

**ZUNI BLUEHEAD SUCKER MONITORING AND
CONSERVATION EFFORTS
2008**



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SUMMARY

Zuni bluehead sucker *Catostomus discobolus yarrowi* historically occurred in the Zuni River and tributaries, including ríos Nutria and Pescado, Tampico Draw, and Agua Remora (formerly Radosovich Creek). These populations have been irregularly studied by the New Mexico Department of Game and Fish (NMDGF), U.S. Fish and Wildlife Service (USFWS), Zuni Fish and Wildlife Department, and U.S. Forest Service since the 1970s, providing presence/absence and life history information. In 2004, NMDGF completed and began implementing the *Zuni Bluehead Sucker Recovery Plan* (Carman 2004), which included annual monitoring. Over the past five years, with the assistance of the USFWS New Mexico Fish and Wildlife Conservation Office, The Nature Conservancy (TNC), Zuni Department of Fish and Wildlife, New Mexico Environment Department (NMED), Silva Family, Albuquerque Biological Park (BioPark), and U.S. Forest Service Cibola National Forest, Mount Taylor Ranger District (USFS), surveys have been completed throughout much of the species historical range and monitoring was implemented in accessible and currently occupied habitats.

In 2008, habitat and fish population monitoring was completed at ten sites in historical Zuni bluehead sucker habitat; persistence of Zuni bluehead sucker was confirmed in the Agua Remora, Tampico Springs, Tampico Draw, and Río Nutria. Sites in the Río Nutria on Pueblo of Zuni and TNC lands had the best habitat for Zuni bluehead suckers, which has improved over recent years as a result of flushing flows and decreased beaver activity. Isolated spring habitats in the upper watershed continued to support Zuni bluehead sucker populations, but significant changes were seen in the location and quality of habitat. Larval or young-of-year suckers were observed in headwater spring and canyon-bound areas. Although several sites have been surveyed in historically occupied habitats in the Zuni River and Río Pescado, Zuni bluehead sucker has not been found in these rivers since the mid-1990s.

Additional conservation activities for Zuni bluehead sucker in 2008 included removal of nonnative green sunfish *Lepomis cyanellus* from the Agua Remora, collection of larval and adult Zuni bluehead suckers for captive rearing investigations, and research into the conservation genetics of the species. Habitat conservation and restoration projects for the year focused on acquisition of headwater habitat. Public information and outreach efforts this year included preparation of a segment for inclusion in the New Mexico Wildlife television program.

AREA OVERVIEW

Three primary areas of Zuni bluehead sucker occurrence were identified using historical records, previous sampling, discussions with local landowners, and reconnaissance surveys: the upper watershed isolated spring habitats, including Agua Remora and Tampico Springs; the middle watershed canyon-bound habitats, including the upper Río Nutria and Tampico Draw; and the lower watershed mainstem habitats, including the Pescado and Zuni rivers (Figure 1). Zuni bluehead sucker historically occurred throughout these areas, but populations are no longer found or suitable habitat is lacking in the mainstem habitats. A summary of the habitats follows:



Isolated Spring Habitats

Zuni bluehead sucker distribution extends to headwater springs in the Zuni Mountains near the continental divide. These habitats are intermittent and may be isolated from downstream reaches and each other; connecting flow to downstream habitats only occurs during high flow events. Currently, the confirmed extant populations occur in perennial habitats in the Agua Remora and Tampico Springs on USFS and private lands. Agua Remora, where sampled, is a series of semi-isolated, permanently-watered pools occupied by Zuni bluehead sucker and green sunfish. Tampico Springs, which is a series of semi-isolated pools, is occupied only by Zuni bluehead sucker. Access to these habitats is dependant on private landowner permission and has been irregular.

Canyon-Bound Habitats

Canyon-bound reaches of the Río Nutria are owned primarily by TNC and the Pueblo of Zuni, and are the current stronghold of Zuni bluehead sucker. Habitat quality and extent varies in response to precipitation, beaver activity, and upstream land-use. Water is primarily perennial and three sites in this area are monitored annually: Tampico Draw, Río Nutria below the confluence with Tampico Draw, and Río Nutria in the box canyon. Since 2006, wetted habitat has been present in the Río Nutria immediately above the confluence and is also sampled. In 2008, NMDGF and TNC completed purchase of upper areas of the Río Nutria, where Zuni bluehead sucker occurred regularly in the 1990s. Tampico Draw near the confluence with Río Nutria on TNC land is perennial, but upper reaches are intermittent and Zuni bluehead sucker has not been confirmed there. Nonnative crayfish *Orconectes virilis* and fathead minnow *Pimephales promelas* are present, with abundance of each increasing downstream; speckled dace *Rhinichthys osculus* historically was present, but has been scarce in recent years.

