ZUNI BLUEHEAD SUCKER (*CATOSTOMUS DISCOBOLUS YARROWI*) RECOVERY PLAN

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1.0 INTRODUCTION

This Recovery Plan was developed under the authority of the New Mexico Wildlife Conservation Act (WCA) amendments of 1995, which direct the New Mexico Department of Game and Fish (NMDGF) to develop recovery plans for species listed as threatened or endangered by the state [17-2-40.1 NMSA 1978]. Each recovery plan should 1) restore and maintain viable populations of a listed species and its habitat, such that the species may be delisted; 2) mitigate adverse social or economic impacts resulting from recovery actions; 3) identify social or economic benefits and opportunities; and 4) use existing resources and funding sources, to the extent possible, to implement the plan.

This Recovery Plan addresses the Zuni bluehead sucker (*Catostomus discobolus yarrowi*), listed as endangered in New Mexico. As required by the WCA, public information meetings were held in December 2003 and January 2004 at the initiation of the planning process. The Advisory Committee for this Recovery Plan includes representatives from federal agencies (U.S. Fish and Wildlife Service, U.S. Forest Service, and U.S. Bureau of Reclamation), state agencies (New Mexico Environment Department and Arizona Department of Game and Fish), local agencies (McKinley County Natural Resources Conservation Service), tribal agencies (Zuni Department of Fish and Wildlife and Navajo Fish and Wildlife Service), academia (Arizona State University), conservation organizations (The Nature Conservancy) and private landowners (Appendix I). Parts of this document are based on *Draft Zuni Bluehead Sucker Conservation Plan* (Hobbes 2002).

The organization of this Recovery Plan follows that detailed in the NMDGF *Guidelines for Writing Long Range, Action, and Operational Plans* (Graves 2002). Section 2.0 of this plan includes background information on the distribution, habitat requirements, biology, and ecology of the Zuni bluehead sucker. Also included are analyses of factors that led to the endangerment of the species and existing and potential threats to the species. Section 3.0 contains the goal for recovery of the species, associated objective and objective parameters, issues affecting attainment of the goal and corresponding strategies.

2.0 BACKGROUND

Section 2.0 consists of background information on the distribution, status, habitat requirements, biology, and ecology of Zuni bluehead sucker. This information provides the basis for assessing current status, threats to persistence, and the most effective recovery strategies for the species.

2.1 NATURAL HISTORY

2.1.1 Name

Zuni bluehead sucker is a subspecies of bluehead sucker, *Catostomus discobolus*. Sublette et al. (1990) support the use of the original spelling of the subspecific epithet as *jarrovii*. However, recent literature (Eschmeyer et al. 1998, Propst et al. 2001) applies *yarrowi* as the appropriate spelling. The subgenus *Pantosteus* may also be employed. Commonly, the subspecies is sometimes known as Zuni mountain sucker.

2.1.2 Description

Catostomus discobolus yarrowi has a slender, fusiform body with total length (TL) rarely exceeding 200 mm (Figure 1). The mouth is subterminal and has fleshy lips covered with small papillae, particularly on the lower lip. The posterior margin of the lower lip extends back at an acute angle to the ventral longitudinal median, and the lower jaw has a well-developed cartilaginous mandibular ridge parallel to the margin of the lower lip. Zuni bluehead suckers are mottled, dark gray-green dorsally and creamy-white ventrally. During spawning season, males develop tubercles on the anal fin and ventral lobe of the caudal fin, and become intensely black dorsally with a bright-red lateral band and a white venter (Propst et al. 2001). The caudal fin is comparatively thick and the dorsal fin usually has fewer than 10 principal rays (Smith 1966). There are 42 or fewer post-Weberian vertebrae, 25 or more gill-rakers in the first row on the first pharyngeal arch, and typically fewer than 100 scales along the lateral line (Smith et al. 1983).

2.1.3 Relationships

Zuni bluehead sucker belongs to the subgenus *Pantosteus*, or mountain suckers. Current phylogeny of this group is probably a consequence of the formation of the many mountain ranges of western North America (Smith 1966). Allopatry dominates the distribution of species

Figure 1. Zuni bluehead sucker illustration by W.H. Brandenburg.

with primary barriers being mountain ranges dividing drainage basins. Although Smith (1966) contended that stream capture of one headwater stream to another drainage was rare, he proposed that in the case of Zuni bluehead sucker, a stream capture did occur. This stream capture in the Late Pleistocene (130,000-10,000 ybp) brought part of the headwaters of San Jose Creek (a Río Puerco – Río Grande tributary) into the Río Nutria (a Zuni River tributary) enabling the "captured" *C. plebius* to intermingle with resident *C. discobolus* (Smith et al. 1983). Based upon morphometry, Smith et al. (1983) theorized that selective introgression of *C. plebius* occurred in downstream reaches as transient barriers were eradicated by increases in river volume or elimination of dry reaches within streams. However, they determined that *C. plebius* characters were rare or nonexistent downstream of Río Nutria and its tributaries. This was supported by Crabtree and Buth (1987), who asserted that introgression of *C. plebius* and *C. discobolus* occurred only in the upper Río Nutria. They also provided additional allozymic data supporting subspecific differentiation of *C. discobolus* in the upper Little Colorado drainage without genetic influence of *C. plebius*. The elimination of downstream populations in New Mexico makes further analysis difficult. Nonetheless, *C. d. yarrowi* found in the upper Zuni River drainage is recognized as a distinct subspecies because of its unique origins. The taxonomic status of *Catostomus (Pantosteus)* species in streams of Arizona remains to be determined.

2.1.4 Historic and Current Distribution

It is likely that *Catostomus (Pantosteus)* species historically occurred in most permanently-watered reaches of the Little Colorado River drainage. Zuni bluehead sucker occurred historically in at least the Zuni River system upstream of the Arizona-New Mexico border. However, it is difficult to accurately characterize historical distribution of Zuni bluehead sucker because of the paucity of systematic collections (Propst et al. 2001). First collected in 1873 (USNM 15783) from the Zuni River near Zuni Pueblo, *C. d. yarrowi* was not again collected until 1948 and 1960 in the ríos Pescado and Nutria respectively, by W.J. Koster (UNM, Museum of Southwestern Biology).

Between 1960 and 1975, many efforts to remove "undesirable" fish species to aid in sport fish management efforts were completed on the Zuni Indian Reservation. As part of these efforts, data about the distribution of Zuni bluehead suckers were collected. According to Merkel (1979), Zuni bluehead suckers were at least found in the Río Nutria from Nutria Box to the Upper Nutria Diversion Dam in the early 1960s (Table 1, Figure 2). Reconnaissance associated with fishery stocking and eradication efforts in the Río Pescado revealed the presence of Zuni bluehead sucker there as well. Subsequent surveys located populations in Agua Remora (formerly Radosevich Creek) in 1972 and downstream from Diversion Dam No.2 on the Río Nutria in 1973 (Merkel 1979).

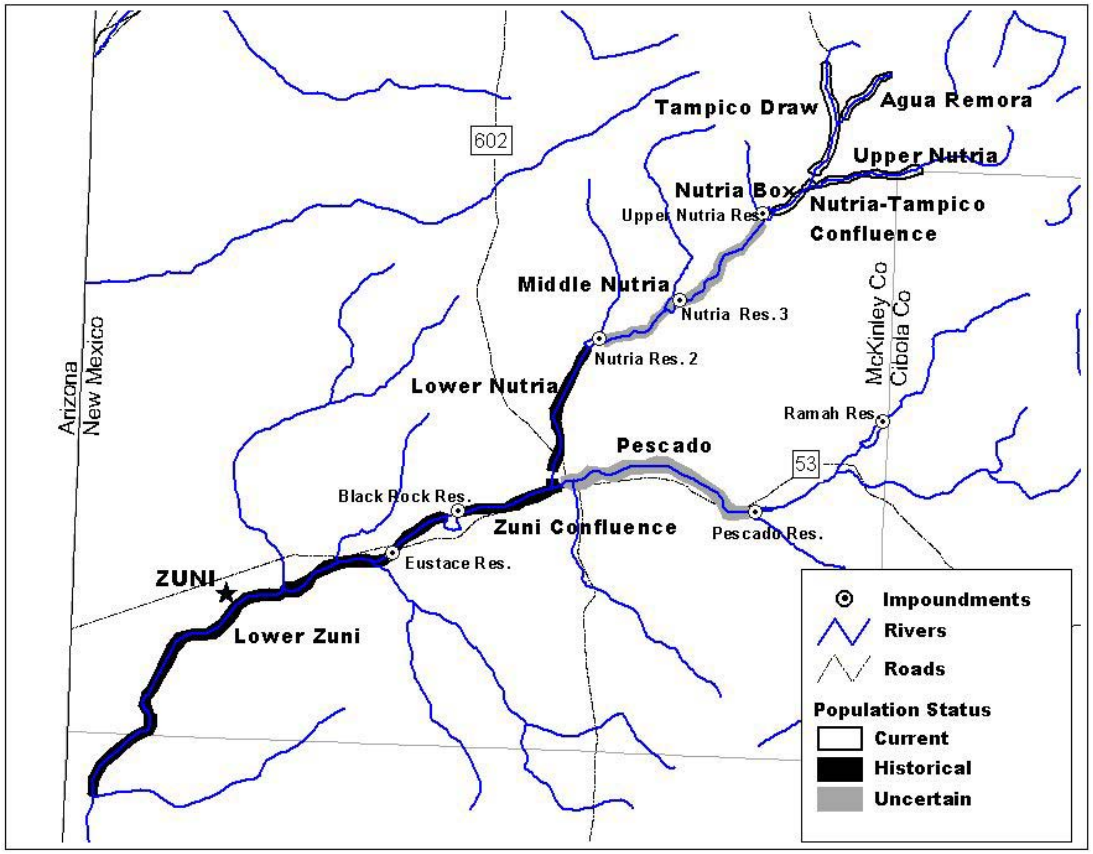
The first systematic survey for the species in New Mexico was conducted in 1978 and 1979 by Hanson (1980), who documented persistence in the Zuni River drainage. Populations were found in Agua Remora, upper Río Nutria, and the Zuni River below the ríos Pescado and Nutria confluence. At all other locations surveyed, Zuni bluehead suckers were rare (Río Pescado, lower and middle Río Nutria, Tampico Draw) or absent.

