-2001) (USGS 2002). The lowest annual mean recorded (1964) was 56.8 cfs (USGS 2001); the 2002 value is the second lowest value recorded for the period of record (1938to 2002) (http://waterdata.usgs.gov/nm/nwis/annual/?site_no= 08386000&agency_cd=USGS viewed February 26, 2003). These values indicate that most likely the shallow groundwater table will be at least slightly depleted and the stream banks and bed will be drier than normal entering into the irrigation season of 2003.

Fortunately, the predictions for the Pecos Basin are in general better than they are for the rest of the state. As of February 1, 2003, the snowpack in the Pecos River basin was 88 percent of average(http://www.wcc.nrcs.usda.gov/water/snow/bor2.pl?state=nm&year=2003&month=2&format=text, viewed February 26, 2003). Several storms in New Mexico during February increased the amount of snow in the mountains. However, reservoir levels are still depleted with both Sumner and Santa Rosa at levels lower than last year at this time. Sumner Reservoir has 12,100 acre feet (af) (12,200 af last year) and Santa Rosa is at 12,900 af (16,700 af last year). Average values for these two reservoirs are 42,000 af and 64,500 af, respectively (http://www.wcc.nrcs.usda.gov/water/snow/bor2.pl?state=nm&year=2003&month=2&format=text, viewed February 26, 2003). Lack of water in storage will limit the management options available in 2003 and perhaps beyond.

Based on collections, the known range of the shiner included the mainstem Pecos River from Santa Rosa, New Mexico, to the New Mexico-Texas border (Chernoff et al. 1982), but it is likely the species occurred upstream to the Pecos River-Gallinas River confluence and downstream to, at least, Live-Oak Creek confluence (near Sheffield, Texas) because the Pecos River had similar characteristics throughout (Pope 1854, Newell 1891, Freeman and Mathers 1911, Dearen 1996). These characteristics included perennial flow, a wide-erosive river channel, and shifting sand-beds (Newell 1891, Fisher 1906, Freeman and Mathers 1911, Thomas 1959, Hufstetler and Johnson 1993, Dearen 1996). The reason the full extent of the historical shiner range is not well defined is that historical fish collections were few and collectors sampled the river at easily accessible localities such as bridge crossings and villages (Sublette et al. 1990).

Development of irrigated agriculture began in the early 1850s with acequia diversions from headwater reaches of the mainstem Pecos River and tributaries (U.S. National Resources Planning Board 1942). Large-scale diversion and impoundment of the mainstem Pecos River began in the 1880's (U.S. National Resources Planning Board 1942), while groundwater pumping became widespread after 1900 (Lingle and Linford 1961). By 1940, when systematic fish collections were initiated, Pecos River hydrology and geomorphology were already dramatically changed (Grover et al. 1922, U.S. National Resources Planning Board 1942, President's Water Resources Policy Commission 1950, Campbell 1958, Thomas 1959, Grozier et al. 1966, Ashworth 1990, Hufstetler and Johnson 1993). The response of Pecos River fishes to early human developments is unknown, but it is significant that the majority of native species were decimated in areas directly impacted by irrigation projects, such as the Pecos River between Carlsbad, New Mexico and Girvin, Texas (Campbell 1958). The same pattern has been documented in other sand bed streams (Arkansas and Cimarron rivers) (Cross et al. 1985). Native fishes have survived best in reaches with fewer direct impacts, such as the Pecos River between Taiban Creek and Salt Creek confluences (Hoagstrom 2000).

Currently, six dams (Santa Rosa, Sumner, FSID Diversion Dam, Brantley, Avalon, and Black River) largely control the flow of the Pecos River in New Mexico (Figure 1). The uppermost dam, Santa Rosa (completed in 1980), is operated by the Corps for flood control and irrigation. Sumner and Brantley dams are operated by Reclamation primarily for irrigation purposes and secondarily for flood control. Sumner Dam was built in 1937 and is 55 mi (88 km) downstream from the Santa Rosa Dam. The FSID Diversion Dam is located 14 mi (23 km) downstream of Sumner Dam and was completed in 1951. Brantley Dam was completed in 1989 and is 225 mi (360 km) downstream of Sumner Dam. Brantley Dam replaced McMillan Dam, which was completed in 1893.

The construction of the dams, and human activities have had many adverse effects on the Pecos River ecosystem over the last 100 years. Santa Rosa and Sumner Dams trap sediment needed for shiner habitat development and alter the downstream flow regime (Collier et al. 1996). When these effects are combined with the depletion of groundwater, diversion of Pecos River flows, capture of sediment by tributary dams, water pollution, and salt cedar colonization, the result is large scale changes to the Pecos River hydrograph and shiner habitat. The Pecos River downstream of Roswell has become highly incised, and is poor habitat for the shiner (Tashjian 1995, Hoagstrom 2002). The reach from Sumner Dam to the FSID Diversion Dam has become incised and armored with gravel and cobble (Hoagstrom 2003). This substrate does not provide the sand/silt habitat that the shiner prefers (Tashjian 1993, 1994, 1995, 1997; Hoagstrom 2000, 2001, 2002).

The FSID Diversion Dam diverts up to 100 cfs (2.8 m^3/s) for delivery to agricultural fields from March 1 through October 31. Water can also be diverted for two, eight-day periods during the winter; however, recently, this diversion has been made in the two weeks prior to the irrigation season (i.e., February 15 to March 1). Fort Sumner Irrigation District has no storage rights in the upstream reservoirs, but is entitled to water rights that predate Sumner Dam construction (1937). The water entitlement is based on a calculation made by the OSE from flow data collected every two weeks throughout the irrigation season. Reclamation releases water from Sumner Dam for FSID and the water travels 14 mi (23 km) downstream to the FSID Diversion Dam. The water is diverted into a main canal which is 15 mi (24 km) long and then into smaller lateral canals. The system also includes a drain canal which collects seepage and runoff from the fields and carries these return flows back to the Pecos River near the confluence of Taiban Creek. The return flows to the Pecos River may be up to half of the amount diverted, but were less than 20 cfs (0.6 m^3/s) in 2002. A pumpback system, located at the lower end of the irrigation canal, pumps from 10 to 15 cfs (0.28 to 0.42 m^3/s) from the main return canal back into lateral canals. A new pump which can pump 2 -3 cfs more than the old pump has further reduced the amount of water returning to the river (G. Dean, Reclamation, pers.comm. 2002).

The Pecos Bluntnose Shiner Recovery Plan stated that the operation of Sumner Dam had significantly altered flow regimes in the upper Pecos River (Service 1992). During the period 1913 to 1935, prior to dam operation, flows were never less than 1 cfs (0.03 m^3/s) at the Sumner Dam Gage. For the period after dam operation began, 1937 to 1990, flows less than 1 cfs (0.03 m^3/s) occurred an average of 55 days per year. After Sumner Dam was completed, it prevented all movement between the shiner population above and below the dam. Shiners were last collected above Sumner Dam in 1963 (Platania and Altenbach 1998).

The effect of upstream water storage and diversion on the downstream reaches of the Pecos River was to virtually eliminate floods (Table 1), eliminate winter inflows (Table 2), and reduce summer inflows (Table 3). These Tables and the implications for the shiner and its habitat are described in detail below.

The maximum release capacity of Sumner Dam is 1,400 cfs (40 m^3/s). Prior to the completion of Sumner Dam, flows greater than 1,400 cfs (40 m^3/s) occurred an average of 7 days per year and the lowest annual peak mean daily discharge was 2,020 cfs (57 m^3/s) (Table 1). By comparison, only two of 18 post-Sumner Dam years had mean daily discharge greater than 1,400 cfs (40 m^3/s) for an average of 1 day per year. The maximum mean daily discharge in the pre-Sumner Dam years was 26,200 cfs (740 m^3/s) while the maximum of the 18 post-Sumner Dam years was 1,980 cfs (56 m^3/s). This maximum was less than the lowest annual peak of the pre-dam period. Reduced peak discharge has caused the channel to become narrower, less braided, and to have less complex fish habitat (Tashjian 1993, 1994, 1995, 1997; Hoagstrom 2000, 2001, 2002).

Table 1. Summary of change in frequency and magnitude of flows > 1400 ft^3/s (maximum Sumner Dam release) at the Pecos River Below Sumner Dam Gage. The Fort Sumner gage represents inflow into the Pecos bluntnose shiner range. The pre-Dam summary was completed using mean daily discharge data for the 18 calendar years with complete records. The post-Dam summary was completed using the calendar years 1962 through 1979 (18 years). This period was chosen because it represented flow conditions after the 1950s drought, pre-Santa Rosa Dam, and pre-1980s and 1990s wet years. In other words, this 18-year period was the most ‘normal’ for the post-Sumner Dam period.

Period	Days	Days > 1400 ft^3/s	Mean Days per Year > 1400 ft^3/s	Years With Flows > 1400 ft^3/s	Maximum Discharge (ft^3/s)
Pre-Dam	6574	128	7.1	18	26200
Post-Dam	6574	18	1.0	2	1980

Before the construction of Sumner Dam, mean daily discharge in the non-irrigation season (winter), was 97 cfs (3 m^3/s) with a minimum flow of 41 cfs (1.2 m^3/s) (Table 2). After the dam was built (1962 to 1979), mean daily discharge in the winter was 6 cfs (0.2 m^3/s), a reduction of 94 percent. The storage of winter season base flows in Sumner Reservoir reduced the amount of water and habitat available to the shiner. Since 1998/1999, the winter season operation of Sumner Dam has been modified to divert water to storage only when not required to meet downstream flow targets at the Acme gage. Reclamation bypasses flows in the winter to target approximately 35 cfs at the Acme gage. Typically, 5 to 10 cfs are bypassed in November to supplement natural flows in the river. By February or March about 25 to 30 cfs are bypassed, depending on the natural flows. Flows coming into Sumner greater than the amounts bypassed to supplement natural flows are stored (Reclamation 2002).