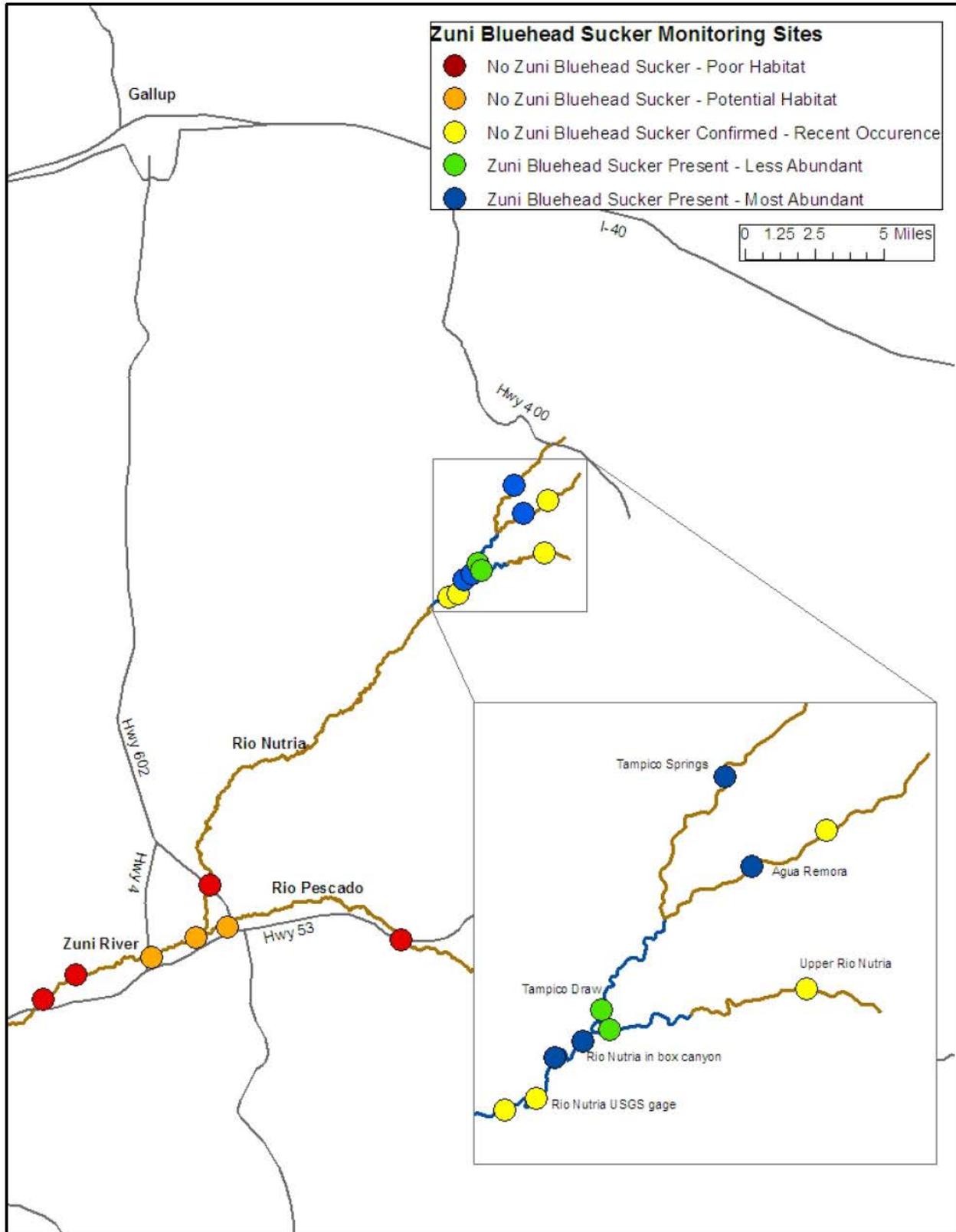
Mainstem Habitats

Mainstem habitats in the lower watershed occur solely on Pueblo of Zuni land. The Río Nutria below the box canyon meanders through a willow wetland and a series of impoundments. One site at the uppermost part of this section, just below the mouth of the box canyon near the USGS gage, is monitored annually and Zuni bluehead sucker have been present recently. Crayfish and fathead minnow are common and beaver activity is increasing. Although Zuni bluehead sucker have been reported downstream of the gage, they are likely dispersants from upstream populations.

The Río Pescado, which flows primarily on Pueblo of Zuni land, historically held populations of Zuni bluehead sucker. Since 2004, several sites have been sampled, but neither Zuni bluehead sucker nor suitable habitat was found. Ríos Pescado and Nutria join above BIA Rte 4 to form the Zuni River, which historically had populations of Zuni bluehead sucker. Habitat is now degraded and few areas exist with permanent flow, most occurring below Black Rock Reservoir. While perennial waters exist in some areas of the Río Pescado and Zuni River, suitable habitat is lacking and nonnative predators such as green sunfish and Northern pike *Esox lucius* dominate.



Figure 1. Zuni bluehead sucker monitoring and survey sites, 2004 through 2008, with inset of upper watershed sites. Blue areas indicate perennial watercourses, brown intermittent or ephemeral.





ANNUAL MONITORING

Evaluation Methods

Areas for monitoring Zuni bluehead sucker populations were selected using historical records, previous sampling, discussions with local landowners and managers, and reconnaissance surveys. Monitoring sites were identified in three main areas of the watershed (Figure 1). Monitoring of several sites is irregular, based upon landowner permissions and presence of wetted habitat.

Fish collection and habitat evaluation methods follow those commonly used by NMDGF Conservation Services Division for monitoring endangered fish species, including past Zuni bluehead sucker surveys. Because these methods have been used successfully in the past, population and habitat trends can be estimated for Zuni bluehead suckers. These fish collection methods have been shown to be most effective and least intrusive for collecting benthic species. Sucker species, which often hide under cover or in deeper areas, are easily and effectively captured with electrofishing gear, which draws them out and up from hiding places. When used properly, occurrence of harmful effects from electrofishing is significantly reduced and mortality is minimal. Additionally, electrofishing is less disruptive to benthos, which is vital for species that feed and live on the substrate. In the Zuni River watershed, other fish capture methods such as seining are ineffective because of instream obstructions (e.g., boulders and instream debris) and habitat depth (some >1.5 m).

Fish collection began at the downstream boundary of the site and proceeded upstream until all available mesohabitats (e.g., pool, riffle, and run) were sampled. Sampling effort per mesohabitat (area sampled and elapsed time electrofishing) was recorded. Fish were collected using a battery-powered backpack electrofisher (24 V DC) set to appropriate levels for sucker collection based on local conductivity. Two netters immediately removed stunned fish and placed them into aerated buckets until completion of the pass. Native fish were identified, enumerated, measured (length and mass), sex determined when possible, and released at the approximate point of capture. Non-native fishes were preserved for identification and accession to University of New Mexico Museum of Southwestern Biology or removed. When needed for genetic surveys, small clips (<2 mm²) were taken from the pelvic fin of Zuni bluehead suckers and preserved in 95% ethanol.

To determine movement between upstream and downstream populations, Zuni bluehead sucker over 150 mm total length (TL) were implanted with Passive Integrated Transponder tags (PIT tags) and the number and location recorded in 2005 and 2006. All Zuni bluehead sucker over 150 mm TL were scanned with a PIT tag reader to check for recapture in 2006 and 2007. In 2007, PIT tag implantations ceased because few fish greater than 150 mm TL were captured.

Quantitative habitat evaluation methods were used to determine availability of Zuni bluehead sucker habitat at each site. Water depth and velocity were measured and recorded at randomly selected points within each sampled mesohabitat. Substrata was visually characterized (e.g., sand, cobble, bedrock) at each depth/velocity measurement point. Presence of silt over base substratum was also recorded at each depth/velocity point, as well as information on cover and vegetation. Water quality parameters (water temperature, dissolved oxygen, pH, conductivity,



and salinity) were measured at each site. Qualitative site descriptions were recorded, including riparian vegetation descriptions, stream size, and weather observations. Location data, including GPS points, were recorded for all sites.

Monitoring occurred on 13-15 September 2004, 22-24 August 2005, 28-31 August 2006, 19-21 August 2007, and 24-28 August 2008

Habitat Monitoring Results

The best habitat for Zuni bluehead sucker (clean, hard substrate with flowing water) was found in the canyon-bound reaches, especially Río Nutria on TNC land and in the box canyon on Pueblo of Zuni land (Table 1). Río Nutria above the confluence was found wetted again in 2008, providing additional habitat. Sites immediately adjacent to these areas, Tampico Draw above the confluence and Río Nutria at the USGS gage, and in the isolated headwater habitats, had marginal habitat (some flowing water over patchily silted or debris-laden substrate). Lower mainstem areas had degraded habitat (pooled water over silt).