More recent surveys (early to mid 1990s) determined the distribution of Zuni bluehead sucker in New Mexico to be limited mainly to the Río Nutria drainage upstream of the mouth of the Nutria Box Canyon (Propst et al. 2001). This included the mouth of Río Nutria box canyon, upper Río Nutria, confluence of Tampico Draw and Río Nutria, Tampico Spring, and Agua Remora.

Table 1. Occurrence of fish species in the Zuni River drainage, New Mexico: 1960-1975 (Merkel 1979), 1978-1979 (Hanson 1980), 1990-1993 (Propst and Hobbes 1996), and 2000-2001 (Carman et al. 2003). Stream reaches are shown in Figure 1. Native species are indicated with an *. X indicates presence of species, a blank space indicates absence, - indicates data were not collected.

	Lower Zuni				**Zuni Confluence**				**Rio Pescado**				**Lower Nutria**				**Middle Nutria**				**Nutria Box**				**Upper Rio Nutria**				**Nutria-Tampico Confluence**				**Tampico Draw**				**Agua Remora**			
Year	60-75	78-79	90-99	00-01	60-75	78-79	90-93	00-01	60-75	78-79	90-93	00-01	60-75	78-79	90-93	00-01	60-75	78-79	90-93	00-01	60-75	78-79	90-93	00-01	60-75	78-79	90-93	00-01	60-75	78-79	90-93	00-01	60-75	78-79	90-93	00-01	60-75	78-79	90-93	00-01
Zuni Bluehead Sucker *	-			-	-	X	X		X	X	X		X	X		-	X	X	X	-	X	X	X	X	-	X	X	-	-	X	X	X		X	X	-	X	X	X	-
Speckled Dace *	-			-	-				X	X	X					-				-	X				-			-	-							-				-
Plains Killifish	-		X	-	-	X	X			X	X			X	X	-			X	-					-			-	-							-				-
Fathead Minnow	-		X	-	-	X	X	X		X	X	X		X	X	-	X	X	X	-	X	X	X		-			-	-		X		X			-				-
Green Sunfish	-	X	X	-	-	X	X	X	X	X	X	X	X	X	X	-	X		X	-	X				-			-	-							-		X		-
Largemouth Bass	-	X		-	-											-				-					-			-	-							-				-
Northern Pike	-	X		-	-										X	-				-					-			-	-							-				-
Cutthroat Trout	-			-	-										X	-				-					-			-	-							-				-
Rainbow Trout	-			-	-	X								X	X	-	X			-	X	X			-			-	-							-				-
Crayfish	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-		-	-	-	-	-	-	-	-

Figure 2. Current and historical distribution of Zuni bluehead sucker in the Little Colorado River drainage, New Mexico. Marked stretches correspond to Table 1 locations and indicate potentially occupied reaches; not all areas within the marked stretches are occupied.



Collectively, the reaches total about 15 km of permanently-watered habitat. Zuni bluehead sucker was reported irregularly near the confluence of the ríos Nutria and Pescado and the Río Pescado, but was not found in the mainstem of the Zuni River or lower Río Nutria (Propst et al. 2001). Surveys in 2000 and 2001, while not as extensive as the previous surveys, confirmed the persistence of Zuni bluehead sucker in the upper Río Nutria Drainage (Carman et al. 2003). Zuni bluehead sucker was not found at the confluence of the ríos Nutria and Pescado or in the Río Pescado in the recent surveys. Additional information about the distribution of Zuni bluehead sucker over time is presented in Section 2.2.2, Population Trends.

Historical records exist of *Catostomus discobolus yarrowi* in Kinlichee Creek, Apache County, Arizona, but the occurrence of the subspecies outside the Zuni River Watershed is currently

disputed. Smith (1966) and Smith et al. (1983) concluded that the introgressive hybrid Zuni bluehead sucker was found downstream into the upper Little Colorado River, including Kinlichee Creek. However, Crabtree and Buth (1987) concluded that the hybrid Zuni bluehead sucker occurs only in Zuni River and that other upper Little Colorado River bluehead suckers may be a unique subspecies. A recent examination of several samples indicated *Catostomus discobolus yarrowi* in the Río Nutria, and two additional bluehead sucker forms in the upper Little Colorado River, one similar to typical *Catostomus discobolus* and one unique to the drainage (Secor et al. *in prep*). Recent surveys conducted in Little Colorado River tributaries within Arizona located several bluehead sucker populations, including in Kinlichee Creek (Carman et al. 2003). Samples were retained for further examination of molecular and morphological variation to characterize taxonomic affinities and determine if remnant populations of Zuni bluehead sucker persist elsewhere in the Little Colorado River watershed.

2.1.5 Required Habitats

Definitive habitat associations for Zuni bluehead sucker have not been determined. Hanson (1980) described Zuni bluehead sucker habitat as largely shaded, pool and riffle habitats with coarse substrates. Propst and Hobbes (1996) found Zuni bluehead sucker primarily in shaded pools and pool-runs, about 0.3 to 0.5-m deep with water velocity less than 10 cm/s. Zuni bluehead suckers were found over clean, hard substrate, from gravel and cobble to boulders and bedrock. In general, Zuni bluehead sucker was rare or absent in reaches where the substrate was dominated by silt or sand. Emergent aquatic plants often edged pool and pool-run habitats. Perilithic and periphytic algae were seasonally present in habitats where suckers were common. Collections in 2000 and 2001 also found Zuni bluehead sucker in these same general habitats, with the majority taken from shady, cobble and bedrock pool-run stretches of a stream (Carman et al. 2003).

Although habitat needs for specific life stages of Zuni bluehead sucker have not been described, this information is available for bluehead sucker. Bluehead sucker juveniles tend to be found in shallow, slower areas along shorelines, moving out into the deeper, faster channel with age (Childs et al. 1998). Preferred spawning habitat for bluehead suckers is clean gravel beds (Maddux and Kepner 1988).

2.1.7 Food Habits

Zuni bluehead suckers have physical adaptations that reflect their benthic feeding habits. The jaws are ventrally placed and the lower mandible is modified with a cartilaginous ridge for scraping the substrate to obtain attached algae. Additionally, most suckers within the subgenus *Pantosteus* have an elongated intestinal tract, designed to break down rough food items, such as algae. Stomach analysis has revealed that Zuni bluehead sucker diet is primarily composed of fine particulate organic material, filamentous algae, midge (Insecta: Chironomidae) larvae and flatworms (Platyhelminthes), with occasional ingestion of other aquatic invertebrates and fish scales and eggs (Smith and Koehn 1979). Zuni bluehead suckers have been observed scraping perilithic algae from bedrock, boulders, and cobble (A. L. Kingsbury, NMDGF, pers. obs.).

2.1.7 Reproductive Biology and Growth

Zuni bluehead sucker spawning was reported from early April to early June when water temperatures were 6 to 15°C, peaking around 10°C (Propst 1999, Propst et al. 2001). Propst et al. (2001) found evidence that spawning may be bimodal with most spawning occurring early in the season. Females typically produce 200 to 300 ova with larger females producing more eggs. Zuni bluehead suckers may grow to about 50 mm TL by the end of their first season (age 0), and have little or no growth during winter (Propst 1999). By the end of the second growing season (age 1), most suckers are between 60 and 90 mm TL and subsequent growth increments are 30 mm annually (Propst et al. 2001). Based upon individuals for which sex could be determined, most Zuni bluehead suckers are mature by age 2. Zuni bluehead suckers may live up to 5 years (Hanson 1980), but fish older than age 3 are rare (Propst et al. 2001). Field studies indicate that males outnumber females in all size classes, except the largest (≥120mm SL); (Propst et al. 2001).

2.1.8 General Habits

There is little information currently available on the movements and social habits of Zuni bluehead suckers. It has been suggested that Zuni bluehead suckers move very little during their life cycle. Larvae may move a short distance downstream and adult may stay in or near one pool throughout adult life, only moving several meters upstream to spawn (D. Propst, NMDGF, pers.

comm.). This is similar to activity patterns reported for other *Catostomus* species (Emery 1973, Pearson and Healey 2003).

2.1.9 Diseases

There is no published information on diseases of the Zuni bluehead sucker, although information is available from nearby drainages for similar species. Fish health surveys were conducted in the San Juan River from 1992-1999 and revealed that ailment incidence was low for all species except during spring floods, when incidence of lesions was higher (Landye et al. 1999). While several bacterial species were found infecting these lesions, they did not appear to be the cause of the lesions. Some common parasites of catostomid species in the San Juan River drainage include the protozoan *Ichthyophthirius* (ich) and the non-native parasite, *Lernaea cyprinacea*. Asian tapeworms, *Bothriocephalus acheilognathi*, were introduced to the watershed, but have not been shown to affect sucker species.