Table 2. Summary of winter flows (i.e., flows reported for the typical FSID non-irrigation season, 1 November to 14 February) at the Pecos River Below Sumner Dam Gage. The Fort Sumner gage represents inflow into the Pecos bluntnose shiner range. The pre-Dam summary was completed using mean daily discharge data from the 18 calendar years having complete flow records. The post-Dam summary was completed using the calendar years 1962 through 1979 (18 years). This period was chosen because it represented flow conditions after the1950s drought, pre-Santa Rosa Dam, and pre-1980s and 1990s wet years. In other words, this 18-year period was the most 'normal' for the post-Sumner Dam period.

Period	Days	Mean ft^3/s	Minimum ft^3/s	Maximum ft^3/s
Pre-Dam	1908	97.3	41	265
Post-Dam	1908	6.0	0	99

During the irrigation season (March 1 to October 31), prior to Sumner Dam, the mean daily discharge flows exceeded 100 cfs (2.8 m^3/s) 147 days per year compared to 69 days per year after the completion of Sumner Dam (Table 3). Discharge adequate to overflow (greater than 100 cfs [2.8 m^3/s]) the FSID Diversion Dam during the irrigation season was recorded more than twice as often in the years prior to Sumner Dam, than in the post-Dam period. Overflow of the FSID Diversion Dam was less frequent and of greater magnitude after Sumner Dam was built because of block releases of water from Sumner Dam. Before November 1998, all water available above FSID's 100 cfs (2.8 m^3/s) requirement was stored in Sumner. Since 1999, the Sumner Dam operations have been modified to bypass water that is available above FSID's 100 cfs (2.8 m^3/s) requirement in an attempt to keep the water flowing in the reach from Sumner Dam down to the Acme gage. In 2002, water was bypassed on fewer than 5 days during the irrigation season.

Table 3. Summary of flows at the Pecos River Below Sumner Dam Gage during the FSID irrigation season (March through October). The pre-Dam summary was completed using mean daily discharge data for the 18 calendar years with complete records. The post-Dam summary was completed using the calendar years 1962 through 1979 (18 years). This period was chosen because it represented flow conditions post 1950's drought, pre-Santa Rosa Dam, and pre-1980's and 1990's wet years. In other words, this 18-year period was the most 'normal' for the post-Sumner Dam period. Since FSID can divert a maximum 100 ft^3/s, it was assumed that flows >100 ft^3/s overflowed downstream. Mean overflow for each period was calculated solely for the days in which overflow presumably occurred (discharge >100 ft^3/s).

Period	Days	Days > 100 ft^3/s	Mean Days per Year > 100 ft^3/s	Mean Overflow (ft^3/s)
Pre-Dam	4666	2649	147.2	355.7
Post-Dam	4666	1238	68.8	594.2

Dams have many downstream effects on the physical and biological components of a stream ecosystem (Williams and Wolman 1984). Some of these effects include a change in water temperature, a reduction in lateral channel migration, channel scouring, blockage of fish passage, channel narrowing, changes in the riparian community, diminished peak flows, changes in the timing of high and low flows, and a loss of connectivity between the river and its flood plain (e.g., Sherrard and Erskine 1991, Power et al. 1996, Kondolf 1997, Friedman et al. 1998, Polzin and Rood 2000, Collier et al. 1996, Shields et al. 2000). To our knowledge temperature studies on the Pecos River have not been conducted and it is not known how the temperature regime below

Sumner dam may be different from the historical temperature regimes. However, the other downstream effects have been noted. In particular, Sumner Dam has reduced sediment inflows from the upper basin, caused channel scour from the dam to the Taiban Creek confluence, and eliminated large floods. Large floods are an important component of riverine ecosystems because they maintain channel width and complexity, limit colonization of non-native vegetation, maintain native riparian vegetation, recharge the alluvial aquifer, increase nutrient cycling, and maintain the connection between the aquatic and riparian ecosystems (Ward and Stanford 1995, Schiemer 1995, Power 1996, Shafroth 1999). Sumner Dam blocks fish passage fragmenting the Pecos River and preventing shiners from migrating upstream. Shiners have been extirpated above Sumner Dam (none collected since 1963).

Reclamation diverts water to storage at Sumner Reservoir for the Carlsbad Project and then releases the stored water for the CID. The release of water occurs in “blocks” where large amounts of water (usually a minimum of 1,000 cfs [28 m^3/s]) are released over a short period of time. Blocks of water are used because less water is lost to evaporation and groundwater seepage during transport. Sumner Dam block releases occurred between one and four times per year from 1990 to 2001 (not including the years in which block releases were modified for hydrologic studies). The average annual number of block releases per year was 2.6. The block release durations ranged from 7 to 30 days, with an average of 15.7 days. Since 1999, the Sumner Dam irrigation season operations have been modified to: 1) limit the block release duration to a maximum of 15 days; and 2) limit block release timing and frequency.

Block releases that occur during the spawning season from May through September have adverse effects on the shiner by rapidly transporting their semi-buoyant eggs and larvae into Brantley Reservoir. The eggs require water velocity to remain suspended in the water column. In the reservoir, the eggs sink to the bottom and likely perish when they are covered with sediments and suffocate or are eaten by predators. Larval fish are likely eaten by predatory fish. Eggs and larvae drift downstream for a total of 3-5 days; the distance they travel depends on the rate of egg and larvae development and water velocity (Platania and Altenbach 1998). Assuming a drift rate of 1.8 mi/h (3 km/h), the eggs and larvae could be transported 176 to 220 mi (284 to 354 km) in 4 to 5 days. Swifter currents and a more uniform channel would carry the eggs and larvae a greater distance. Block releases exceeding 65 days per year have a cumulative negative effect on shiner size class distribution because many Age 0 shiners are transported into the Farmlands reach (Hoagstrom 2002). The effect is not as pronounced when the total is less than 65 days per year.

From monitoring conducted on one day of a block release in August 1997, it was estimated that approximately 22 million eggs would be transported into Brantley Reservoir (Reclamation 2002). That equals approximately 1.2 million eggs per day of a block release (Reclamation 2002). Clearly the number of eggs and larvae transported to Brantley will be highly variable depending upon the number of females producing eggs, the number of eggs produced per female, the magnitude of the discharge, and the timing within the spawning season. Eggs and larvae would enter Brantley Reservoir by natural flood flows without block releases, but the number would be much smaller (Dudley and Platania 1999). Very little retention of eggs and larvae occurs downstream of Roswell due to unsuitable habitat (relatively narrow and deep channel).

Groundwater pumping has reduced Pecos River base-flow. Local pumping reduced seepage inflows from Truchas Creek, near Fort Sumner (Akin et al. 1946) and along the Pecos River between Fivemile Draw and the U.S. Geological Survey surface water gaging station Near Acme (Shomaker 1971). Inflows from the Roswell Artesian Basin (from the Pecos River Near Acme to McMillan Dam) were severely reduced during the 1920s to 1950s (Fiedler and Nye 1933, Thomas 1959). Groundwater development of the Roswell basin aquifers reduced the amount of natural discharge into the Pecos River by 80 to 90 percent (Reynolds 1989 as cited in Reclamation 2002). The State of New Mexico has retired many of these water rights, and the result has been an increase in the water level in the Roswell artesian aquifer (Garn 1988, Balleau et al. 1999).

In 2000, Reclamation leased 3,492 af of water rights from river pumpers. Additionally, as a result of mediation in Federal District Court, Reclamation entered into an emergency forbearance program with FSID through which Reclamation paid for crops foregone as a result of reduced water use by participating FSID members. The Service provided additional funding ($100,000) in October 2000 to increase the number of irrigators participating in the forbearance program. This program resulted in additional water in the river downstream of the FSID Diversion Dam. In 2002, Reclamation leased approximately 4,500 af of water from a variety of land owners to make up for water bypassed for the shiner.

In March 2002, CID moved 27,000 af of irrigation water from Santa Rosa and Sumner Reservoirs, drawing Sumner down to its minimum pool of 2,500 af and leaving only 1,000 af in Santa Rosa. The combination or the early season block release and the drought conditions led to extensive river drying throughout the summer of 2002. With no storage left in the reservoirs, alternative water operation actions to limit intermittency and the effects of the drought on the shiner were precluded. The subsequent river drying killed shiners and dewatered approximately 38 mi (61 km), including 10 to 15 mi (16 to 24 km) of upper critical habitat (D. Propst, NMDGF, pers. comm. 2002, C. Hoagstrom, Service, pers. comm. 2002, USGS 2002 stream flow records as reported at: http://waterdata.usgs.gov/nm/nwis/rt). Sumner Reservoir was drained May 30 to June 1, 2002. As the reservoir was drained, silty, muddy water was released downstream affecting water quality in the Pecos River below the dam (G. Dean, Reclamation, pers. comm. 2003).

Before 2002, there was always a sufficient amount of water in Sumner Dam to bypass to meet FSID's calculated water right for water. From May 30 to June 1, 2002, Sumner Reservoir dried, stopping the bypass of water to FSID for 3 days. When there is no release from Sumner Reservoir for approximately 8 days, the probability of drying in the reach from Sumner Dam to the Taiban Creek confluence becomes very high (G. Dean, Reclamation, pers. comm. 2002). Repeated releases of small blocks of water from Santa Rosa Reservoir kept Sumner Reservoir from drying again after June 1.