The occupied isolated spring habitats (Tampico Springs and Agua Remora) in the upper areas of the watershed were visited in 2008 for annual monitoring. These habitats are quite different from the lower areas of the watershed where Zuni bluehead sucker is found; these are small (about 1-2 m x 10 m), spring-fed semi-connected pools in grassy meadows (Figure 2). Water in these areas is tannic, yet clear unless the substrate is disturbed, and slow moving and substrate was largely silt overlaying boulder.

Reports were received of isolated Zuni bluehead sucker populations and habitats in additional areas of the upper watershed. In August 2008, visual surveys of some areas revealed many drying/dried pools and a few small wetted areas; a Zuni bluehead sucker adult was confirmed in one pool. Likely, these isolated areas occur throughout the upper watershed and serve as population refuges.

Areas of marginal habitat in the canyon-bound reaches in previous years, Tampico Draw above the confluence and in Río Nutria at the USGS gage, were impounded by beaver dams in 2006 and 2007 (Figure 3). In 2008, beaver activity decreased, and less silt and standing water was observed in these areas (Figure 4).

Surface water was found again at several sites that had been dry in recent years: Río Pescado at Hwy 602, Zuni River below the confluence of ríos Pescado and Nutria, and Zuni River at BIA Rte 4. The Zuni River between Black Rock and Eustace reservoirs was also visited and found wetted in 2008. Zuni bluehead sucker habitat was poor at all sites, consisting of deep, slow moving water over heavily silted substrate. Río Nutria at Highway 602 was visited, but was dry.

Water chemistry data collected by NMDGF during 2004-2008 Zuni bluehead sucker monitoring is summarized in Table 2. Water temperature was coolest in the canyon-bound and isolated spring habitats; mainstem habitats were substantially warmer. Dissolved oxygen was greatest in canyon-bound habitats and least in areas of standing water, such as the Río Nutria at the USGS gage. Generally, salinity and conductivity increased downstream. Tampico Draw exhibited higher conductivity than Río Nutria.



Table 1. Habitat variables collected in the Zuni River watershed, 2004 through 2008. Dashed lines indicate information was not recorded. Current Class is based on average of cubic feet per second measurements: Minimal ≤ 0.04 cfs; Moderate > 0.04 cfs. Shading indicates sites where Zuni bluehead sucker populations have not been recently verified. 2008 data are bolded.

Site	Year	Macro-habitats Sampled	Dominant Mesohabitat Type(s)	Average Depth (m)	Dominant Current Class	Dominated Substrate	Secondary Substrate	Dominant Cover
Tampico Springs	2007	2	Pool	0.64	Minimal	Silt	Cobble	Boulder
	2008	2	Pool	0.47	Minimal	Silt	Sand	Vegetation
Agua Remora, Forest Service	2005	2	Pool	1.75	Minimal	Cobble	Boulder	Vegetation
	2006	3	Pool	0.62	Minimal	Silt	Boulder	Algae
	2007	3	Pool	0.56	Minimal	Silt	Boulder	Vegetation
	2008	2	Pool	0.28	Minimal	Silt	Boulder	
Tampico Draw above confluence	2004	2	Pool	0.56	Minimal	Bedrock	Silt	
	2005	2	Pool	0.58	Moderate	Gravel	Silt	Boulder
	2006	1	Pool	0.52	Minimal	Bedrock	Silt	Vegetation
	2007	3	Pool	0.21	Minimal	Silt	Bedrock	Vegetation
	2008	2	Pool	0.24	Minimal	Silt	Bedrock	
Río Nutria above confluence	2006	1	Pool	----	Minimal	Cobble	Bedrock	
	2007	1	Pool	0.29	Minimal	Bedrock	Silt	Boulder
	2008	1	Pool	0.42	Minimal	Bedrock	Gravel	Boulder
Río Nutria below confluence	2004	2	Pool	0.68	Minimal/Moderate	Bedrock	Silt	Filamentous algae
	2005	2	Pool	0.69	Minimal/Moderate	Bedrock	Silt	Boulder
	2006	3	Pool	0.35	Minimal	Bedrock	Boulder	Boulder
	2007	3	Pool	0.23	Minimal	Bedrock	Silt	Boulder
	2008	3	Pool	0.17	Minimal	Bedrock	Silt	Boulder
Río Nutria in box canyon	2004	4	Pool	0.35	Minimal	Clay	Bedrock	Willow
	2005	3	Pool	1.34	Moderate	Gravel	Boulder	
	2006	3	Pool	0.42	Minimal	Gravel	Silt	Boulder
	2007	3	Pool	0.39	Minimal	Bedrock	Silt	Boulder
	2008	2	Pool	0.60	Minimal	Bedrock	Gravel	Boulder
Río Nutria at USGS gage	2004	2	Pool	0.39	Moderate	Clay	Gravel	Debris
	2005	2	Pool	1.46	Minimal	Gravel	Silt	Vegetation
	2006	2	Pool	0.41	Minimal	Silt	Gravel	Vegetation
	2007	2	Pool	0.52	Minimal	Silt	Gravel	Vegetation
	2008	3	Slow Run	0.53	Minimal	Gravel	Silt	Vegetation
Río Nutria in willow wetland	2004	----	Slow Run	----	Minimal	Silt		Willow
Río Pescado at Hwy 53	2004	9	Slow Run	1	Minimal	Clay	Silt	Vegetation
Río Pescado at Hwy 602	2006	1	Slow Run	----	Minimal	Silt	Silt	Boulder
Zuni River at confluence	2008	1	Pool	1.0	Minimal	Silt	Gravel	
Zuni River at BIA Rt 4	2006	1	Pool	0.50	Minimal	Silt	Boulder	Boulder
	2007	1	Pool	---	Minimal	Silt	Boulder	
	2008	2	Pool	0.33	Minimal	Silt	Boulder	Boulder
Zuni River below Black Rock	2004	2	Wetland Pool	0.34	Minimal/Moderate	Silt	Boulder	Woody
	2007	1	Wetland Pool	---	Minimal	Silt		Vegetation
Zuni R. between Black Rock & Eustace	2006	2	Slow Run	0.63	Minimal	Silt	Concrete	Vegetation
	2008	3	Slow Run	0.06	Minimal	Bedrock	Silt	Vegetation

Figure 2. Sampling isolated spring habitat, Tampico Springs, 2007. Photo: Matthew Silva.



Figures 3-4. Beaver dams in Tampico Draw, 2007. Photo: Martha Schumann, TNC. Quality habitat in the Río Nutria, 2008. Photo: Angela James, USFWS.