2.1.10 Population Dynamics

Based on length-frequency histograms from the Río Nutria Box Canyon Mouth population, sampled 7 times between 1978 and 2000, four length-classes can be estimated (Hanson 1980, Propst and Hobbes 1996, Carman et al. 2003; Figure 3). Age 0 fish range from ≤20 to 60 mm TL, age 1 range from 60 to 90 mm TL, age 2 range from 90 to 120 mm TL, and age 3 range from 120 to 160 mm TL. These size classes correspond reasonably well with the size-ranges for each age-class Hanson (1980) reported.

Hanson (1980) reported age-class structure differences among populations of Zuni bluehead suckers. A population dominated by individuals ≤ age 2 was found in Agua Remora, a small headwater stream, and a population dominated by individuals ≥ age 2 was found at the ríos Pescado and Nutria confluence, comparatively larger streams. These differences were also noted in later studies. In 1994 and 1995 samples, while one or two age classes dominated upper Río Nutria, Nutria Box and Agua Remora populations, four age classes were present in the population at the confluence of Río Nutria and Tampico Draw (Propst et al. 2001).

Age 0 fish tended to be larger by mid-summer in Agua Remora (50-70 mm TL) and upper Río Nutria (50-70 mm TL) than those in Nutria Box Canyon Mouth (20-50 mm TL) or Río Nutria-Tampico Draw confluence (20-60 mm TL) (Propst and Hobbes 1996). Earlier spawning, more rapid growth, or both may explain the difference. Sites higher in the watershed tend to have less shade, which may result in higher water temperatures and more algal growth, and hence higher growth rates.

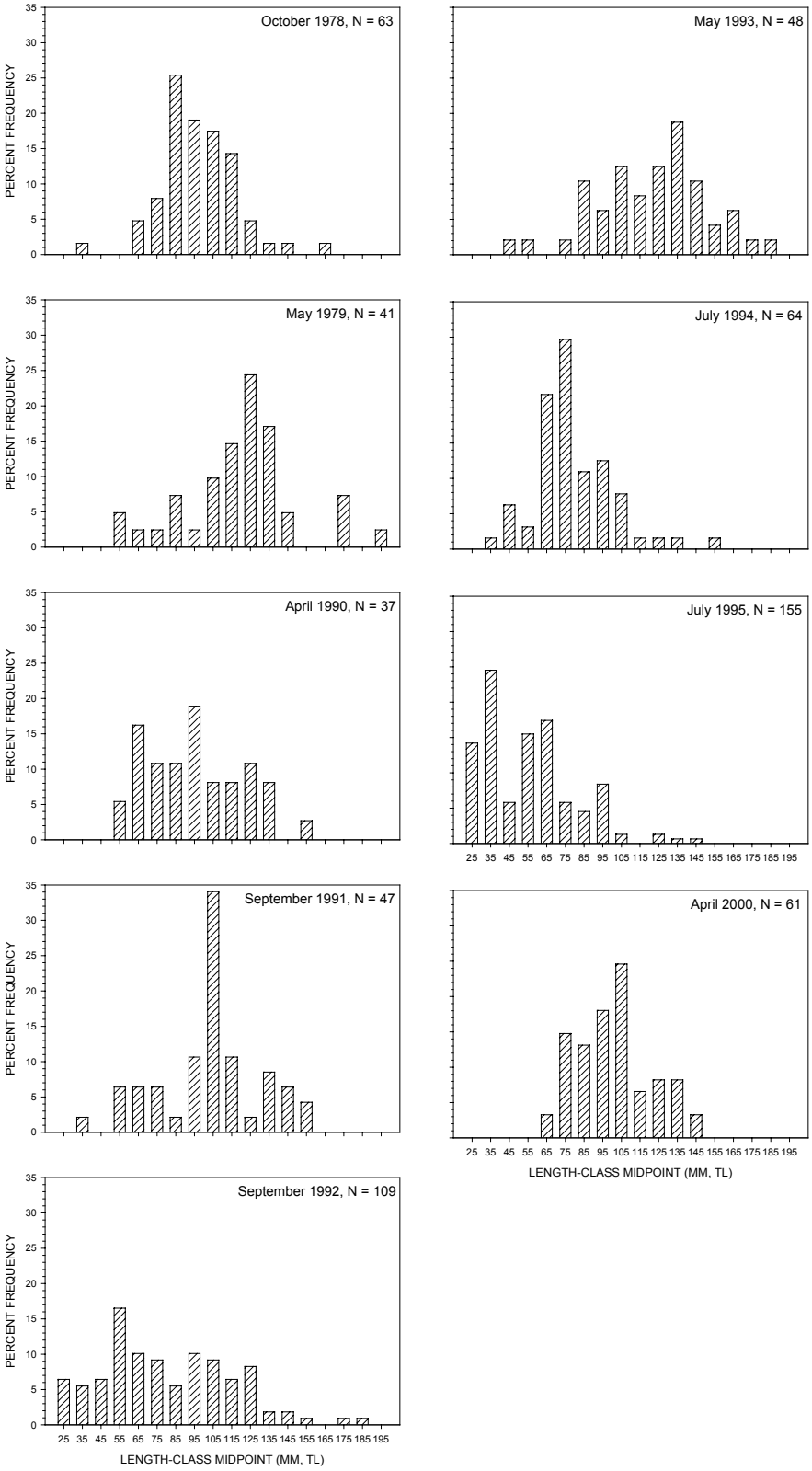
Condition also varies among Zuni bluehead sucker populations. While the population at the confluence of Río Nutria-Tampico Draw tended to have more large individuals, often longer than 200 mm TL, mean relative condition at this site was lower than that of other populations (at Nutria-Tampico Draw, K=1.67; other sites up to K=2.2) (Propst and Hobbes 1996, Carman et al. 2003). Propst et al. (2001) also found that at Río Nutria-Tampico Draw confluence and upper Río Nutria sites, females had significantly greater mass than males.

2.1.11 Associated Species

Historically, Zuni bluehead sucker was associated with roundtail chub, *Gila robusta*, and speckled dace, *Rhinichthys osculus* (Sublette et al. 1990). Roundtail chub was first collected in the Zuni River in 1851 (Baird and Girard 1853) and subsequently only once by H. W. Henshaw in 1873 (USNM16635). Occurrence of speckled dace in the Zuni River was first recorded in 1926 at Zuni Pueblo (ANSP 19938-19941). Subsequent collections by W. J. Koster in 1948 in the Río Pescado were quite large (MSB 964, n=3071; MSB 2437, n=275). Surveys after 1970 rarely collected speckled dace (Table 1).

Eight non-native fish species have been reported from the Zuni River drainage (Hanson 1980, Propst and Hobbes 1996), but only green sunfish, *Lepomis cyanellus*, fathead minnow *Pimephales promelas*, and plains killifish, *Fundulus zebrinus*, are comparatively common and widespread. Several species have been introduced as sport fish, including northern pike, *Esox lucius*, and rainbow trout, *Oncorhynchus mykiss*. Currently, McGaffey Lake, in the upper headwaters of Río Nutria, is stocked with channel catfish, *Ictalurus punctatus*, and rainbow trout, and Ramah Lake, in the headwaters of Río Pescado, is stocked with rainbow trout. Sterile, triploid grass carp, *Ctenopharyngodon idella*, were stocked in McGaffey Lake to control

Figure 3. Zuni bluehead sucker length-frequency histograms, Río Nutria Box Canyon Mouth, 1978 to 2000.



vegetation pre-1990, but stocking has not been repeated. Non-native fish species are uncommon or absent in those portions of Río Nutria occupied by Zuni bluehead sucker (Table 1).

2.2 HISTORICAL PERSPECTIVE

2.2.1 Habitat Trends

The pre-European-settlement condition of the Zuni River watershed is not well-documented. While there is much written about the extensive ponderosa pine forests and pinyon-juniper woodlands of the area, accounts of early European expeditions vary on the quality and quantity of the watercourses present (McCallum 1981). Post-European settlement changes to the landscape and subsequent effects on the rivers are well documented (see *Zuni River Watershed Plan*, NRCS 1998, for a summary). The Zuni River watershed was subject to extensive logging and overgrazing in the late 1800s and early to mid 1900s, resulting in severe degradation of the natural resources of the area. Impacts from the mass removal of vegetation included increased surface erosion, gullying, headcutting, wide discharge fluctuations, and loss of water in the system. The impacts were so severe that the Pueblo of Zuni brought litigation against the United States government in the early 1970s. The settlement, the Zuni River Watershed Act of 1990, seeks to restore tribal lands damaged due to upstream misuse of resources.

Subsequent to the impacts of the early twentieth century, the Zuni River was dammed for flood control, irrigation storage, and recreational fishing (Table 2). These reservoirs inundated Zuni bluehead sucker habitats and prevented or diminished fish movement among habitats. Additionally, water withdrawals for irrigation and human consumption led to decreased surface discharge in the system.

Increased road density in the watershed also has had indirect adverse effects on the habitats. Analysis of aerial photos from 1935 and 1991 indicated that road density in the Río Nutria subwatershed rose 47 percent (NRCS 1998). Road construction activities lead to increased soil erosion and sedimentation in streams. Additionally, the increase of roads leads to an increase in residential development, logging, grazing, and off-road vehicle use.