In 2002, intermittency occurred in the Pecos River from near 6-mile Draw to Bitter Lake National Wildlife Refuge (38 mi [61 km]) and led to the death of shiners (D. Propst, NMDGF, pers. comm. 2002). The lower end of the upper critical habitat designated for the shiner became intermittent from near the DeBaca County line, downstream. The 30 mi (48 km) reach of the Pecos River from Taiban Creek to Dunlap normally remains perennial even in extremely low flow conditions. During low flows, the source of water for this reach is primarily from groundwater seepage, return flows from the FSID diversion canal, and Taiban Creek. A second, 2 mi (3 km) reach of river is kept wet because of the pumping of water from the Lynch Ranch Well. When the flow at the Acme gage falls to 10 cfs (0.28 m^3/s) pumping from the Lynch Ranch Well begins (G. Dean, Reclamation, pers. comm. 2002). After intermittency, it is believed that shiners from these two refugia repopulate the river downstream.

From May through August 2002, FSID diverted virtually the entire flow of the Pecos River (http://waterdata.usgs.gov/nm/nwis/rt viewed February 26, 2003). This caused river drying from the FSID Diversion Dam to the Taiban Creek confluence (10 mi [16 km]) and increased the probability of intermittency downstream of the Taiban Creek confluence. Fort Sumner Irrigation District's pumpback operation further reduces the amount of water returning to the river and increases the amount and duration of intermittency downstream (G. Dean, Reclamation, pers. comm. 2002).

The combined effects of Sumner Dam, block releases of water for CID, and water diversion and pumpback operations by FSID, have reduced the amount of water in the channel, increased the likelihood of the river drying, reduced the amount and suitability of habitat for the shiner, and decreased the survival of shiner eggs, larvae, and adults. Drought conditions in 2002, increased the difficulties of maintaining water in the river for the shiner. Diversions by FSID contributed significantly to river drying in 2002 and the early season block release by CID may have significantly reduced the opportunity to alleviate later season drying.

IV. Effects of the Action

The Service must consider the direct and indirect effects, as well as the effects of interdependent and interrelated actions to the shiner. Indirect effects are those that are caused by, or result from, the proposed action, and are later in time, but are reasonably certain to occur.

The number of river miles that may be dewatered, the frequency and duration of drying events, and the number of years within the 3-year life of the project in which major drying events occur are dependent on many variables in addition to the proposed action. These variables include precipitation and other climatological conditions, the ability to store water in upstream reservoirs, and the availability of supplemental water for leasing. Long-term moisture deficits have led to extremely low soil moisture conditions that will significantly decrease spring runoff (Natural Resources Conservation Service 2003). There is evidence that the Pacific Decadal Oscillation (PDO) cycles, a measure of sea surface temperatures in the northern Pacific Ocean, mimic precipitation levels in the Southwest, specifically New Mexico (Liles 2000a, 2000b). The previous positive cycle (i.e., high levels of precipitation in New Mexico) occurred from 1977 to the late 1990s (Liles 2000a). Data suggest that the PDO cycle has been negative since 1998, indicating the beginning of a dry precipitation cycle in New Mexico (Liles 2000a). "The data would suggest, during an average 10-year period during the negative part of this [PDO] cycle, there would be 5 dry years, one wet year, and four normal years (Liles 2000a)." Overall, below average precipitation levels are expected until at least 2010 and possibly until 2025 based upon this PDO cycle (Liles 2000a, 2000b). Consequently, it is reasonable to expect that over the next several years, New Mexico will most likely experience several dry or average years. While forecasts vary and can certainly change as conditions change, based on the Surface Water Supply Index (calculated from snowpack, streamflow, precipitation and reservoir storage) the Pecos Basin may experience a severe drought in 2003 (http://www.nm.nrcs.usda.gov/snow/forecast/wy03/maps/ nm2swsi.htm.Viewed February 24, 2003).

Because of the current low levels of water storage in Santa Rosa and Sumner Reservoirs (20 percent and 29 percent of average, respectively), management options for 2003 and perhaps beyond are much more limited than if the reservoirs were full. Unless the spring of 2003 brings precipitation and runoff well above normal, based on 2002, it is likely that there will be significant periods of intermittency in the Pecos River during the summer. Without a change in management practices, if 2004 and 2005 are also dry years, intermittency could be even more extensive (i.e., greater than 38 miles) than seen in 2002 because of decreasing soil moisture, a depletion of the shallow groundwater table, and potentially entering each irrigation season with less water in storage.

Because block releases over the last three years have occurred in a range of wet to dry years, we review in detail the block releases that have occurred since 2000 as an indicator of how block releases may be managed in the next three years. As mentioned earlier (Environmental Baseline), 2000 was a wet year with the annual mean flow at Acme above the long-term annual mean. In 2000, there were 4 block releases: February (9 days), May (16 days), July (15 days) and August (15 days). Intermittency did not occur in 2000. Flows were low in May before the block release (4.3 cfs) and became low again in late September and early October but were always over 2 cfs. In 2001, there were 2 block releases, one that lasted 17 days (May) and 1 that lasted 10 days (July). The water from the block release in July arrived at Acme after it had been dry for four days at that site. Although flow became very low again (0.1 cfs) in August, it appears the site did not dry completely (USGS 2002). In March 2002, there was 1 block release that lasted 11 days. Because it occurred so early in the irrigation season, it effectively eliminated all options to alleviate intermittency later in the season. Had the water been held until May, it could have shortened the length of time of intermittency that occurred in May and June.

Although block releases are maintaining channel width, as discussed in the Environmental Baseline, peak flows are now much lower than they were before Sumner Dam was built (Table 1). The maximum release capacity of Sumner Dam is 1,400 cfs (40 m^3/s). Prior to the completion of Sumner Dam, flows greater than 1,400 cfs (40 m^3/s) occurred an average of 7 days per year and the lowest annual peak mean daily discharge was 2,020 cfs (57 m^3/s) (Table 1). By comparison, only two of 18 post-Sumner Dam years had mean daily discharge greater than 1,400 cfs (40 m^3/s) for an average of 1 day per year. The maximum peak flow since 1938 occurred in 1941 and was estimated to be 45,000 cfs (1274 m^3/s). Biological consequences of diminished peak flows can include changes in the riparian vegetation (Polzin and Rood 2000), aquatic macroinvertebrate species composition (Sheldon et al. 2002), nutrient exchange processes (Schiemer 1995), and shorter food webs (Power et al. 1996). These changes could have an indirect effect on the fish community including the shiner. However, these complex ecosystem interactions have not been investigated on the Pecos River.

Disturbance (e.g., flooding, debris flows, drying) is a normal occurrence in stream ecosystems. For large, western rivers, the primary disturbance, and the one to which its biota are adapted, is flooding (Meffe and Minckley 1987, Resh et al. 1988, Poff and Ward 1989). Certainly the majority of research on disturbance in stream ecosystems has focused on flooding (e.g., Meffe and Minckley 1987, Grimm and Fisher 1989, Pearsons et al. 1992, Angradi 1997). Biota may be adapted to drying; however, adaptations to drying are seen in the biota of streams that regularly go dry, such as those in Mediterranean climates (Gasith and Resh 1999).

In a perennial river, drying is considered a “biologically devastating phenomenon” (Stanley and Fisher 1992). Although it is not known with certainty if the Pecos River was once perennial in the affected area, intermittency, if it occurred, would certainly have been a rare event and abundant oxbow lakes and side channels would most likely have provided refugial habitat for organisms. In addition, the lack of barriers to dispersal (dams) would have ensured repopulation of areas affected by drying. The biota of perennial rivers are not resistant to drying; that is they have no mechanisms or adaptations to survive during an absence of water. When the water disappears the organisms must either disperse to follow the receding water or die. Some species may be resilient to drying in the sense that once the river is whole again, their population can rebound fairly quickly. Resilience has been documented for aquatic insects (Gray and Fisher 1981, Molles 1985) and some species of fish (Larimore et al. 1959). The resilience of shiner to drying is not known; however, its slow rebound after past periods of intermittency on the Pecos is reason for concern. There were extended periods of intermittency from 1989 to 1991 (15-32 days per year). When population monitoring began in 1992, the density and relative abundance of shiner were at the lowest levels recorded (Figures 3 and 4) (Hoagstrom 2003). It took 11 years for the density and relative abundance to slowly increase with reduced intermittency and increased flows created by a series of years with above normal precipitation and more frequent bypass flows (Figures 3 and 4) (Hoagstrom 2003).

The time it takes for a species to recover after disturbance is roughly related to the organism’s size and generation time (Fisher and Grimm 1991). Bacteria and algae can recover from disturbance in a couple of weeks, while larger organisms (fewer generations per year) take much longer. Typically after a disturbance, community dynamics change (as evidenced by the change in percent composition in the shiner guild). Good colonizers or species that survive in higher numbers take advantage of the available habitat and have a competitive advantage over their competitors. This effect has been demonstrated for aquatic invertebrates and trout (Allan 1995). It is unknown how the change in percent composition within the shiner guild will affect the ability of the shiner population to rebound. However, as noted above, it took 11 years for the shiner population to slowly increase.

Direct Effects

Reclamation's proposed operation to bypass available inflows to target 35 cfs (1 m^3/s) at Acme is intended to augment base flows for the shiner and improve habitat conditions by increasing the wetted area of the river. Although this target is beneficial to the shiner, and can typically be met during the winter, the target was not attainable during the 2001 and 2002 irrigation seasons. From May to September 2002, FSID diverted virtually the entire flow of the Pecos River and water was available for bypass flows on fewer than 5 days (http://waterdata.usgs.gov/nm/nwis/rt, viewed February 26, 2003). The river became intermittent during the irrigation seasons of 2001 and 2002. Although the number of shiners that died in the intermittent reach in 2002, cannot be known with precision, mortality was documented (D. Propst, NMDG&F, pers. comm. 2002). A portion of the shiner eggs, larvae, and adults that repopulated the rewetted reach in July, most likely died during the periods of intermittency that occurred in August and September.