In 2004, NMED completed water quality and chemistry analyses in the Zuni River watershed. Within Zuni bluehead sucker occupied habitat, one exceedence of New Mexico Water Quality Standards (State of New Mexico Standards for Interstate and Intrastate Surface Waters, 20.6.4 NMAC as amended through February 16, 2006) criteria was reported: dissolved oxygen levels were 2.93 mg/L in the Río Nutria above Tampico Draw, below the 6 mg/L standard for coldwater aquatic life. The complete NMED report is available at:

<http://www.nmenv.state.nm.us/swqb/Surveys/ZuniSurveySummary2004.pdf>

Based on the information collected, NMED is proposing to designate the Río Nutria as a coolwater system with dissolved oxygen 6 mg/L or more, temperature 29°C (77°F) or less, and pH between 6.6 to 9.0 criteria. The proposal is available at:

<ftp://ftp.nmenv.state.nm.us/www/swqb/Standards/TriennialReview/2008/TriennialReview-12-16-2008DRAFTAmendments.pdf>

Fish Collections

During 2008 monitoring, Zuni bluehead sucker was present at six sites and absent at four (Table 3, Figure 5). Zuni bluehead sucker was found at two sites where it had not been collected in recent years: Tampico Draw, where beaver activity had diminished habitat in 2006 and 2007, and Río Nutria above Tampico Draw confluence, which had been dry prior to 2006. Zuni bluehead sucker was absent in the Río Nutria at the USGS gage, where deep water and heavy siltation degraded habitat for Zuni bluehead sucker. Most Zuni bluehead sucker specimens were collected in the Río Nutria canyon area, Agua Remora, and Tampico Springs. Fathead minnow presence was confirmed in the Río Nutria from the confluence with Tampico Draw to Pueblo of Zuni land. Green sunfish were present in the Agua Remora, but catch rates were lower than in previous years (Figure 6). No speckled dace was captured in 2007 or 2008. Crayfish were observed during fish surveys in the Río Nutria upstream of the USGS gage, but not at the Río Nutria box canyon site. This represents an increased spread of approximately 100 m since 2004.

A total of 200 Zuni bluehead sucker ranging from young-of-the-year to 178 mm total length (TL), was caught in August 2008. The majority of Zuni bluehead sucker caught appeared in excellent physical condition, with spawning coloration (red lateral stripe) noted on some males at all sites. Black spot, a common fish parasite, was found on Zuni bluehead sucker in the Agua Remora and Río Nutria box canyon. No fish had a swollen vent or expressed milt in August 2008. Young-of-year Zuni bluehead suckers were found in the Río Nutria, Tampico Draw, and Tampico Springs.

The second year of sampling was completed in Tampico Springs. Zuni bluehead sucker in Tampico Springs were smaller than at other sites, ranging from 22-107 mm TL. As reported in 2007, fish (8/66) captured at Tampico Springs exhibited facial deformities (misshapen mandible and twisted lips).

Monitoring efforts at the Agua Remora site have focused on the two lower pools, as the upper pool was fishless in 2005 and 2006. In 2006, 11 Zuni bluehead sucker captured from the middle pool were moved into the upper pool. In 2007, persistence of Zuni bluehead sucker in the upper pool was documented, with capture of four fish from the upper pool. In 2008, extensive debris made sampling impossible in the upper pool, but Zuni bluehead sucker presence was visually confirmed. Green sunfish has not been documented in the upper pool.



Table 2. Water chemistry variables collected by NMDGF in the Zuni River watershed 2004-2008. Dashed lines indicate that information was not collected. Bold indicates 2008 data, shading indicates sites where Zuni bluehead sucker have been absent recently.

Site	Date	Temperature (°C)	Salinity (ppt)	pH	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Conductivity (mS)	Specific Conductivity
Tampico Springs	19 Aug 2007	17.0	0.24	7.0	5.71	59	418	494
	25 Aug 2008	16.2	0.2	8.0	6.07	62	347	418
Agua Remora, Forest Service, Lower Pool	24 Aug 2005	12.9	0.3	7.6	----	----	403	525
	30 Aug 2006	12.6	0.3	7.4	9.26	88	438	574
	19 Aug 2007	19.4	0.3	---	8.40	90	519	582
	25 Aug 2008	13.0	0.23	7.4	5.85	56	368	477
Tampico Draw above confluence	14 Sept 2004	14.9	----	8.1	12.08	157	----	----
	23 Aug 2005	15.8	0.3	8.1	----	----	531	643
	31 Aug 2006	14.8	0.3	8.2	8.57	86	530	667
	28 Aug 2008	21.3	0.3	8	9.45	107	577	621
Río Nutria above confluence	31 Aug 2006	15.8	0.1	8.1	7.06	71	243	294
	28 Aug 2008	15.0	0.18	8.0	9.53	95	308	381
Río Nutria below confluence	23 Aug 2005	15.4	0.3	8.4	----	----	496	607
	31 Aug 2006	15.5	0.3	8.7	10.20	102	504	615
	28 Aug 2008	14.6	0.28	8.0	11.34	103	464	579
Río Nutria in box canyon	15 Sept 2004	17.6	0.3	---	6.63	70	405	504
	22 Aug 2005	19.7	0.2	8.4	----	----	347	386
	29 Aug 2006	13.8	0.2	9.4	8.71	84	241	306
	21 Aug 2007	16.2	0.2	7.7	9.60	98	320	384
	27 Aug 2008	17.2	0.18	8.2	8.31	87	315	370
Río Nutria at USGS gage	15 Sept 2004	13.7	0.3	----	3.75	36	489	625
	22 Aug 2005	13.7	0.3	7.4	----	----	506	643
	29 Aug 2006	13.9	0.2	8.4	1.79	18	306	388
	21 Aug 2007	14.5	0.3	6.6	4.70	47	468	584
	27 Aug 2008	14.9	0.28	7.6	2.45	24	472	578
Río Pescado at Hwy 53	13 Sept 2004	17.7	0.2	----	3.06	----	400	465
Río Pescado at Hwy 602	29 Aug 2006	17.8	0.2	8.4	5.90	62	316	366
Zuni River at confluence	26 Aug 2008	22.3	0.2	8.4	10.0	115	401	420
Zuni River at BIA Rte 4	29 Aug 2006	18.2	0.1	8.8	5.34	58	204	235
	26 Aug 2008	19.7	0.16	8.3	9.38	104	296	330
Zuni River below Black Rock	20 Aug 2007	21.0	0.46	6.3	9.43	106	866	938
Zuni R. between Black Rock & Eustace	28 Aug 2006	20.25	0.5	8.8	2.91	32	855	941
	26 Aug 2008	16.3	0.46	7.9	11.25	116	771	925



Figure 5. Fish community by site in the Zuni River watershed, 2004-2008.