Table 2. Major impoundments of the Zuni River watershed.

River	Impoundments
Zuni River	Black Rock and Eustace Reservoirs
Lower Río Nutria	Upper Nutria Diversion, Nutria Reservoirs 2, 3,4
Río Pescado	Ramah and Pescado Reservoirs

The quality of water in the Zuni River watershed is largely unknown. The Pueblo of Zuni currently has no water quality standards or regular, long-term monitoring program. While the river reaches outside of Tribal lands fall under the management of the New Mexico Environment Department (NMED) and the authority of the New Mexico Water Quality Act, [74-6-1 through 74-6-17 NMSA 1978] and the federal Clean Water Act, as amended [33 U.S.C. Section 1251 *et seq.*], baseline as well as current data are lacking and quality indicators have not been assigned.

Currently, the quality and quantity of habitat in the watershed appropriate for Zuni bluehead sucker vary. Continuous flow is not present from the headwaters downstream to the Arizona/New Mexico border; surface flow is generally only continuous during heavy spring run-off. Many stream reaches are dry except near perennial springs. Pools over exposed bedrock are the predominant habitat in the headwaters of the ríos Nutria and Pescado. These upper reaches are largely canyon-bound and have a moderate gradient. In the lower reaches, intermittent flows connect deep pools. The gradient decreases as the rivers flow through fluvial floodplain. The mainstem of the Zuni River is intermittent, slow and meandering, and interrupted by several reservoirs (Propst and Hobbes 1996).

The severe decline in Zuni bluehead sucker range, to only about 15 km (9 mi), or 10%, of historical range, is largely because of these habitat changes. Zuni bluehead suckers require continuously inundated habitat, primarily shaded pools and pool-runs, about 0.3 to 0.5-m deep over clean, hard substrate. Increases in siltation and sedimentation and reduced and altered flows are detrimental for the subspecies. The presence of fine sediments in the habitat can lead to reductions or prevention of algal growth and the smothering of newly spawned eggs (Propst and Hobbes 1996).

2.2.2 Population Trends

Historical and current comprehensive population data are lacking for the Zuni bluehead sucker. Uncertainty regarding the original distribution of the subspecies complicates understanding population trends. However, a significant decline in populations is apparent from presence/absence and distribution data (Table 1, Figure 2). The United States Fish and Wildlife Service (USFWS) Candidate Listing Form (2002b) states that populations decreased by about 90% in the past 20 years, perhaps to only a few hundred individuals. Zuni bluehead sucker is no longer present in many areas it historically inhabited. The collection in 1873 (USNM 15783) from the lower Zuni River near Zuni Pueblo has not been repeated. In fact, viable Zuni bluehead sucker populations have not been confirmed in the Zuni River, lower Río Nutria, or Río Pescado since 1979. Stroh and Propst (1993) classified these as depleted populations. After the early 1990s surveys, the population at the confluence of the ríos Pescado and Nutria, reported as one of three main Zuni bluehead sucker populations by Hanson (1980), was determined to be declining (Stroh and Propst 1993).

Populations in the upper reaches of the Río Nutria have been found consistently throughout the past 40 years. The populations, first reported in the 1960s and 1970s at Nutria Box Canyon, Nutria-Tampico confluence, upper Río Nutria, Tampico Draw, and Agua Remora, were present when surveyed in the 1990s and 2000. These semi-isolated populations in the upper watershed were considered stable after sampling in the early 1990s and constitute the stronghold of the subspecies (Stroh and Propst 1993, Carman et al. 2003). No surveys of Zuni bluehead sucker populations have been conducted in the past 4 years.

Persistence of these five populations may be attributed to several factors. Fish eradication efforts of the 1960s and 1970s were limited to the middle and lower Río Nutria and Río Pescado; private landowners in the upper reaches did not allow eradication efforts on their lands. These 27 chemical treatments resulted in removal of at least four concentrations of Zuni bluehead sucker (Merkel 1979). Introductions of non-native species also had a negative effect on Zuni bluehead sucker populations. Stocking efforts, particularly in reservoirs on the Zuni River, Río Nutria, and Río Pescado, have introduced several species, including northern pike, largemouth bass, *Micropterus salmoides*, and green sunfish, that are piscivorous and likely prey on Zuni

bluehead sucker. Other introduced species, such as fathead minnow and plains killifish, may compete with Zuni bluehead sucker for food and habitat resources. Few, if any Zuni bluehead sucker are found lower in the watershed where non-native species are common (see Table 1).

Finally, the lower portion of the watershed has been subject to more habitat degradation than the upper areas. This is due in part to more human development in the lower reaches, but also to the cumulative nature of watercourses. Upstream impacts, like siltation, sedimentation, and pollution, accumulate as rivers flow downstream, resulting in greater habitat (Pringle 2001).

2.2.3 Use and Demand Trends

Zuni bluehead sucker is not a game fish and does not have identified recreational or commercial value. Because the species is listed as endangered under the Wildlife Conservation Act, fishing for the species is prohibited and a permit must be granted for scientific collection. Although Zuni bluehead sucker as a species does not have particular value for Zuni tribal members, as part of the natural community it has an essential importance in Zuni culture.

2.2.4 Past Management

During the 1920s, the Radosevich brothers, two young boys who wanted to have fish in their small headwater stream, transported "minnows" from the headwaters of Río Nutria by bucket to Agua Remora. These "minnows" were almost certainly Zuni bluehead sucker. Even if not intentional, this is the first documented effort to conserve Zuni bluehead sucker (Winter 1979).

In the mid-1900s, efforts were made to establish a sport fishery in the reservoirs of the Zuni River watershed. Stocked fish included channel catfish, largemouth bass, northern pike, and rainbow trout (Hanson 1980). Incidental introductions likely associated with stocking efforts included green sunfish, fathead minnow, and plains killifish. Many stocking efforts did not succeed and currently only rainbow trout and northern pike persist locally. Green sunfish and fathead minnow dispersed and became established throughout much of the lower drainage.

Between 1960 and 1975, piscicides were applied to major portions of the ríos Nutria and Pescado to eliminate "undesirable species" which were in competition with game fish. Rotenone and

toxaphene were applied in at least two-dozen treatments at eight localities in the lower reaches of the ríos Nutria and Pescado (Merkel 1979); private landowners in the upper areas of the watershed did not allow access to their lands for eradication efforts. It was observed during several of these treatments that large numbers of Zuni bluehead sucker were present and killed. While records are largely incomplete, it is known that populations of Zuni bluehead suckers near the mouth of Nutria Box were eradicated and that substantial numbers were also taken from other reaches of the Nutria and Pescado drainages.

In 1975, representatives of USFWS, NMDGF and Zuni Tribe reintroduced Zuni bluehead sucker to areas in the upper Zuni River watershed (Merkel 1979). Fish were taken from Agua Remora and distributed into Río Nutria above Nutria Box, Tampico Draw near Dean Creek, Dean Creek, and Cebolla Creek. A large portion (up to 50%) of the fry died during transit and two of the reintroduction sites, Tampico Draw and Cebolla Creek, were later determined "unsuitable" as the reaches are often dry. The effort was repeated in 1978 in the Río Nutria above Nutria Box, an area that is unable to be naturally re-colonized because of impassable waterfalls.

Zuni bluehead sucker was listed as endangered in New Mexico under the WCA in 1975 because habitat modification and predation by non-native fishes jeopardized its ability to persist and reproduce within New Mexico (19 NMAC 33.1, Propst 1999). Protection under the WCA is limited to take only; there is no critical habitat designation or regulatory protection of occupied or potential habitats. Zuni bluehead sucker is listed in Arizona as a species of special concern, but this designation neither prohibits take nor protects habitat (Arizona Game and Fish Department 1996). These state listings prompted the American Fisheries Society, a national association of fishery professionals, to recognize Zuni bluehead sucker as a species of special concern (Williams et al. 1989).

The U.S. Fish and Wildlife Service and NMDGF first considered federal listing of the Zuni bluehead sucker in 1980, but that did not occur. In 1991, Zuni bluehead sucker was designated Category 2, a species that may merit federal listing, but for which there are no substantial data on vulnerability and threats [56 FR 225]. The USFWS discontinued the designation of Category 2 species in 1996. In October 2001, Zuni bluehead sucker was listed in the Federal Register as a

Candidate Species, "one for which [USFWS] has on file sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened but for which preparation and publication of a proposal is precluded by higher-priority listing actions" [66 FR210]. Candidate species receive no statutory protection under the Endangered Species Act (ESA), although the USFWS encourages conservation of these species, as existing conditions may warrant future protection under the ESA. Currently, Zuni bluehead sucker has a priority number of 3, which is the highest ranking a subspecies can be given (USFWS 2002a,b).

The Cibola National Forest commissioned *Zuni Mountain Sucker Habitat Management Plan* (Winter 1979) to "perpetuate the Zuni Mountain Sucker in its native waters by intensive management of the habitat." Among management actions advised and completed as part of this plan were protection of several stream reaches occupied by Zuni bluehead sucker. The section of Agua Remora (Cibola National Forest) fenced in 1978 showed marked improvement including regrowth of the riparian area (Merkel 1979, Stefferud 1985). In 1988, NMDGF Share with Wildlife partnered with the U.S. Forest Service (USFS) to increase the fenced area, doubling the amount of protected occupied habitat. Currently, the fence is often in disrepair and legal access difficulties preclude its maintenance. The USFS and adjacent private landowners are attempting to redefine access rights to property to aid in better management of the habitat.