If the current drought continues as predicted, it is unlikely that there will be sufficient water during the irrigation season to meet the 35 cfs target. Consequently, it is highly likely that intermittency will occur in the 2003 irrigation season, and possibly in 2004 and 2005. Stream drying causes direct mortality to shiners when the pools in which they are trapped dry. Mortality can occur before complete drying of the pools if the combination of dissolved oxygen level (too low) and water temperature (too high) become lethal. Changes in pH, salinity, carbon dioxide, and ammonia levels can make the fish more vulnerable to changes in dissolved oxygen or can be lethal on their own. Fish trapped in pools are easy prey for both terrestrial and avian predators and may also be eaten by predatory fish if they are trapped in the same pool (e.g., Larimore et al. 1959).

It is difficult to predict the duration of channel drying or its extent. Obviously, the longer the period of intermittency and the greater the extent, the greater the magnitude of impact on the shiner population. It is reasonable to predict that drying will occur after spawning. Typically, eggs and juvenile fish are more vulnerable to environmental extremes than adults (Hoar and Randall 1969). Consequently, drying events that occur during the summer can potentially have a great impact on the success of the reproductive effort of the shiner. Mortality of YOY is often high but with the added stress of environmental extremes, we predict that mortality of eggs and larvae trapped in isolated pools will be even higher than normal. Because the shiner is a short-lived fish, poor reproductive success of one year class can have a significant impact on the population. If there are consecutive years of intermittency and decreased reproductive success, the population can soon be reduced to very low levels.

In May, June, and August 2002, the Lynch Ranch Well water maintained up to 2 mi (3 km) of flowing water in the intermittent reach upstream of Acme. Reclamation anticipates that this source of water will be available in the future. This reach may serve as a refugium for a small number of shiners, but it is unlikely that there are enough shiners in this area to effectively repopulate the intermittent reach once flow resumes. The primary source population will be shiners from the upper critical habitat (from the Taiban Creek confluence to Dunlap). The perennial nature of the this reach and the relatively natural channel is the primary reason the shiner still persists in the Pecos River.

From 1938 to 2002, block releases have occurred 0 to 5 times per year. After irrigation block releases are made to CID, bypass flows are continued to meet FSID's water right up to 100 cfs (Reclamation 2002). All inflows available above 100 cfs are bypassed, when necessary, to meet the target flow at Acme (Reclamation 2002). Block releases that occur during the spawning season from May through September have a direct effect on the shiner by rapidly transporting their semi-buoyant eggs and larvae into Brantley Reservoir (Dudley and Platania 1999). The eggs and larvae die in the reservoir from predation and lack of appropriate habitat. Although eggs and larvae are lost into Brantley Reservoir during natural flood events, the number is less because the peak of a flood hydrograph lasts for a very short time (several hours). In contrast, the peak flow in a block release is maintained for several days (10-15). The narrow channel and lack of slack and back water habitat in the lower reach of critical habitat results in fewer eggs and larvae being retained in that reach, poor survival and growth of the juveniles, and greater transport of eggs and larvae into the reservoir (Hoagstrom 1997, 1999, 2000, Dudley and Platania 1999). Block releases do help maintain channel morphology (Tetra Tech 2003).

Indirect Effects

The indirect effects of intermittency on the shiner have not been investigated, but based on knowledge of stream ecology and fish biology, several indirect effects can be predicted. It is more difficult to predict how many shiners may die or be harmed from indirect effects. Fish typically function best within a relatively narrow range of water quality characteristics such as water temperature, pH, dissolved oxygen, and salinity. When fish are subjected to conditions outside their preferred range it causes physiological stress (Schreck 1990). The longer the fish is subjected to unfavorable conditions the greater the stress (Barton et al. 1986). Consequences of physiological stress are typically a decrease in fitness (lowered reproductive success) (Donaldson 1990) and an increased susceptibility to disease (Anderson 1990). Fish can be afflicted by viral, bacterial, and fungal infections and internal and external parasites. Disease can cause death or lead to decreased fitness. When fish are trapped in isolated pools and the water quality of the pools deteriorates, the fish become increasingly stressed. If continuous flow is restored before the fish dies, the fish may survive but eventually succumb to disease or produce fewer (or smaller) eggs as a consequence.

When an ecosystem is disturbed, species that are generalists or species with habitat requirements that more closely match the disturbed system will flourish and species that are specialists or that have more specific habitat requirements typically become less abundant or are eliminated (Allan 1995). In 2002, a dramatic decline in the relative abundance of shiner was documented both by NMFRO and Valdez et al. (2003) (Table 4). The long-term consequences of this shift in species composition is unknown. However, based on research on other aquatic species (McAuliffe 1984, Allan 1995), it is possible that a competitive advantage was gained by red shiner that could slow the recovery of the shiner. Unfortunately, the extent of competition among the species within the Pecos River has not been investigated so the magnitude of this effect (if it occurs) is unknown.

Table 4. Relative abundance (percent) of shiner and red shiner in the shiner guild from seine haul collections made in 2002. NMFRO collections were made in April, August, and October. Valdez et al. (2003) collections were made in May, June, and October. NMFRO collections included sites from Brantley Reservoir inflow (River mile 483.7) upstream to Old Fort Sumner State Park (river mile 673.5). A total of 23,230 fish in the shiner guild were collected. Valdez et al. collections were from three sites (Yeso Creek, Cedar Creek, and Fivemile Draw). They collected 6,043 fish in the shiner guild.

Pecos bluntnose shiner	Spring	Summer	Fall
NMFRO	18.4	14.9	5.0
Valdez et al.	20.9	22.6	3.7
Red shiner			
NMFRO	75.7	58.6	75.0
Valdez et al.	43.6	25.4	62.5

In a flowing river, food resources and nutrients are carried downstream continuously (Allan 1995). When the flow is interrupted, this transport of material is stopped. Nutrient cycling and nutrient spiraling systems are disrupted (Stanley et al. 1997). How long it takes for the system to regain its equilibrium is unknown. Possible consequences of this disruption of nutrient cycles are changes in the amount and quality of food available to shiners. In addition, nearly all the aquatic macroinvertebrates (a food source for shiner) that lived in the intermittent reach would die as the river dried. While macroinvertebrates are typically resilient to disturbance and their populations can rebound fairly quickly (Molles 1985), most are not resistant to dessication (Boulton et al. 1992, del Rosario and Resh 2000). Repeated drying events will reduce their populations. If less food is available or if it is of lesser quality it could affect the growth, condition, and fitness of the shiner. Consequently, fewer, or smaller (less fit), eggs may be produced. If intermittency occurs several years in a row, the net effect could be the production of fewer shiners.

Effects to Critical Habitat

Constituent elements of the critical habitat include clean, permanent water; a main river channel with sandy substrate; and low water velocity. Of these constituent elements, maintaining clean, permanent water will be most affected by the project proposal because intermittency may occur, especially if the drought continues. It is not anticipated that the lower section of critical habitat will become intermittent.

The second constituent element likely to be affected is the maintenance of a wide channel with sandy substrate. Reduced peak flows cause channel narrowing (Friedman et al. 1998) and allow non-native vegetation to encroach on the channel (Shafroth 1999, Polzin and Rood 2000, Shields et al. 2000). Once non-native vegetation is established, it maintains a narrower channel leading to increased water velocities and the loss of fine sediments such as sand. Peak flows also maintain high levels of habitat diversity through channel migration (Ward and Stanford 1995). A reduction in peak flows reduces channel migration and channel complexity (Shields et al. 2000). The result is less habitat is available to the shiner. Although block releases help maintain the existing channel width, the magnitude of the block release is limited by Sumner Dam and is much less than historical peak flows leading to a reduction in shiner habitat.

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 BO. 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. Although many adverse effects have occurred to the shiner, it appears that river intermittency is the primary threat to the continued existence of the shiner.

Cumulative effects include:

- Increased urban use of water, including municipal and private uses. Further use of surface water from the Pecos River will reduce optimal river flow and decrease available habitat for the shiner.

- The diversion of up to 100 cfs (2.8 m^3/s) from March 1 through October 31, by FSID and the pumpback operation that sends return flows back to agricultural fields. The FSID diverts 100 percent of the river onto agricultural fields when their calculated allotment is 100 cfs or less. In dry years, seldom does the calculated allotment reach 100 cfs (2.8 m^3/s). Consequently, FSID is able to divert the entire natural flow. This reduction in flow played a large role in the drying of the river in 2002 (Reclamation 2002). It is expected that the diversion will continue to have a significant impact on the amount of water available to the river in the future. Without a pumpback system as much as half the diverted water returns to the river. With the pumpback operation, less than 20 cfs (0.6 m^3/s) returned to the river in 2002 and it is expected that similar low returns will occur in the future. The FSID diversion reduces river flow, reduces shiner habitat, and increases the probability of river drying and subsequent mortality of shiners.

- Continuing change in floodplain vegetation from native riparian species (i.e. willows, cottonwoods) to non-native species (i.e., salt cedar). A channel lined with a dense corridor of salt cedar results in a narrow, relatively deep river channel because the water is constricted within the armored banks. Water velocity in a constricted channel is greater than in a wide braided channel. Small substrate such as silt and sand can be carried by the faster current, leaving a channel dominated by cobble and gravel, which is not suitable habitat for the shiner. In addition, the higher water velocity increases downstream transport of shiner eggs and larvae. Backwater areas with low velocity, favored by the shiner, are reduced.