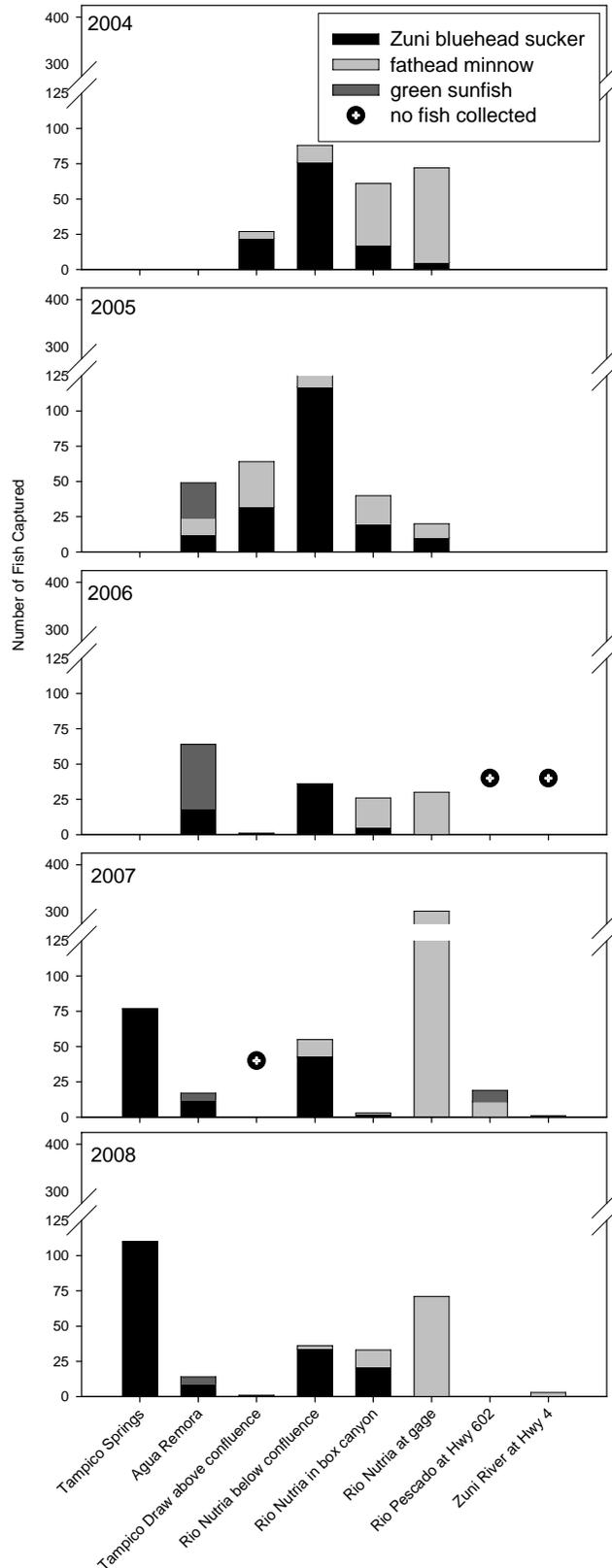




Table 3. Fish collections in the Zuni River watershed, August 2008. Range of Zuni bluehead sucker total length (mm) indicated in parentheses. Crayfish presence (observed during fish surveys) indicated by X.

Site	Effort (Shocking Seconds)	Zuni Bluehead Sucker	Fathead Minnow	Green Sunfish	Plains Killifish	Crayfish
Tampico Springs	588	130 (22-107)				
Agua Remora on Forest Service	956	10 (140-178)		5		
Tampico Draw above confluence	275	1 (yoy)				
Río Nutria above confluence	303	4 (104-170)				
Río Nutria below confluence	818	34 (55-150)	2			
Río Nutria in box canyon	1400	21 (32-157)	12			
Río Nutria at USGS gage	1049		71			X
Zuni River at confluence	537		3	6	5	X
Zuni River at BIA Rte 4	994		3			
Zuni River between Black Rock and Eustace	1223			23		X
Totals	8143	200	91	34	5	