In 1988, USFS designated Zuni bluehead sucker as a sensitive species for the Southwestern Region, which includes Arizona and New Mexico (USDA 1988, 1999). A sensitive species is defined by the Forest Service Manual as those plant or animal species identified by the Regional Forester for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density, and downward trends in habitat capability that would reduce a species existing distribution. Sensitive species must receive special management emphasis by the Forest Service to ensure their viability and to preclude trends toward endangerment that would result in the need for Federal listing. Zuni bluehead sucker is included on the proposed revision to the Regional Forester's list due to be finalized before the end of 2004.

In the 1970s, the Pueblo of Zuni sued the United States for damage to lands as a result of federal improprieties. The case was settled with the Zuni Land Conservation Act of 1990 (Public Law 101-486), which provided funds for the Pueblo of Zuni to take corrective measures within the Zuni Indian Reservation. This included establishing the Zuni Conservation Project, which utilizes Zuni-based expertise and local and traditional knowledge supplemented with outside support to "restore damaged lands and deal with complex issues of sustainable development into the 21st century" (Zuni Conservation Project Annual Report 1996). Components of this project include watershed rehabilitation, restoration efforts, fish and wildlife monitoring programs, and sustainable agricultural projects. Zuni bluehead sucker are protected from fishing on Pueblo of Zuni waters by Zuni Pueblo Law and Order Code 57-5-3 par. 36.

The Zuni River Watershed Act (Public Law 102-338) was passed in 1991 to "formulate a plan for the management of natural resources…within the Zuni River watershed and upstream from the Zuni Indian Reservation." This act recognized that severe degradation of the watershed occurred because of overgrazing, excessive timber harvest, and indiscriminate road construction. Though most of these activities occurred in the late 1800s and early 1900s, the subsequent erosion, gullying, headcutting, and loss of water continued to cause deterioration of natural resources, including habitat for Zuni bluehead sucker. National Resources Inventories (NRI) were conducted in 1992 by the Natural Resources Conservation Service (NRCS) in the Zuni River watershed outside of the Zuni Indian Reservation. *Zuni River Watershed Plan* (NRCS 1998) was completed in 1998 and details current conditions of the watershed, recommendations for protection and rehabilitation of the watershed area, management guidelines for maintaining and improving resources, a system for monitoring conditions, and proposals for voluntary cooperative programs among partner agencies (NRCS 1998). Many of these management directives could affect Zuni bluehead sucker habitat and populations.

In 1990 and 1992, The Nature Conservancy (TNC) partnered with the New Mexico Energy, Minerals, and Natural Resources Department (EMNRD) under the Natural Lands Protection Act (NLPA) to purchase two tracts along Río Nutria. The purpose of NLPA was to assist in "acquisition and protection of unique and ecologically significant lands in New Mexico…" [75-5.2 NMSA 1978], and in this case, assisted in the purchase of habitat containing one of the last

substantial populations of Zuni bluehead sucker. *Natural Lands Protection Act Management Plan: Río Nutria Preserve* (TNC 1997) details the goals of the partnership, foremost of which is protection of the Zuni bluehead sucker population in the upper Río Nutria. In 1994, TNC and the Zuni Tribe entered into a Memorandum of Understanding to guide their common conservation efforts in the Zuni watershed.

In the late 1990s, NMDGF initiated efforts towards a Zuni Bluehead Sucker Conservation Plan. Individuals from Zuni Department of Game and Fish, private landowners, USFWS, TNC, the Forest Service, and the McKinley County Wildlife Association were invited to participate in the planning and drafting of the document. Absence of allocated funds for the efforts prevented completion of this conservation plan. In 2000, Section 6 funds were used by NMDGF to develop *Draft Zuni Bluehead Sucker Conservation Plan* (Hobbes 2002). Although this plan was not circulated for external review at this stage, it laid the groundwork for the current recovery efforts.

2.3 HABITAT ASSESSMENT

Occupied habitat is currently limited to about 15 km (9 miles) of stream in several semi-isolated reaches. Protection of these reaches is of utmost importance for conservation of Zuni bluehead sucker.

2.3.1 Current Status

Severe degradation of the watershed occurred because of overgrazing, excessive timber harvest, and indiscriminate road construction. Although these activities occurred in the late 1800s and early 1900s, subsequent erosion, gullying, headcutting, and loss of water continued to cause degradation of natural resources, including habitat for Zuni bluehead sucker. Extensive information on the condition of the Zuni River watershed outside of the Zuni Indian Reservation was collected as part of *Zuni River Watershed Plan* (NRCS 1998) and is summarized here. Average sediment yield (0.32 acre-feet per year) is moderate for the southwestern U.S. Approximately 205 acre-feet per year of sediment are produced in the watershed outside of the Zuni Reservation, delivering about 96 acre-feet per year to the reservation, where it contributes to sedimentation in the river and reservoirs. Approximately 26% of total sediment is produced by

channel erosion, 32% by gully and road erosion, and 42% by sheet and rill erosion. Comparison of aerial photographs from 1935 to 1991 indicates that road density has increased 40-130% in subwatersheds of the Zuni River.

The principal uses of surface and ground water within the Zuni River watershed are human consumption, livestock, and irrigation. Diverting water for agricultural use is the primary purpose of at least five impoundments and several other reservoirs act as flood control structures. Degradation of the upper watershed has led to increased sedimentation and many of the reservoirs are now only shallow, eutrophic ponds or wetlands with little or no storage capacity. Sediment trapping by these impoundments has also changed the character of the streams by altering channel morphology and substrate composition. The lower Río Nutria was once characterized as a perennial stream with generally wide meanders bordered by willow (*Salix* spp.) and cottonwood (*Populus* spp.). It is now within a broad-flat valley in which the channel is deeply incised and substrate is predominantly silt or silt-sand. Flow is intermittent between ephemeral pools and impoundments. Current habitat conditions are not favorable for Zuni bluehead sucker in much of the watershed downstream from the mouth of Río Nutria Box. Upstream of the Canyon Box, permanent flow is associated with springs and bedrock is the predominant substrate.

Land ownership in the upper Zuni River watershed is a checkerboard of USFS (Cibola National Forest) and private lands, including TNC's Río Nutria Preserve (Figure 4). The upper Río Nutria is primarily privately owned. The U.S. Forest Service and private landowners alternately own the uppermost sections containing Agua Remora and Tampico Draw. All the lower courses of the ríos Nutria and Pescado and the Zuni River to the New Mexico border are within the Zuni Indian Reservation.

Currently, the fact that much of New Mexico's Zuni bluehead sucker-occupied habitat is within the Cibola National Forest and TNC Río Nutria Preserve is helping to limit degradation of habitat. Additionally, many of the privately-owned sections have been managed in ways that allow for conservation of Zuni bluehead sucker. However, there are no formal plans or agreements with private landowners that ensure these management practices will continue. An

arrangement between USFS and the family owning sections of Agua Remora has not yet been worked out to allow access to National Forest lands encircled by private lands. Thus, the Forest Service cannot effectively manage the land and NMDGF cannot monitor Zuni bluehead sucker populations in the lower Agua Remora.

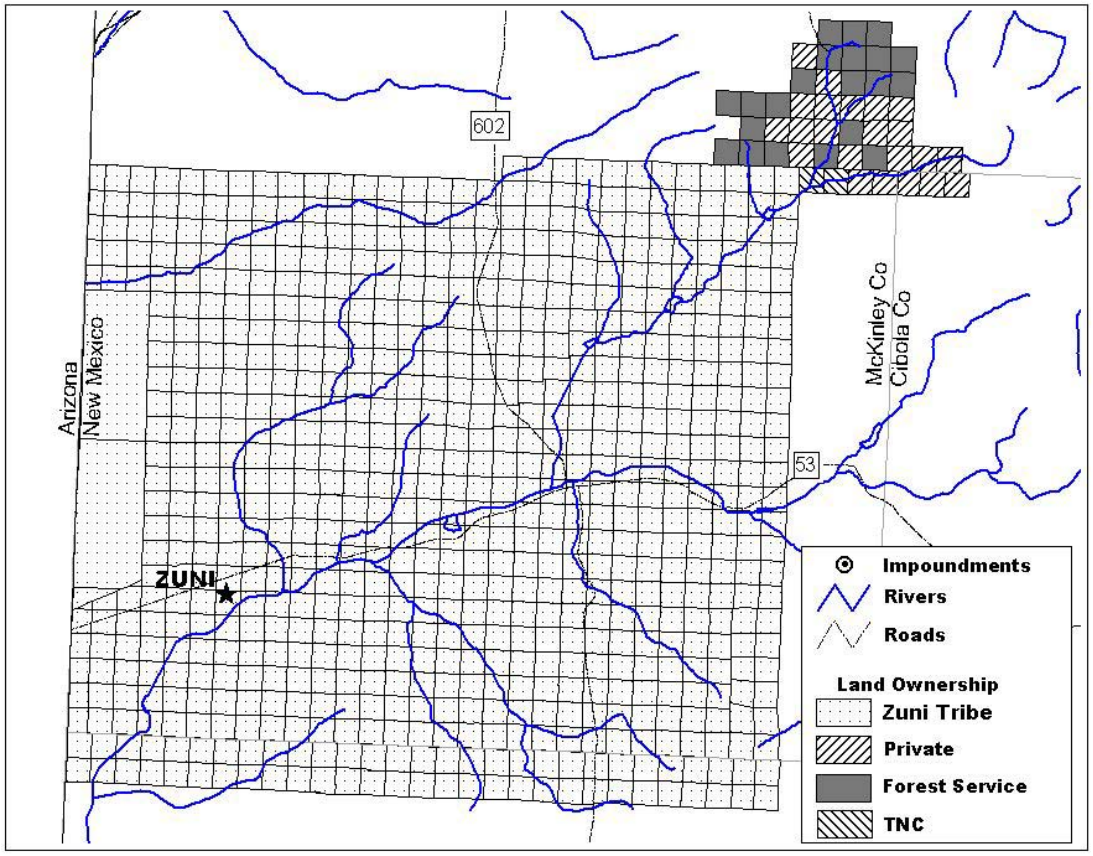
Recently, there has been limited road development, vegetation removal, and building construction in the upper areas of the Zuni River watershed. In early 2003 an application to subdivide and develop a 5-section parcel along Tampico Draw was made to McKinley County on behalf of the Southern Cross Ranch, LLC. Preliminary preparations were completed for the subdivision, including development of water wells and roads. After Zuni Pueblo, EMNRD, TNC, and New Mexico Chapter of the Wildlife Society expressed serious concerns, the application was withdrawn in autumn 2003. In early 2004, McKinley County filed an application for a right-of-way easement for Forest Road 191D, which could substantially improve access to the Tampico Draw area. Low-level urbanization, such as the building of subdivisions, has been documented to have negative effects on stream fishes diversity and abundance, especially for species that rely on specific substrates for foraging and spawning (Scott et al. 1986, Taylor and Roff 1986, Weaver and Garman 1994).