- Capture of sediment by dams on streams tributary to the Pecos River. There are many flood control dams built to protect municipalities that effectively stop the input of fine sediments into the Pecos River. The shiner prefers a silt/sand substrate. Reduction of these fine materials can alter the substrate composition over time.

- The water quality of irrigation return flows to the Pecos River is unknown. However, irrigated agriculture amounts to 84 percent of total water use in De Baca, Chaves, and Eddy counties (Department of Interior 1989). Typically, irrigation return flows are higher in salts than freshwater and may also contain pesticides, herbicides, and elevated amounts of nutrients (nitrogen and potassium) from fertilizers used on crops (http://www.fao.org/docrep/W2598E/w2598e04.htm). When irrigation return flows are diluted by natural flows water quality is not usually a problem. However, in situations where return flows provide a large portion of the total water available to the shiner (i.e., below the FSID diversion canal) and the pesticides, herbicides, and nutrients from fertilizers become further concentrated as the water evaporates, it is possible that water quality could negatively affect the shiners. This would be especially true if shiners were caught in isolated pools that were drying.

- Oil and gas development. There is extensive development of oil and gas wells between Artesia and Carlsbad with associated roads and pipelines. Most of the pipelines are laid on top of the ground. Many pipelines cross ravines and some cross the Pecos River. Leaks and breaks in the lines have been documented (Steve Belinda, Bureau of Land Management, pers. comm. 2002). Delivery of petroleum products to the Pecos River either directly or by storm runoff, could have a negative impact on the shiner.

In summary, human activities have had many adverse effects on the Pecos River ecosystem in the last 100 years. Although many adverse effects have occurred, it appears that lack of permanent flow and an altered hydrograph (diminished peak flows and sustained block flows) are the primary threats to the continued existence of the shiner.

V. Conclusion

After reviewing the current status of the shiner, the environmental baseline for the action area, the effects of the proposed water operations, and the cumulative effects, it is the Service’s biological opinion that the proposed Pecos River water operations as proposed, is not likely to jeopardize the continued existence of the shiner, and is not likely to destroy or adversely modify designated critical habitat.

The Service's conclusion is based on the premise that Reclamation's proposed action will, at a minimum, maintain flowing water through critical habitat even during dry years and that in average to wet years (as defined in the Reasonable and Prudent Measures section) additional water will be bypassed for the shiner. For the period of this consultation (3 years) in which it appears that the state will remain in a drought cycle, the primary focus will be to avoid intermittency in all years. In average hydrologic years, 20 cfs will be targeted at the Acme gage during the irrigation season and 35 cfs will be targeted at the Acme gage in the non-irrigation season. In wet years, 35 cfs will be targeted year-around at the Acme gage. While these values may not be optimal, they will ensure the continued existence of the shiner through this drought period.

VI. Incidental Take Statement

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct) of endangered and threatened species, respectively, without special exemption. 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 to any applicants, as appropriate, for the exemption in section 7(o)(2) to apply. Reclamation 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 the applicant to adhere 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

Based on the best available information concerning the habitat needs of this species, the project description, and information furnished by Reclamation, from the date of this biological opinion, through February 28, 2006, take of the shiner will occur. Take will occur in the form of harm, harassment, and kill.

Adult shiner populations generally increased until the summer of 2002 (Hoagstrom 2003), indicating that block releases less than 15 days did not significantly affect adult shiner population numbers upstream. Therefore, we do not anticipate that block releases will result in take of adult shiners.

The Service anticipates that shiner eggs and larvae will be taken as a result of this proposed action. This incidental take is expected to be in the form of harm, harass, and kill as the result of block releases during the spawning season. These block releases are anticipated to transport the eggs and larvae downstream into Brantley Reservoir. This will harm many eggs and larvae by modifying their habitat and subjecting them to abnormally large and lengthy discharges that will transport them into Brantley Reservoir where death will occur, or where they will be unable to successfully develop and breed and thereby contribute offspring to the next generation. It will also harass larvae through the disruption of the normal behavior pattern of seeking sheltered mesohabitats as they would under more natural, lower discharges. It is anticipated that killing of larvae and eggs will occur when they reach Brantley Lake through consumption by predatory fish, by exposure to higher salinity, or by other unsuitable habitat conditions in the reservoir. Reclamation’s BA estimates that approximately 1.2 million eggs could be transported into Brantley Lake per day of block release (Reclamation 2002). Because the survival of shiner from egg to adult is probably 1 percent or less (Reclamation 2002), in this particular case, approximately 12,000 adults are potentially lost to the population. Loss of these individuals has an adverse effect on the population. The precise level of incidental take is difficult to identify and quantify because shiner eggs and larvae are similar in size and color to four other fish species in the Pecos River.

Because the proposed action is expected to provide continuous flow through critical habitat, and optimally will avoid intermittency throughout the river, the Service anticipates that take of shiner eggs, larvae, or adults will not occur as the result of intermittency in the Pecos River.

The Service anticipates incidental take of shiners will be difficult to detect for the following reasons: The small size of the species’ eggs and larvae, their similarity to those of other species in the Pecos River, and the wide area over which take is anticipated will make it difficult to identify and monitor total incidental take. However, the level of take of this species can be measured by monitoring the relative abundance of the shiner within the shiner guild. The percent shiner within the shiner guild has been calculated by year since 1990 (Figure 7) (Hoagstrom 2003). If over the 3-year time frame of this consultation, the percent of shiner within the shiner guild falls to 5 percent or less, incidental take will be exceeded. Population monitoring must be conducted in a manner comparable to the last 10 years (Hoagstrom 2003). Five percent represents the mean lowest value recorded for the shiner within the shiner guild over the last 13 years. The population was able to recover from this low level over 8 years and we are assuming that if it reaches this low level, it will be able to recover again if conditions improve. Proportion of guild is used rather than population because we have good baseline data on that measure and it is related to the overall population size. This surrogate measure of incidental take is related to take of larvae and eggs by the impact of loss of those larvae and eggs to recruitment of adults into the population the following year.

Effect of the Take

In the accompanying biological opinion, the Service determined that the level of anticipated take is not likely to result in jeopardy to the shiner or destruction or adverse modification of critical habitat.

VII. Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the shiner.

1. Maintain flows in the Pecos River commensurate with the hydrologic year. We feel that it is appropriate to adjust the amount of water provided for the shiner to reflect the hydrologic conditions present each year. To meet this goal we have defined dry, average, and wet years based on "effective Brantley storage" in conjunction with the Palmer Drought Severity Index (PDSI). Effective Brantley storage is defined as:

Avalon + Brantley + (0.75 x Sumner) + (0.65 x Santa Rosa).

The monthly PDSI records from 1895 to 2003 were averaged to get previous nine and two month average values on each April 1 evaluation date. Results were then classified for each interval (9 month, 2 month, and 1 month) as being wet, dry, or average. If all indices were average, then that year was average. However, if any one of the indices were wet or dry, then that year was classified as such. None of the years had both wet and dry indices. As a result of this analysis the following definitions were developed:

Dry year: Effective Brantley storage is less than 75,000 af.

Average year: Effective Brantley storage is greater than 75,000 af and less than 110,000 af.

Wet year: Effective Brantley storage is greater than 110,000 af.

Storage will initially be assessed on March 1. However, because the amount of water in the system can change dramatically in the Pecos basin, Reclamation, the Service, the State and other interested parties will meet regularly (May 1, June 1, July 15, September 1) to assess the amount of water in storage to see if there has been a marked increase or decrease. Flow targets could be adjusted if there was a substantial increase or decrease in storage. The flow targets are set for the period of this consultation only (3 years), recognizing and expecting that over this time frame the state most likely will remain in a drought cycle. Under a different set of conditions (e.g., after a series of wet years) these targets could be modified in an attempt to increase the shiner population.

2. Work with interested parties to explore alternatives or modifications to block releases to reduce incidental take of shiner eggs and larvae while maintaining river flows for adult shiners and meeting the needs of water users.

3. Monitor the status of the shiner population to ensure that incidental take of eggs and larvae is not limiting recruitment of adult shiners to an extent that will not sustain the population.

4. Under the proposed action, intermittency is not expected to occur. However, if intermittency does occur, monitor river drying. The length of river that dries, the number of days that it remains dry and the number of dead fish seen must be recorded.

Terms and Conditions

In order to be exempt from prohibitions of section 9 of the Act, Reclamation must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following implements reasonable and prudent measure 1:

a. Dry years. From March 1 to November 1, maintain flow through upper critical habitat and avoid intermittency at the Acme gage if at all possible. From November 2 to February 28 target a low flow of 35 cfs at Acme. Schedule block releases from May to September to alleviate the lowest of low flows.

The intent in the dry years is to avoid intermittency if at all possible. If not enough water is available to maintain a connected river, then, at a minimum, flowing water should be maintained through upper critical habitat. Maintaining flow will provide at least a minimal amount of habitat and reduce mortality of all life stages from entrapment in isolated pools.

b. Average years. From March 1 to November 1, target a low flow of 20 cfs at the Acme gage. From November 2 to February 28, target a low flow of 35 cfs at Acme. Schedule block releases from May to September to alleviate low flows during the summer. Higher flows in average years will provide backwater and slack water habitats for retention and growth of larval fish, increasing their survival. Water quality (water temperature, dissolved oxygen, pH, ammonia, salinity) is expected to be more consistent and not be a source of stress for fish, leading to increased fitness and survival of all life stages. It is also expected that food resources would be greater with an increase in water, leading to better growth and survival and a reduction in take.

c. Wet years. Target a low flow of 35 cfs at the Acme gage throughout the year. Whenever possible, higher flows should be bypassed for the shiner and maintenance of channel morphology. It is expected that higher flows will lead to better recruitment and survival because of increases in habitat availability and suitability. With an increase in wetted area, food resources are expected to increase, competition with other fish is expected to decrease, and the survival and fitness of the shiner is expected to increase.