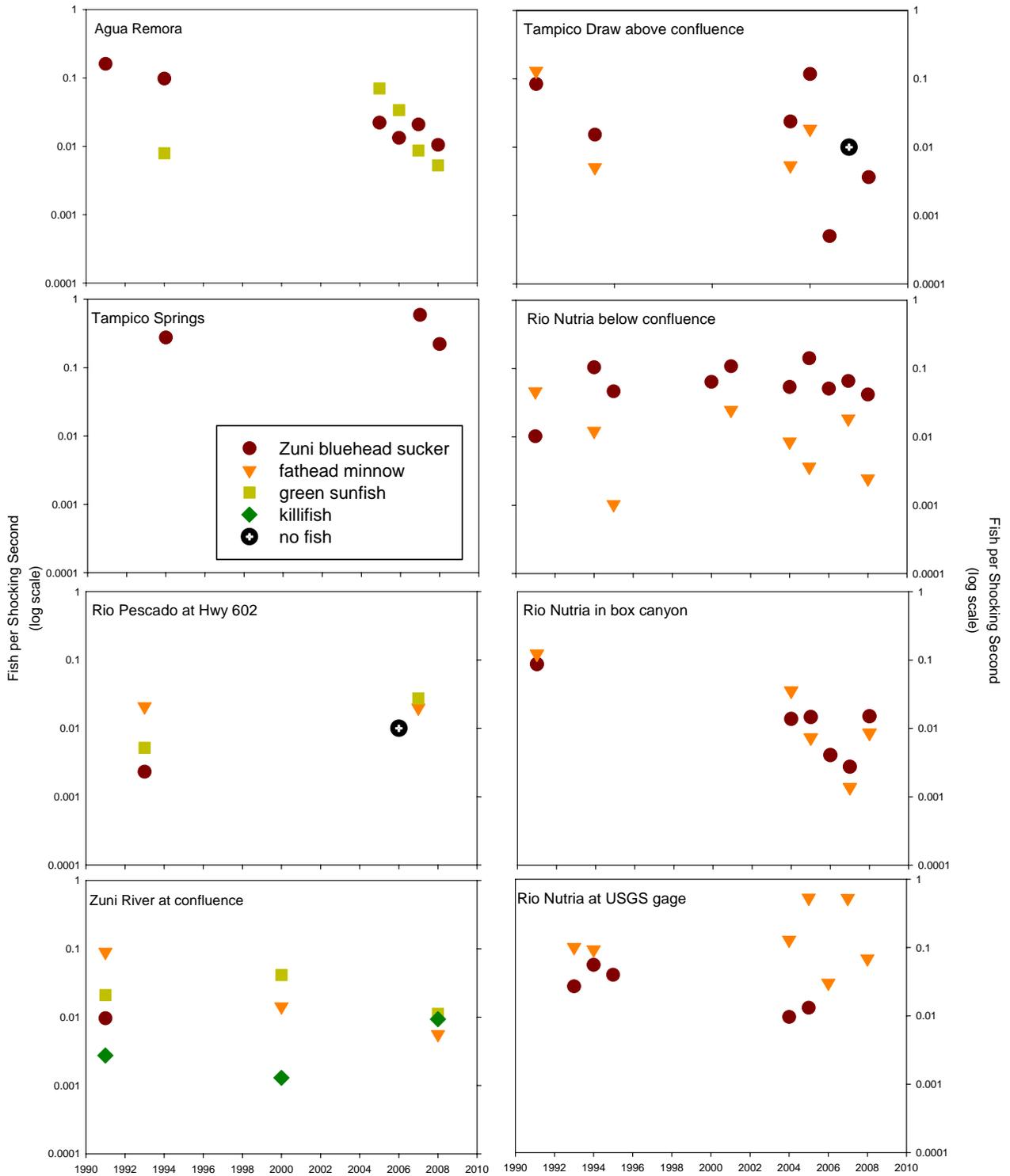
Population Trends

Zuni bluehead sucker sampling has been conducted irregularly since 1990, but when methods were similar across years, comparisons could be made concerning several population variables. Herein, number of fish per second electrofishing is the metric (catch per unit effort - CPUE) used to characterize populations trends.

Slight declines were noted in CPUE of Zuni bluehead sucker captured in the headwater spring area, but Tampico Springs still had the highest CPUE among sites. Catch rates in the canyon-bound habitats remained similar to previous years. One fish was captured in Tampico Draw in 2008 and many young-of-year (>100) were visible in unsampled pools, confirming presence at this site after two years of absence. As in 2006 and 2007, no Zuni bluehead sucker was found in the Río Nutria at the USGS gage.



Figure 6. Catch per unit effort (shocking seconds) in the Zuni River Watershed, 1990-2008.





Length-frequency histograms for Zuni bluehead sucker populations in the headwater springs indicate considerable shifts in the size structure of the populations (Figure 7). Since 2005, no Zuni bluehead sucker smaller than 120 mm TL has been captured in the Agua Remora during annual monitoring, although larvae were successfully captured there in July 2007. This may indicate that there is little to no recruitment occurring in the Agua Remora. Green sunfish removal efforts appear to have decreased its abundance (see Nonnative Species Control Efforts, page 15), but recruitment of Zuni bluehead sucker has not been documented since the 1990s.

Length-frequency data are scarce for the Tampico Springs populations, but comparison of 1994 with 2007 and 2008 data indicates a decline in number of larger individuals (>100 mm TL). From data collected in part at Tampico Springs in the 1990s, estimated age for Zuni bluehead sucker smaller than 100 mm TL is under two years (Propst et al. 2001). However, based upon the presence of adult fish characteristics (spawning coloration, gravid females) on fish as small as 57 mm TL, it appears that adult fish are present and spawning. The truncated size distribution may be a consequence of greater fish density coupled with reduced habitat size. The presence of gravid females, males with spawning coloration, and larvae and occurrence of multiple, if compressed, size-classes in 2007 and 2008 indicate that spawning and recruitment are occurring in Tampico Springs.

Length-frequency histograms for Zuni bluehead sucker in the Río Nutria indicate that although there have been minor shifts in length class distribution, both populations in the canyon continue to be comprised of individuals of multiple size classes (Figure 8). The presence of small fish (<50 mm TL), presumably young-of-year, indicated the species successfully reproduced and recruited in the Río Nutria in 2008.

NONNATIVE SPECIES CONTROL EFFORTS

Nonnative crayfish *Orconectes virilis* was reported and confirmed in the Río Nutria at the USGS gage in 2004. In 2008, it was approximately 100 m further upstream than in 2004. Crayfish occupies a wide range of habitats and is an opportunistic omnivore, feeding on a variety of foods including macrophytes, invertebrates, fish eggs, fish larvae, and dead or dying fishes, making it a serious threat to native stream fish (Childs 1999). Reduction or elimination of crayfish in the Río Nutria will be difficult. Modified minnow traps (opening widened) set in 2004 captured Zuni bluehead sucker as well as crayfish. A review of crayfish control methods found that there is no effective method to eliminate crayfish without adverse affects on other aquatic animals (Hyatt 2004). For example, intense trapping may depress a crayfish population, but without sustained efforts, populations quickly rebound. Chemical methods, such as rotenone, insecticides, or other toxicants, can be effective at removing crayfish, but also affect non-target animals, such as fish and aquatic insects. Based on the summary presented in *Investigation of Crayfish Control Technology* (Hyatt 2004), it appears that sustained, intensive trapping with modified minnow traps (PVC pipe inserted to prevent capture of fish; Morgan et al. 2001) is the best option for crayfish control. In 2008, a project to control crayfish with these methods was planned, but not completed.



Figure 7. Length-frequency of Zuni bluehead sucker collected from headwater springs, 1991-2008.