Unoccupied reaches of historical habitat are largely degraded. Lower portions of Río Nutria and Zuni River have been altered through diversions and reservoirs, creating marginal habitat for the Zuni bluehead sucker. Río Pescado was also subject to hydrologic alterations and the extent of suitable habitat there is unknown.

2.3.2 Projections

Like most of the southwest, McKinley County has recently experienced a significant human population increase. From 1990 to 2000, county population increased 23%, to 74,798 people (Census 2000 Demographic Profile for McKinley County). Although population densities are still low compared to more developed urban areas, growth is expected to continue over the coming decades, leading to increased pressures on the landscape. In the upper Río Nutria drainage, there has been increased interest in subdivision and development. Increased residential water use may further deplete aquifers that sustain spring systems and perennial reaches within

Figure 4. Land Ownership in the Zuni River Watershed.



the drainage. Secondary effects of development, such as increased waste, domestic animals, and exotic species, may have negative impacts on habitat as well. Urbanization, including road construction, vegetation removal, and building construction may lead to increases in siltation and sedimentation rates in the system, negatively impacting the fish community (Scott et al. 1986, Weaver and Garman 1994).

At this time, there is at least one application before the Cibola National Forest filed by McKinley County and Permits West, a local consultant, for further development of roads in the upper watershed. The project would upgrade Forest Road 191D near Tampico Draw to McKinley County Road standards. The presence of the improved road could encourage new subdivision development and enable seasonal residents to consider year-round occupancy of vacation homes.

There is strong interest in Zuni River conservation from local constituents. The McKinley County NRCS has helped several area landowners get involved in programs such as the Conservation Reserve Program (CRP) through the Farm Service Agency. This program sets aside valuable riparian areas from agriculture and ranching through lease agreements and cost-share incentives.

There is increased interest in the Zuni River watershed from the resource management agencies as well. The Surface Water Quality Bureau of NMED is conducting a water quality assessment of the Zuni River watershed for 2004, including water chemistry, aquatic biology, and habitat surveys. The Zuni Pueblo is working closely with NMED in order to complete this assessment and establish regular water quality standards and monitoring. The U.S. Forest Service continues to consider Zuni bluehead sucker habitat and conservation in its management actions.

2.4 POPULATION ASSESSMENT

Zuni bluehead sucker is currently limited to five semi-isolated populations in the upper reaches of the Zuni River watershed (Propst et al. 2001). According to USFWS (2002b) estimates, there could be as few as several hundred individuals total in these populations.

2.4.1 Current Populations

Surveys were conducted in the 1990s and early 2000s in the Zuni River watershed to evaluate persistence of Zuni bluehead sucker. Based on these data, there are approximately five "stable" populations of Zuni Bluehead sucker, limited to areas in the vicinities of Nutria Box Canyon, Nutria-Tampico confluence, upper Río Nutria, Tampico Draw, and Agua Remora (Stroh and Propst 1993, Propst et al. 2001, Carman et al. 2003). These populations, which have been found consistently since the 1970s, may include only a few hundred individuals (USFWS 2002b). Zuni bluehead sucker populations in other areas of the watershed are either declining (confluence of ríos Pescado and Nutria) or depleted (Zuni River, lower Río Nutria or Río Pescado) (Stroh and Propst 1993, Propst et al. 2001, USFWS 2002b).

Recent surveys were also conducted in Little Colorado River tributaries within Arizona to ascertain existence of *Catostomus (Pantosteus)* species (Carman et al. 2003). While several

bluehead sucker populations were found, including in Kinlichee Creek, a historical site for Zuni bluehead sucker, the taxonomic status of these fish is uncertain. Specimens were retained for morphomeristic and genetic analyses by Thomas Dowling, Anthony Gill, and Paul Marsh of Arizona State University. Their project will compare bluehead suckers collected in adjacent areas of the upper Little Colorado River watershed to Zuni bluehead suckers to characterize taxonomic affinities among bluehead sucker populations and to determine if remnant populations of Zuni bluehead sucker persist elsewhere in the Little Colorado River watershed.

2.4.2 Projections

The extremely limited range of Zuni bluehead sucker is the primary factor that makes the subspecies vulnerable to human activities. Each of the five known populations is isolated from others by intermittent reaches or barriers to upstream movement. It is possible that perturbations, either natural (e.g., wildfire, drought) or human-caused (e.g., elevated sediment deposition, non-native species) could eliminate a population. It is conceivable that either could eliminate Zuni bluehead sucker from New Mexico.

In addition to limitations presented by habitat degradation, introduction and establishment of non-native fishes (e.g. green sunfish, fathead minnow) has been shown to be negatively related to Zuni bluehead sucker range and populations. Zuni bluehead sucker evolved relatively uninfluenced by predaceous aquatic species. Consequently, introduction of piscivorous species, particularly green sunfish, has likely been a factor in the decrease in abundance or extirpation of Zuni bluehead sucker from portions of its historically occupied habitat. Piscivory by green sunfish upon native fishes within the Colorado River drainage has been well documented (Meffe 1985, Marsh and Douglas 1997, Dill and Cordone 1997, Dudley and Matter 2000). Propst et al. (2001) documented few or no Zuni bluehead sucker in areas occupied by green sunfish.

Other predatory aquatic organisms of concern are crayfish (*Orconectes* and *Procambarus* spp.). Crayfish, though common in many North American river drainages, are not native to the Colorado River Basin (Johnson 1986). Two species, northern crayfish (*Orconectes virilis*) and red swamp crayfish (*Procambarus clarkii*), have been documented in the lower Colorado River drainage (Childs 1999). Crayfish are a serious threat to native stream fish in the southwestern

United States (Childs 1999). Crayfish are easily introduced into waters by anglers and have been reported in the Río Nutria (N. Luna, pers. comm.).

Competition from non-native fish species also may have negative impacts on Zuni bluehead sucker. Several fish species, including fathead minnow and plains killifish, which have been introduced into the Zuni River drainage, are likely competitors with Zuni bluehead sucker. Competition from crayfish species is also a concern. These non-natives may compete for space, cover, or food with Zuni bluehead sucker.

Hybridization is another threat from non-natives. White sucker, *Catostomus commersoni,* a native of the Mississippi River drainage, has been inadvertently introduced as a baitfish into many western drainages, including the Río Grande and San Juan drainages of New Mexico (Platania 1991, Ryden 2000). Hybridization between white and bluehead suckers has been observed in the San Juan River (Ryden 2000) and it is plausible that it could hybridize with Zuni bluehead sucker should the species gain access to the Zuni River drainage.

The threat of non-natives is exacerbated in disturbed habitats, such as the lower Zuni watershed. Increased human development allows more opportunities for non-native introductions, through aquaria and bait bucket releases and stocking efforts, either intentional or accidental by both professionals and laypersons. Additionally, invasion and establishment of non-natives occurs more readily in habitats that are accessible to and impacted by humans (Ross 1991).

2.5 ECONOMIC IMPACTS

McKinley County, which contains all of the historical and current populations of Zuni bluehead sucker, has a human population of approximately 74,798, with a median age of 26.9 (2000 Census). Average annual salary is $24,548 (2000 Census) and unemployment is approximately 5.9% (November 2003, New Mexico Department of Labor). Top industries in the county are retail trade (18.5% of total employed persons), local government (15.5%) and accommodation and food service (12.6%) (1st Quarter 2002, New Mexico Department of Labor). There are 224 farms in the county, primarily cattle operations (2000, New Mexico Department of Agriculture).