The following implements reasonable and prudent measure 2:

Initiate a working group for Pecos River water management so that managers, researchers, and water users can meet on a regular basis to communicate about management issues. The goal would be to try to reach a common understanding of the issues, build trust among the groups, and try to think of innovative ways to manage the river to reduce the incidental take of shiner.

The following implements reasonable and prudent measure 3:

Continue population monitoring of the shiner using methods and sites that are consistent with the surveys that have been conducted over the last 11 years. A minimum of 4 collections will be made during the year, with at least 2 months separating each collection. Collections should not be made when discharge is greater than 250 cfs. Twelve to fifteen sites will be sampled between Sumner and Brantley Reservoirs. Ten to twenty seine hauls should be made at each site, depending on habitat complexity, discharge, and fish abundance (i.e., if habitat heterogeneity is high or fish abundance is low, more samples would be taken). Results from each seine haul should be recorded individually (i.e., do not lump all seine hauls from one site together). All mesohabitats at a site should be sampled at least once. Seine hauls should be taken roughly in proportion to the area of the mesohabitat types present (i.e., if 80 percent of the area is a run then the majority of seine hauls should occur in runs). The length, area, and mesohabitat type of each seine haul should be recorded. Sample design should be evaluated and coordinated yearly with NMDGF and NMFRO.

The following implements reasonable and prudent measure 4:

a. Install a video camera at the lower end of the upper critical habitat to monitor river drying by September 2003.

b. Once drying begins, accurately document the extent of intermittency. This could be accomplished by flying the river, through the use of video cameras, by having personnel visit the site, or by a combination of these methods. The extent of intermittency has not been accurately documented in the past and it hampers efforts to assess the impacts of intermittency and leads to disputes over the extent of river drying.

c. A field crew will monitor the condition of accesible isolated pools daily until continuous flow is restored. Water quality (dissolved oxygen, pH, conductivity and water temperature at a minimum) will be recorded in the isolated pools. Surface area and depth of the pools should be recorded daily. Signs of predation by mammals or birds will be recorded. If dead fish are seen in a pool, the pool will be thoroughly seined and all fish collected and preserved. Pools in which dead fish are not seen will not be seined. However, it is recommended that underwater observations are made using an underwater viewer or using a face mask and snorkel. Once the river begins to dry, this information will be transmitted to the Service weekly.

The Service believes that incidental take will not limit the ability of the shiner population to sustain itself. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. Reclamation must immediately provide an explanation of the cause of the taking and review with the Service the need for possible modification of the reasonable and prudent measure.

Reporting Requirements

The nearest Service Law Enforcement Office must be notified within 24 hours in writing should any listed species be found dead, injured, or sick. Notification must include the date, time, and location of the carcass, cause of injury or death (if known), and any pertinent information. Care should be taken in handling sick or injured individuals and in the preservation of specimens in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. If necessary, the Service will provide a protocol for the handling of dead or injured listed animals. In the event Reclamation suspects that a species has been taken in violation of Federal, State, or local law, all relevant information should be reported in writing within 24 hours to the Service's New Mexico Law Enforcement Office (505/883-7814) or the New Mexico Ecological Services Field Office (505/346-2525).

VIII. Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act 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.

1. Reclamation should work with the state, CID, and the Service to create a permanent

conservation pool in Santa Rosa and/or Sumner reservoirs, consistent with state and federal law. The conservation water would be released during low flow periods to maintain river base flows and limit intermittency to protect the shiner.

2. The Service and Reclamation should encourage CID and FSID to develop a Habitat Conservation Plan for the shiner. This plan would provide CID and FSID with incidental take permits under Section 10(a)(1)(B) for their water operations.

3. Reclamation should cooperate with the Corps, CID and FSID in developing river restoration projects to benefit the shiner. These could include the removal of salt cedar, destabilizing the banks and widening of the channel, especially in the reaches below BLNWR.

4. The New Mexico Department of Agriculture (NMDA) is currently administering the New Mexico Saltcedar Control Project through local soil and water conservation districts along the Pecos River. To improve habitat for shiner, Reclamation should collaborate with NMDA to investigate the possibility of removing stands of dead salt cedar and destabilizing the river banks so that the river can become reconnected with the flood plain.

5. Reclamation should continue to pursue opportunities for leasing water to provide supplemental water to the shiner consistent with state and federal law.

6. Determine water quality impacts on the shiner.

7. Conduct studies to determine the long term (indirect) effects of physiological stress on the shiner. These studies could include collecting shiner from isolated pools and documenting survival, appearance of fungus or disease, and quantity or quality of reproductive products (eggs and sperm). Plasma concentrations of cortisol or glucose could be measured after simulating stress or after collecting shiner from isolated pools.

8. Examine competitive interactions among the Pecos River fishes to determine the extent that non-native fish or the red shiner may affect the shiner population.

9. Investigate the possibility of modifying outlet structures at Sumner Dam so that releases greater than 1,400 cfs could be made.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations. These accomplishments may be reported in the weekly conference calls and notes.

IX. Reinitiation Notice

This concludes formal consultation on the action(s) outlined in the December 13, 2002, request. As provided in 50 CFR § 402.16, reinitiation 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 critical habitat in a manner or to an extent not considered in this BO; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this BO; or (4) a new species is listed or critical habitat designated that may be affected by the action. This consultation is only valid until February 28, 2006 and therefore consultation must be reinitiated prior to the expiration of this BO to ensure continued compliance with section 7 and 9 of the Act. Updates of any environmental commitments may require reinitiation of consultation. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation. Any questions regarding this BO should be directed to Lyle Lewis or Marilyn Myers at (505) 761-4714 and 761-4754, respectively.

Joy E. Nicholopoulos

cc:
Assistant Regional Director, U.S. Fish and Wildlife Service, Region 2 (ES), Albuquerque, New Mexico
Regional Section 7 Coordinator, U.S. Fish and Wildlife Service, Region 2 (ES), Albuquerque, New Mexico

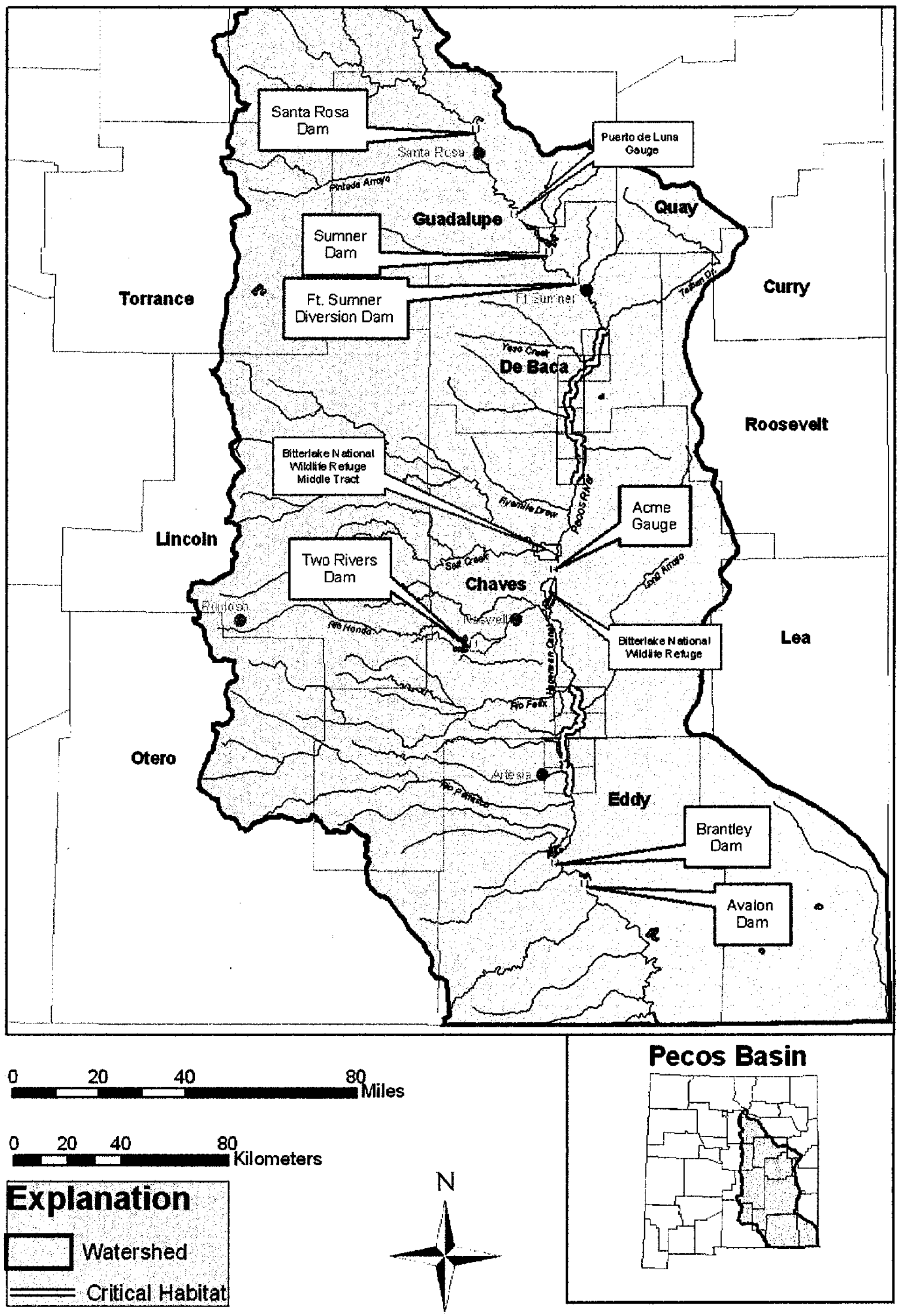


Figure 1. Pecos bluntnose shiner critical habitat, dams and two gauging stations on the Pecos River, New Mexico.