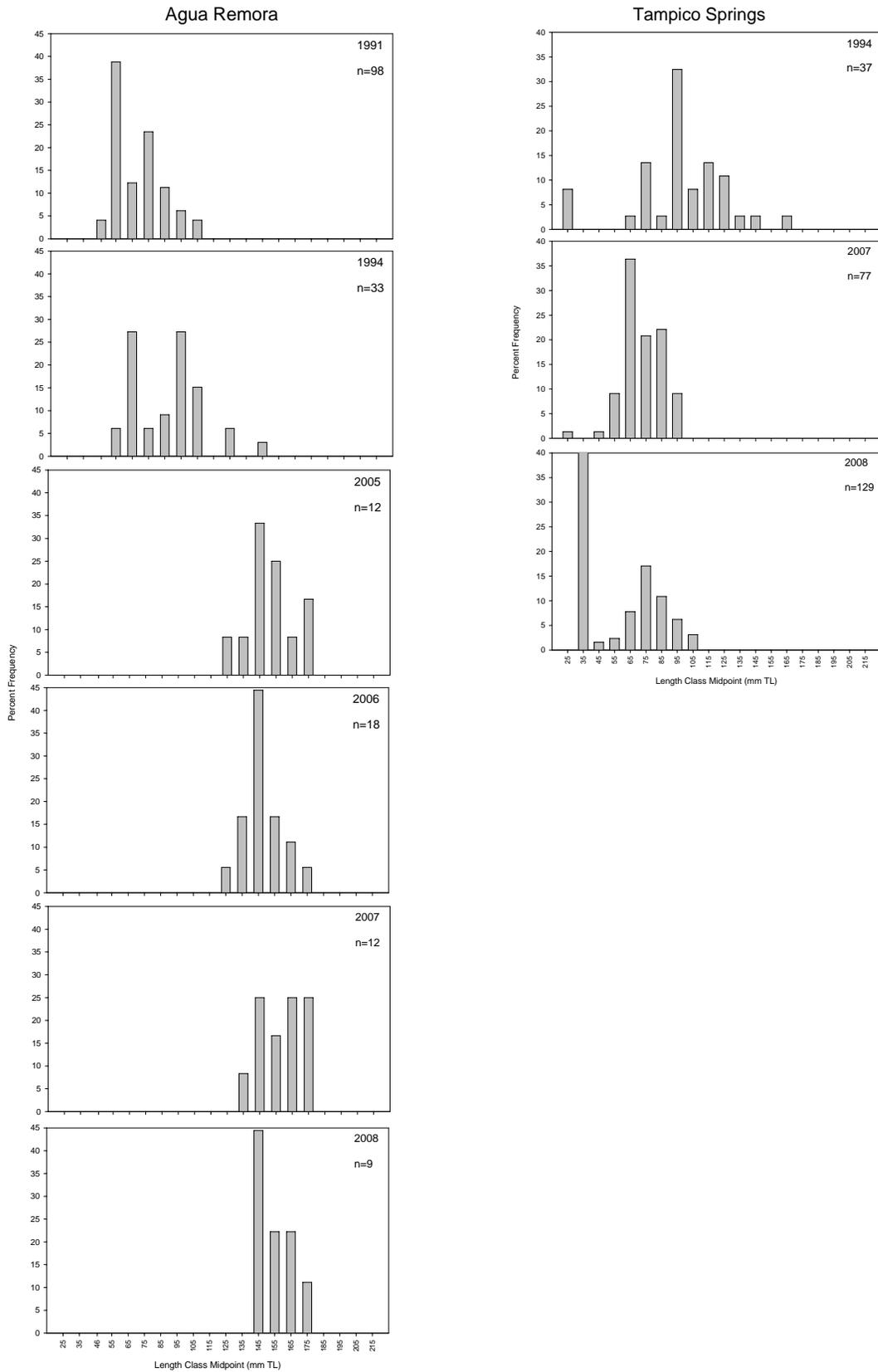
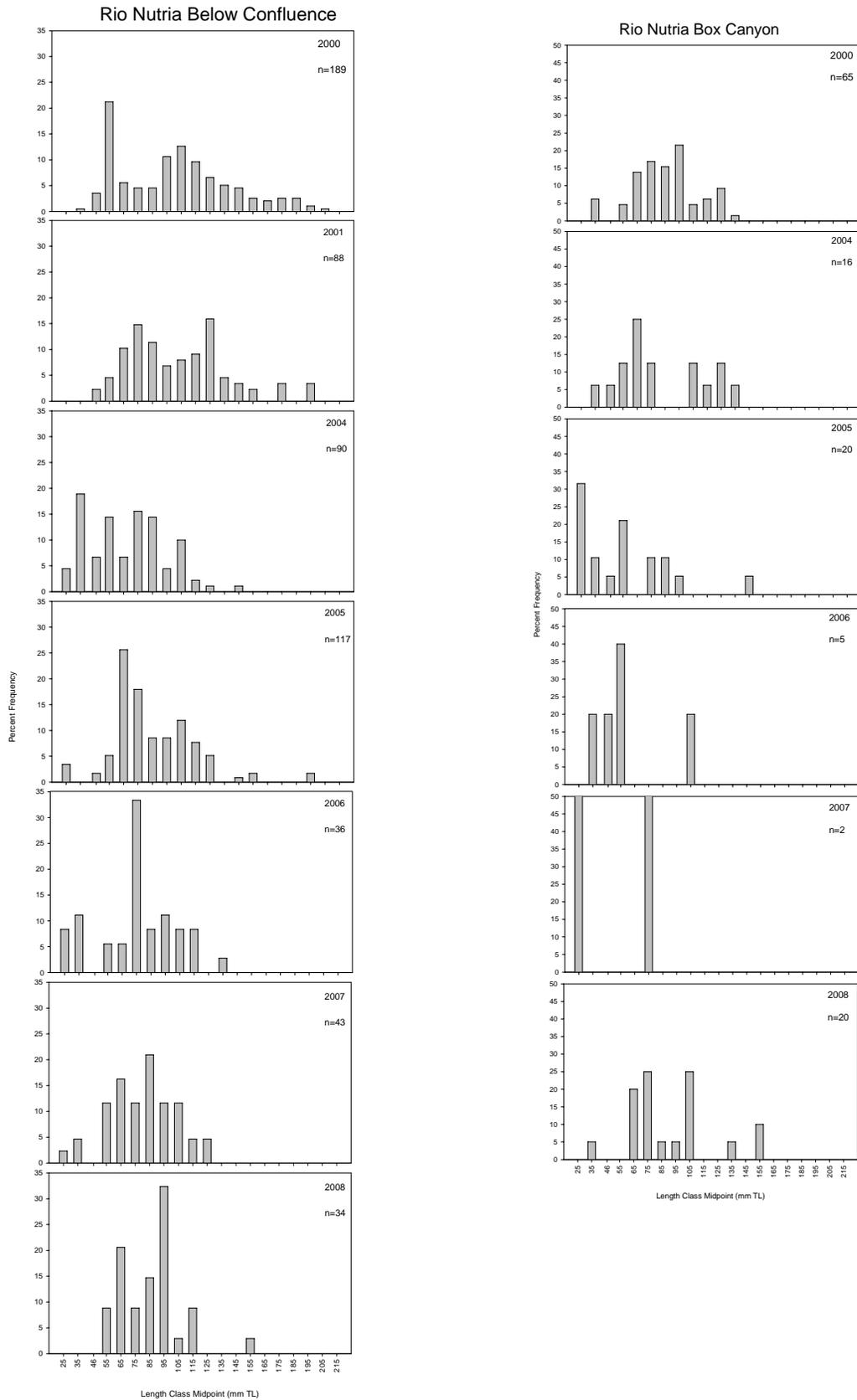




Figure 8. Length-frequency of Zuni bluehead sucker collected from Río Nutria, 2000-2008.