2.5.1 Positive Impacts

Determining the economic value of conservation is a difficult process. By evaluating use and non-use values of environmental assets, the total economic value of conservation activities, such as recovery of Zuni bluehead sucker, can be calculated. Use values include both Direct Use Value, such as recreation activities, and Indirect Use Value, such as ecological function of a system. Non-use values include Option Value, the ability to have this resource in the future, Bequest Value, the value of passing on the resource, and Existence Value, the value of knowing the resource exists (Munasinghe 1992, Bulte and Van Kooten 2000, Hughey et al. 2003). While many of these values are difficult to assign, there is little argument that the public values nature and is willing to place dollar amounts on conservation, through taxes and legislation.

Some Direct Use Values are available for New Mexico: in 2001, state residents and nonresidents spent about $1 billion on wildlife-associated recreation, including fishing, hunting, and wildlife-watching activities, in New Mexico (USFWS 2003). Because recovery of Zuni bluehead sucker will likely lead to rehabilitation and protection of areas surrounding the habitat, an increase in wildlife and recreational opportunities, not only immediately at the site, but throughout a larger area, may be expected. These positive impacts increase natural resource tourist activities, such as hunting, fishing, hiking, and camping in the area. This may lead to increases in the local accommodation and food service sector, as well as the retail trade sector. Throughout the western United States, similar shifts in industry have been occurring, leading to a trend away from extraction sectors, such as mining and timber, toward tourism and service sectors (Ingram and Lewandrowski 1999).

Habitat conservation, as a result of Zuni bluehead sucker recovery, will work toward the goals of the *Zuni Conservation Plan* and the *Zuni River Watershed Plan*. These plans intend to restore damaged lands and protect the natural resources of the Zuni River watershed for future generations. Through combining efforts to restore Zuni bluehead sucker habitat within the Zuni River watershed, greater work can be accomplished and future litigation and restitution activities may be limited. Zuni bluehead sucker habitat improvement may decrease many negative effects that resulted from the severe degradation of the watershed as described in the Zuni River Watershed Act, including reduced renewable resources and loss of water. Side effects of habitat

conservation and restoration may include reduced erosion and improved vegetation. These changes may lead to more forage and better range for livestock, as well as improved Zuni bluehead sucker habitat.

Working cooperatively with federal, state, local, tribal and non-profit agencies, and private individuals also has positive economic value. In addition to avoiding duplicative efforts and funding, cooperation now can avoid increased restrictions in the future. Zuni bluehead sucker is a federal candidate species because it may warrant listing. By working cooperatively to recover the subspecies and its habitat, listing under the Endangered Species Act and possible subsequent restrictions and actions might be avoided. Recovery of Zuni bluehead sucker may contribute to conservation and recovery of other imperiled and rare species that occur in the area.

2.5.2 Negative Impacts

Protection and conservation of Zuni bluehead sucker requires preservation and enhancement of extant populations and restoration of historical populations and habitats. This may include modifications on current livestock grazing, timber harvest, and water withdrawal practices. These practices, when improperly managed, have been shown to be detrimental to the subspecies. Reductions in these activities could have negative economic impacts. Residential and commercial development, as well as the infrastructure needed to support development, such as road improvement and water development, also may have negative impacts on the species. Completion of these activities using methods that minimize impacts on Zuni bluehead sucker may incur additional costs. Inclusion of multiple resource users and land managers into the recovery planning process is intended to mitigate these effects.

2.6 SPECIAL CONSIDERATIONS

2.6.1 Federal Jurisdiction

Zuni bluehead sucker is federally listed as a candidate species, indicating that it may warrant full listing under the ESA in the future (USFWS 2002a,b). Candidate species receive no statutory protection under the ESA, although the USFWS encourages conservation of these species to avoid future protection under the ESA. One of the benefits of this Recovery Plan is to work

toward rehabilitation and conservation of the subspecies to preclude federal listing. If listing occurs, USFWS will have primary jurisdiction over protection of the subspecies.

2.6.2 Zuni Indian Pueblo and Reservation

Much of the current and historical range of Zuni bluehead sucker occurs on the Zuni Indian Reservation. The State of New Mexico recognizes the Zuni Pueblo as a sovereign nation and as such, does not have jurisdiction over wildlife species on Zuni lands. The intention of this plan is to work as partners with the Pueblo of Zuni to achieve recovery of the subspecies, both on and off Indian lands.

United States Secretarial Order 3206 details the responsibilities of Federal agencies concerning the Endangered Species Act when Tribal interests involved, including the management of candidate species. Native American tribes are recognized as sovereign, appropriate governmental entities to manage their resources and as such, the Order instructs Federal agencies to defer to tribal conservation and management plans.

2.6.3 Zuni Land Conservation Act

The Zuni Land Conservation Act of 1990 provided closure to more than 10 years of litigation concerning damaged lands as a result of past federal land management practices. This Act provided a trust fund to begin the Zuni Conservation Project to "restore damaged Zuni lands and to protect and manage Zuni natural resources…for future generations" (Public Law 101-486). Additionally, the Act required the formation of the *Zuni River Watershed Plan* to plan for protection and rehabilitation of all resources in the Zuni River watershed upstream from the Zuni Indian Reservation. These management plans need to be considered as recovery efforts for Zuni bluehead sucker are designed and completed.

2.6.4 Current Applications to Develop

There is currently an application before the U.S. Forest Service and McKinley County to transfer responsibility for Forest Service Roads 190 and 190b to McKinley Country. This action would provide for widening and improvement of these primitive roads to county standards. While there are no current development applications before McKinley County, interest has been shown in

developing the area for private residences. Current and future uses of the land must be considered in conjunction with the recovery of Zuni bluehead sucker.

2.6.5 Scientific and Ecological Uniqueness

Zuni bluehead sucker is considered a species of scientific significance because of its unique evolutionary history. To current knowledge, Zuni bluehead sucker is the only subspecies to have arisen through natural hybridization enabled by a cross-Continental Divide stream exchange. The unique evolution of the subspecies may have much to offer "toward development of principles that will aid in the understanding of other species" (Smith and Koehn 1979). The subspecies is widely recognized for its scientific value by geneticists and evolutionary biologists (Smith and Koehn 1971, Smith et al. 1983, Crabtree and Buth 1987).

2.7 SUMMARY AND CONCLUSIONS

Zuni bluehead sucker is a small sucker native to the Zuni River in western New Mexico. Zuni bluehead sucker requires clean, hard substrate in runs and run-pools. Extensive timber harvest and overgrazing in the 1800s and early 1900s led to severe habitat degradation throughout the watershed. Water withdrawals, reservoirs, and establishment of non-native species in the later 1900s negatively affected the subspecies. Zuni bluehead sucker now is restricted to several small, semi-isolated areas in Río Nutria and Tampico Draw, totaling about 10% of historic distribution.

Primary threats are elevated siltation and sedimentation and decreases in run and run-pools. These threats may be exacerbated with increased development in the area, which may impact groundwater and surface water flows. Zuni bluehead sucker populations are also threatened by competition, predation, and hybridization with non-native species. This plan, although specific to Zuni bluehead sucker recovery, is designed to complement the resource management plans and activities developed for the Zuni River watershed, including those that resulted from the Zuni River Watershed Act. Conservation-oriented management of land by the USFS, TNC, Zuni tribe, and committed private landowners may assist in the protection of Zuni bluehead sucker habitat.

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3.0 MANAGEMENT STRATEGY

Section 3.0 contains the management goal and objective of Zuni bluehead sucker recovery. This section also details the problems and opportunities affecting attainment of the stated objective and the broad strategies that will be employed to surmount these issues and reach the objective.

3.1 Management Goal and Objective

Goal: Have secure, self-sustaining (sub)populations of Zuni bluehead sucker (*Catostomus discobolus yarrowi*) throughout its historical range.

Objective: That by 2015, the populations and distribution of Zuni bluehead sucker are sufficient to ensure its persistence within New Mexico and thereby warrant its removal from the state endangered species list.

Objective Parameters:

- The genetic and demographic structure of existing (sub)populations will be determined to identify appropriate units for management activities.

- All existing (sub)populations in the Zuni River watershed will be secure, self-sustaining and stable as indicated by appropriate demographic and genetic parameters. At a minimum, this will include an indication of increasing or stable population trends and sufficient population size of genetically distinct units to guard against losses due to stochastic events.

- Threats, such as habitat degradation, that negatively impact current populations and that prevent expansion throughout the historical range, will be reduced such that the (sub)populations might be considered secure.

- Replicate self-sustaining, secure (sub)populations are present as necessary for restoration throughout historic distribution sufficient that no single human-caused or natural event threatens the security of the subspecies.

3.2 Management Issues and Strategies

Issue 1. Lack of Current and Historical Distribution Information. *Lack of precise information concerning current and historical habitats and populations of Zuni bluehead sucker prevents comprehensive protection, recovery and reestablishment of the subspecies. Uncertainty regarding the relationship and distribution of the subspecies to bluehead sucker confuses the understanding of historical distribution information and makes determining appropriate areas for repatriation difficult.*

Strategy 1. Complete a thorough investigation of sources to delineate Zuni bluehead sucker historical distribution.

Strategy 2. Complete a thorough survey of potential habitats, including areas where populations were recently reported.

Strategy 3. Support research to determine the relationships and distribution of bluehead suckers in the Little Colorado River Basin.

Issue 2. Limited (Sub)Populations and Distributions. *Zuni bluehead sucker currently may number as few as 200 individuals in several semi-isolated areas in a very limited range. These extremely limited numbers make them susceptible to elimination by natural perturbations, such as wildfire, or human induced disturbances, such as siltation or non-native species.*

Strategy 1. Survey the watershed to better determine the location and extent of extant populations.