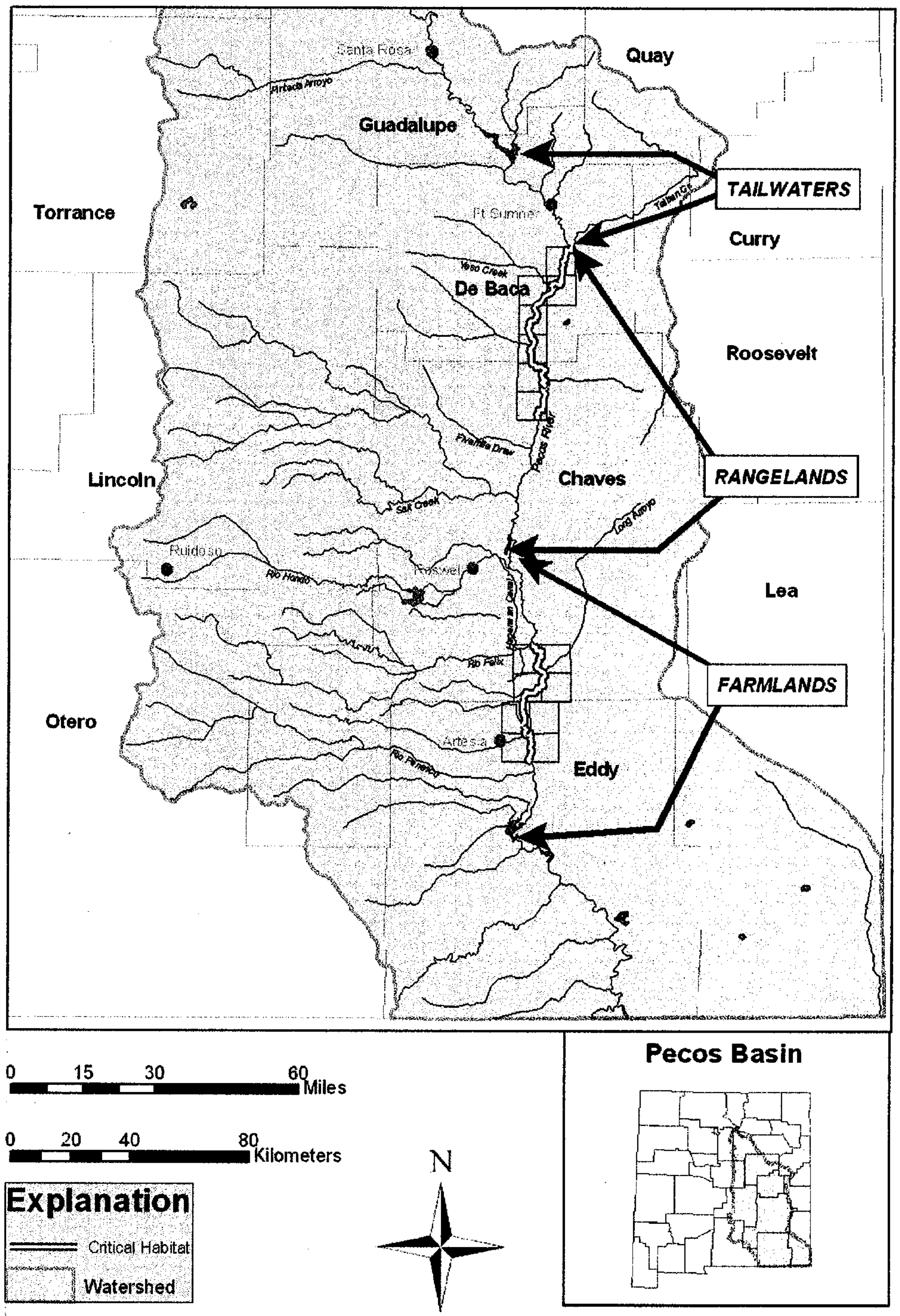
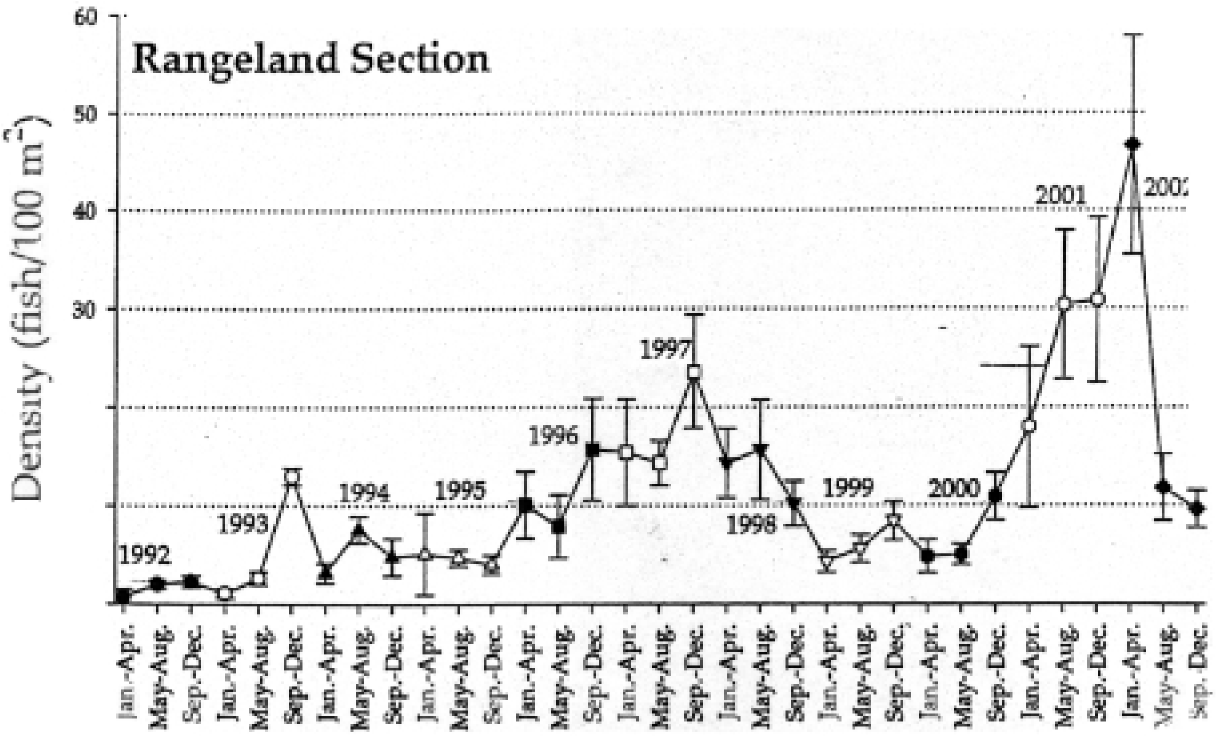


Figure 2. River reaches of similar character designated for Pecos bluntnose shiner research.

Figure 3. Density of Pecos bluntnose shiner in the Rangelands from 1992 to 2002. See Figure 2 for location of the Rangelands. Source: New Mexico Fishery Resources Office.

Figure 4. Relative abundance Pecos bluntnose shiner (number of Pecos bluntnose shiner caught divided by total number of fish caught) in the Rangelands from 1992 to 2002. Source: New Mexico Fishery Resources Office.


Rangeland Section
Density (fish/100 m^2)
60
50
40
30
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Jan.-Apr.
May-Aug.
Sep.-Dec.