Strategy 2. Establish a monitoring program to assess the security and stability of current populations.

Strategy 3. Determine minimum populations needed to secure status and required demographics of each population.

Strategy 4. Establish a broodstock program in a hatchery facility, including a broodstock genetic management plan, to act as a refugia population, only to be used for augmentation if absolutely necessary.

Strategy 5. Establish additional Zuni bluehead sucker populations in suitable, secure habitats within its historical range as necessary to achieve the goals of this recovery plan.

Issue 3. Habitat Loss. *Increased siltation and sedimentation and decreased flows have degraded and limited the amount of appropriate habitat for Zuni bluehead sucker.*

Strategy 1. Inform private and public landowners in the watershed about the implications of soil erosion and water withdrawals and assist them in implementing practices that decrease or prevent increases in soil erosion and water withdrawals.

Strategy 2. Inform private and public landowners about the protection of current suitable habitat, including improving livestock and timber-harvest practices to protect the larger riparian and stream habitats, and assist them with the implementation of such practices.

Strategy 3. Identify and rehabilitate habitats where possible and secure their protection.

Strategy 4. Develop a hydrological model of the system to enable water management planning.

Strategy 5. Coordinate efforts within existing projects and current land uses to enable habitat restoration and protection.

Strategy 6. Identify and secure resources to promote habitat restoration and protection.

Issue 4. Aquatic Fauna Dominated by Non-Native Species. *Native species, such as the speckled dace, have largely been extirpated from the watershed and replaced by non-native species. Non-native species present threats to Zuni bluehead sucker through competition, predation, and hybridization.*

Strategy 1. Determine the distribution and abundance of non-native species in the Zuni River watershed and the physical barriers to their expansion.

Strategy 2. Prevent the introduction of new non-native species into the watershed.

Strategy 3. Remove existing non-native species that present a threat to Zuni bluehead suckers.

Strategy 4. Inform local resource users about the impacts of exotic species.

Strategy 5. Re-establish historically associated native species into appropriate habitats in the Zuni River watershed.

Issue 5. Lack of Information on Zuni Bluehead Sucker. *The lack of detailed biological information, such as preferred habitat for specific life stages, diel, seasonal, and life span movements, disease threats, and genetic and demographic structure can lead to speculative management and unsupportable goals.*

Strategy 1. Support research to determine genetic and demographic structure of Zuni bluehead sucker populations in relation to the other *Pantosteus*-suckers of the Little Colorado River basin.

Strategy 2. Support research to determine specific habitat needs of fry, larval, juvenile, and adult Zuni bluehead suckers, including spawning habitat needs.

Strategy 3. Support research to determine diseases, parasites, and other health issues, both current and potential, of Zuni bluehead sucker.

Strategy 4. Support research to determine activity and movement patterns of Zuni bluehead sucker.

Strategy 5. Support research to determine other aspects of Zuni bluehead sucker life history, ecology and biology necessary for the successful recovery of the subspecies.

Strategy 6. Utilize information gained to direct conservation efforts for Zuni bluehead sucker recovery.

Issue 6. Lack of Hydrological Data for the Zuni River Watershed. *The absence of hydrological information for the Zuni River watershed prevents proper management of local water uses planning for habitat protection.*

Strategy 1. Establish a hydrological monitoring program for the Zuni River watershed.

Strategy 2. Create a historical record for the upper watershed to the extent possible for comparison with current conditions.

Strategy 3. Identify the implications of changes in water use on the hydrology of the Zuni River and Zuni bluehead sucker recovery.

Strategy 4. Utilize the information gained to direct conservation efforts for Zuni bluehead sucker recovery.

Issue 7. Fragmented Management. *Stewardship of Zuni bluehead sucker habitat and management of the (sub)populations falls under the control of several tribal, federal and state agencies and private organizations and individuals. While various formal and informal programs exist for rehabilitation and conservation of natural resources in the watershed, there is little consistency or collaboration among entities. This disconnect in management practices can lead to conflicting goals, duplication of efforts, and inconsistency of management actions.*

Strategy 1. Draft and implement a conservation agreement to facilitate coordination of conservation activities of landowners and managers in the Zuni River watershed

Strategy 2. Create a recovery implementation team of stakeholders to coordinate efforts among landowners and agencies and guide the direction of conservation efforts.

Strategy 3. Educate and inform local agencies, landowners, and users about the life history and conservation of Zuni bluehead sucker and recovery efforts on its behalf.

Strategy 4. Identify and secure funding to promote the goals of this recovery plan.

4.0 APPROVALS

This Recovery Plan for the Zuni bluehead sucker is approved by:

Lisa Kirkpatrick 12/27/04

Lisa Kirkpatrick, Conservation Services Division Chief
New Mexico Department of Game and Fish

Date

Bruce C. Thompson 1-4-05

Dr. Bruce Thompson, Director
New Mexico Department of Game and Fish

Date

1-4-05

Guy Riordan, Chairman
New Mexico State Game Commission

Date

APPENDIX I

SUMMARY OF PUBLIC INVOLVEMENT ON THE ZUNI BLUEHEAD SUCKER RECOVERY PLAN

Wildlife Conservation Act

The Wildlife Conservation Act (WCA) [17-2-40.1 NMSA 1978] directs the New Mexico Department of Game and Fish (NMDGF) in the process to be followed for the recovery of endangered and threatened species. Public participation in the recovery process is detailed in the WCA and includes initial public information meetings, the formation of an Advisory Committee and review of the document by affected and interested organizations, agencies and individuals prior to submission to the State Game Commission.

Public Information Meetings

The public meeting is the first step in the Recovery Plan process. Public meetings were held to provide opportunities for individuals and private and public entities to express views about the development of the recovery plan and attendant social or economic impacts, if any, that may result from implementation of a recovery plan. At the meetings, background information about the listing, an explanation of the process, and probable content in general terms of the recovery plan were presented, and participation in the recovery plan advisory committee was solicited. Meetings were advertised through mailings to over sixty private and public organizations, agencies and individuals, newspaper advertisements (Albuquerque Journal and Gallup Independent for 10 days prior to each meeting) and NMDGF press releases.

December 11, 2003 – Grants, NM, 6 pm – six participants from local, tribal and federal agencies

January 21, 2004 – Zuni, NM, 2 pm – twelve participants, primarily from Zuni resource agencies

January 21, 2004 – Gallup, NM, 6 pm – thirteen participants, primarily with local interests

Advisory Committee

On January 29, 2004, NMDGF sent sixty-five letters to individuals and public and private agencies formally seeking participation on the Advisory Committee. Confirmation letters were sent to all of the individuals who expressed interest on February 27, 2004. The Advisory Committee consists of seventeen individuals from academia, federal, state and tribal agencies, conservation organizations and private landowners.

The Advisory Committee assisted in the development of the plan through reviews of drafts, contribution of management ideas, and identification of potential problems and opportunities related to recovery. The Background and Situation Analysis section of the Recovery Plan was circulated for Advisory Committee review in April 2004. Suggestions for the content of the Management Strategy section were also sought at this point. Comments and questions were received from seven of the Advisory Committee participants. These were addressed by NMDGF and incorporated into the text of the Recovery Plan. One meeting was held in Zuni, NM on May 5, 2004 to discuss and draft

the Management Strategy Section. Nine Advisory Committee participants were present. The Management Section was drafted by NMDGF and circulated for review by the Advisory Committee in May 2004. After incorporating comments from the Advisory Committee, the completed document was circulated for another review in June 2004. Edits from of the Advisory Committee members and NMDGF review are reflected in the current version of the Recovery Plan.

U. S. Fish and Wildlife Service – Chris Kitcheyan and Marilyn Myers
U. S. Forest Service – Bob Woyewodzic and Ron Maes
Natural Resources Conservation Service – Ed Oliver and Ally Snell
Bureau of Reclamation – Rob Clarkson
Arizona Department of Game and Fish – Matt McKell
New Mexico Environment Department – Gary Schiffmiller
Pueblo of Zuni Fish and Wildlife Department – Tony Povolitis and Nelson Luna
Navajo Department of Fish and Wildlife – David Mikesic
The Nature Conservancy of New Mexico – Robert Findling and Gary Bell
Arizona State University – Thomas Dowling and Paul Marsh
Private Landowner – Matthew Silva

Additional Public Participation

In addition to the announcements of the public meetings and solicitation for participation on the Advisory Committee, many individual communications (e-mails, phone calls) were made to local landowners, conservation organizations, and government agencies to engage them in the recovery planning process. An article describing the Zuni Bluehead Sucker and the recovery planning process appeared in the Winter 2003 issue of Share with Wildlife Update.

The general public, as well as public and private agencies and organizations, had the opportunity to comment on the Zuni Bluehead Sucker Recovery Plan between August 5 and September 20, 2004. Announcements of the public comment period were mailed to 65 individuals and agencies and provided in Department press releases. The Recovery Plan was available electronically on the Department website as well as in hard copy by request. No public comments were received. Comments were to be incorporated into the final draft to be presented to the New Mexico State Game Commission.

New Mexico State Game Commission Approval

The Recovery Plan was presented to the State Game Commission on December 15, 2004 in Albuquerque, New Mexico. Additional public comments were taken at the meeting and no further changes were necessary to the Plan. The Zuni Bluehead Sucker Recovery Plan was approved by the State Game Commission during the same meeting.

Details of activities and correspondence are available from Stephanie Carman, NMDGF (505) 476-8092, scarman@state.nm.us