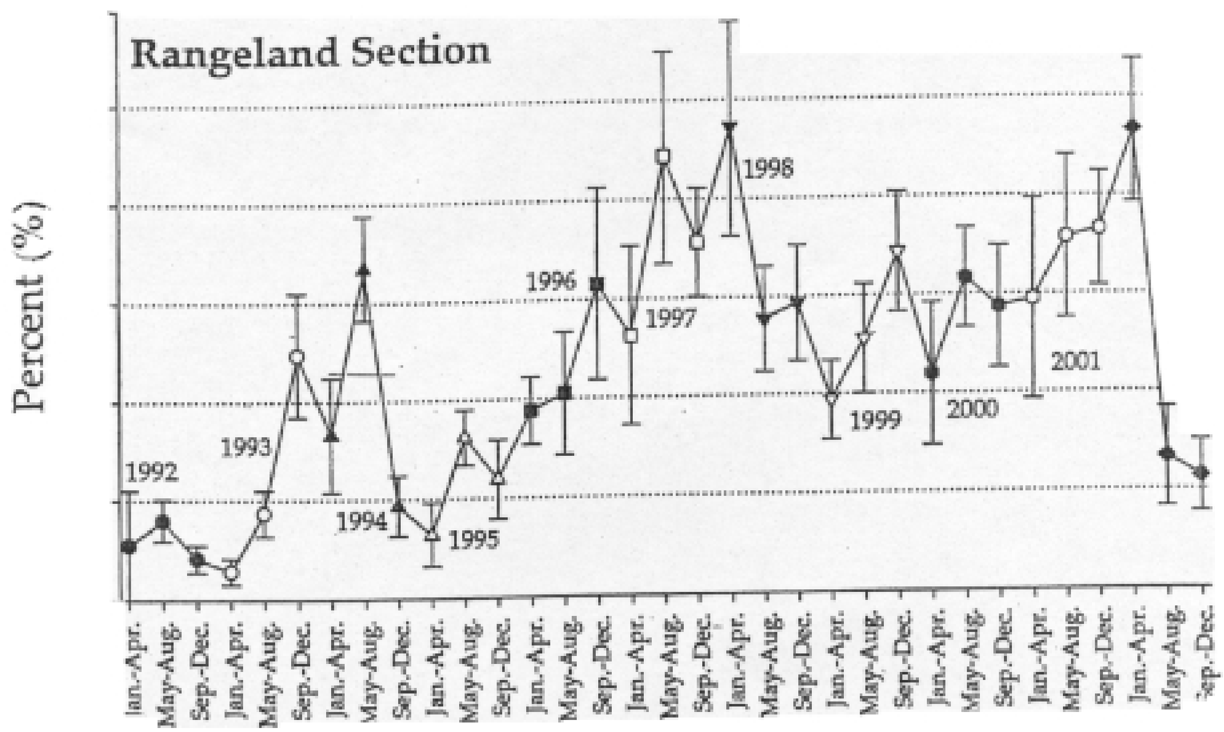
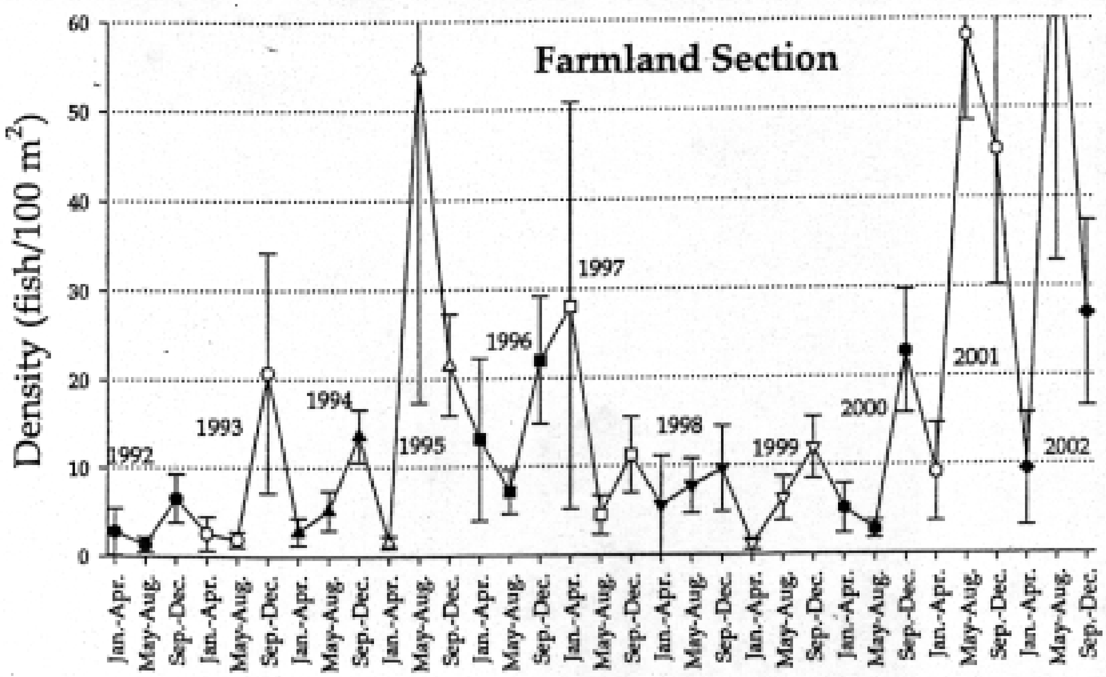
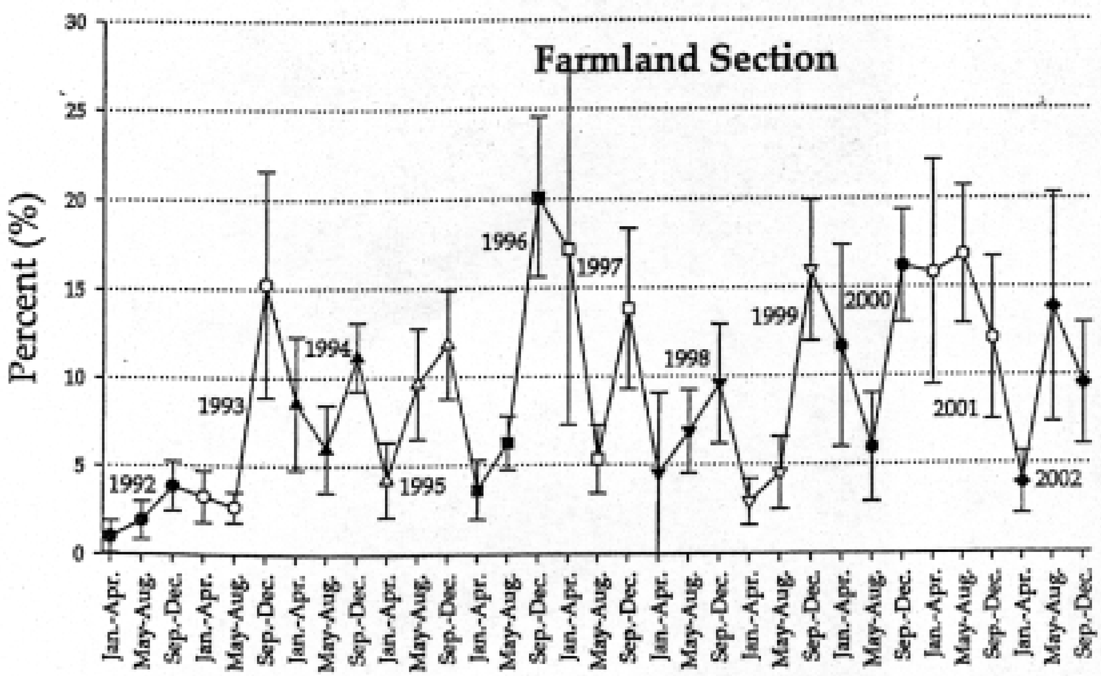

Rangeland Section
Percent (%)
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Jan.-Apr.
May-Aug.
Sep.-Dec.

Figure 5. Density of Pecos bluntnose shiner in the Farmlands from 1992 to 2002. See Figure 2 for location of Farmlands. Source: New Mexico Fishery Resources Office.

Figure 6. Relative abundance Pecos bluntnose shiner (number of Pecos bluntnose shiner caught divided by total number of fish caught) in the Farmlands from 1992 to 2002. Source: New Mexico Fishery Resources Office.


Farmland Section
Density (fish/100 m²)
0
10
20
30
40
50
60
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Jan.-Apr.
May-Aug.
Sep.-Dec.


Farmland Section
Percent (%)
0
5
10
15
20
25
30
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Jan.-Apr.
May-Aug.
Sep.-Dec.

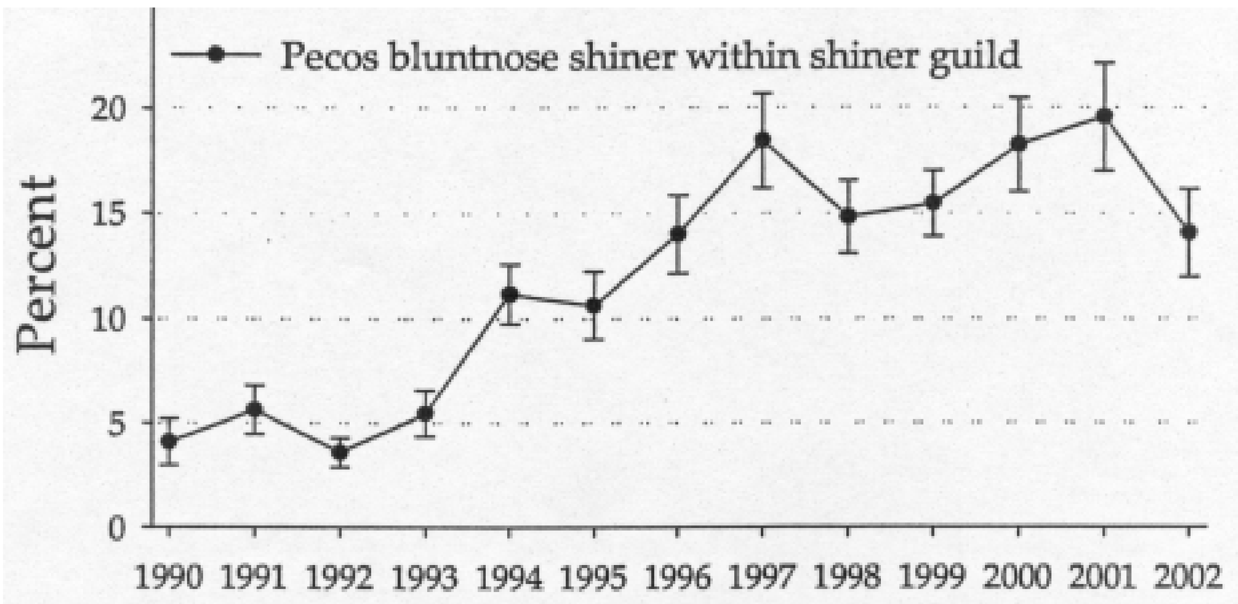


Figure. 7. Mean percent composition (with standard error) of Pecos bluntnose shiner by calender year within the shiner guild of the middle Pecos River. The shiner guild included red shiner, golden shiner, Arkansas River shiner, Rio Grande shiner, and sand shiner as well as Pecos bluntnose shiner. Values for 1990 and 1991 are from collections made by the Service, New Mexico Department of Game and Fish and University of New Mexico (Hoagstrom 2003).

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