Although rare or absent in the 1990s, green sunfish was more common than Zuni bluehead sucker in Agua Remora in 2005 and 2006. The lack of small (< 125 mm TL) Zuni bluehead sucker in the Agua Remora indicated that green sunfish may be preying upon young Zuni bluehead sucker and limiting recruitment; however repeated examination of green sunfish stomachs did not reveal predation on Zuni bluehead sucker. Rapid digestion is likely the reason no Zuni bluehead sucker remains were found in examined green sunfish digestive tracts rather than absence of predation.

Intense efforts to remove green sunfish from the Agua Remora occurred on 24-25 May 2007, 2-3 July 2007, and 27-28 June 2008. Mechanical removal (electroshocking, seining, trammel netting, angling), although difficult because of large amounts of cattail and submerged vegetation and debris, was chosen to limit adverse affects to Zuni bluehead sucker. In 2007, various methods were attempted, with angling being noticeably more effective: angling captured 67 green sunfish with no capture of Zuni bluehead sucker. Three pass electroshocking of the pools yielded 14 green sunfish and 18 Zuni bluehead sucker; passes had to be separated by approximately eight hours because sediment disturbance diminished visibility. Seining efforts (two kick seines of each pool) yielded three Zuni bluehead suckers and no green sunfish and caused extreme turbidity. Trammel nets, set for one hour at dusk, yielded no fish. In 2008, nine person-hours of angling yielded only two green sunfish and green sunfish CPUE (0.005 fish/shocking second) during annual monitoring was the lowest recorded to date.

Nonnative fathead minnows numerically dominated the fish catch in the lower sections of the Río Nutria canyon. Fathead minnows may negatively affect Zuni bluehead sucker and it is removed when found.

GENETIC INVESTIGATIONS

Genetic investigations of bluehead suckers in the Lower Colorado River have been ongoing for several years at Arizona State University by Dr. Thomas Dowling. Preliminary analysis of DNA sequences indicated mountain suckers (subgenus *Pantosteus*) of the Little Colorado River basin (LCR) share a complex evolutionary history that has important ramifications for Zuni bluehead sucker. Patterns of mitochondrial and nuclear DNA sequence variation identified an undescribed form of *Catostomus* in East Clear and Silver creeks in Arizona that is distinct from typical *C. discobolus*. Other populations in the headwaters of the LCR show admixture between individuals of this undescribed *Catostomus* and *C. discobolus* of the mainstream Colorado River. Samples typically assigned to Zuni bluehead sucker (from the Zuni and Kinlichee drainages of the LCR) show admixture of genetic material from these two forms and *C. plebeius*, consistent with the distinctiveness and hypothesized hybrid origin of the latter form (T. Dowling, pers.comm. January 2008).

A similar pattern of variation was also found in a few individuals from the adjacent Chinle drainage (Wheatfields area in Arizona), indicating that introgression of *C. plebeius* alleles has extended further west of the Continental Divide than previously believed. Samples from the Chinle drainage also exhibited unique mitochondrial DNA alleles that are exclusive to that drainage and the headwaters of the LCR. These results: 1) indicate Chinle populations have been



isolated from the San Juan River drainage for some time, 2) identify a past connection between headwaters of the LCR and Chinle drainage allowing movement of genetic material in both directions, and 3) indicate Chinle populations should also receive special consideration when developing management strategies for this group (T. Dowling, pers.comm. January 2008).

Effects of isolation on Zuni bluehead sucker populations, particularly those in the headwater spring habitats, are unknown. In 2008, collection of Zuni bluehead sucker tissues from the Agua Remora, Tampico Springs, and Río Nutria below the confluence was completed in preparation for a conservation genetics study. This project, now underway with the University of New Mexico with NMDGF funding, will document levels of genetic variability and distinctiveness among populations, determine the likely role of founder effects and bottlenecks on genetic diversity in these populations, and assist in identifying appropriate donor stock for re-establishment of populations or brood stock for hatchery supplementation of wild populations to maintain natural levels of genetic variability. Preliminary results show little genetic variability in the isolated spring habitats, Tampico Springs and Agua Remora, with more in the Río Nutria. It also appears that the spring habitats are very closely related. Complete results are anticipated in summer 2009.

CAPTIVE REARING INVESTIGATIONS

Husbandry of Zuni bluehead sucker is an unknown science and given the extremely limited distribution and magnitude of threats, captive holding may be necessary as a recovery action. Therefore, in 2007 NMDGF contracted the Albuquerque BioPark to investigate rearing and holding practices for imperiled aquatic species in the state, including Zuni bluehead sucker. Priorities included collection of fish from the Agua Remora and Tampico Springs as these are the most remote and isolated Zuni bluehead sucker populations and access is irregular. In 2007, larval fish were collected from both Agua Remora and Tampico Springs, and adults were taken from Tampico Springs. In 2008, multiple attempts to collect additional larva at Agua Remora were unsuccessful and adults were collected to attempt captive spawning in spring 2009. Larvae from Tampico Springs were captured in 2008.

The BioPark currently is holding five groups of Zuni bluehead sucker (Table 4) in modified aquaria and specially designed mesocosms. Feed consists of native fish produced chow, bloodworms, mysis shrimp, and algae. Mortality has been low and has occurred primarily among fish from Agua Remora. Necropsy of these fish revealed they were senescent. The larvae captured from Agua Remora and Tampico Springs appear to be growing at approximately the same rate, indicating that the size difference observed in the field is caused by environmental factors.

Currently, coerced spawning is not planned for 2009 for any of the populations. The remaining adults from Agua Remora are likely senescent and sex ratios are unknown. In spring of 2010, the larvae captured from Agua Remora in 2007 may be mature and spawning may be attempted. Additional collection of larvae is anticipated in 2009, including from canyon-bound habitats. Separation of lineages will continue until additional information regarding conservation genetics



of the species is available. There are no plans to put these captive fish or future offspring into natural habitats.

Table 4. Zuni bluehead sucker lots at the Albuquerque BioPark as of April 2009. Update coming

Lot Designation	Origin	Collection Date	Collection Lifestage	Collection Number	Current Number
ABP07-101/SMC07-003	Tampico Spring	3 Jul 2007	Larvae	18	13
ABP07-011/SMC07-002	Agua Remora	2 Jul 2007	Larvae	27	8
ABP07-016/SMC07-008	Tampico Spring	19 Aug 2007	Adults	19	17
ABP08-010/SMC08-004	Tampico Spring	28 Jun 2008	Larvae	21	13
ABP08-015/SMC08-008	Agua Remora	25 Aug 2008	Adults	5	2

HABITAT STATUS

Acquisition and Development

Development in the Zuni River watershed has been increasing in recent years and augmented threats to Zuni bluehead sucker habitat from water development and habitat degradation from siltation and pollution are a concern. In 2007, Tampico Springs Ranch Subdivision, a ranchette community northwest of occupied Zuni bluehead sucker habitat, was proposed for a total of 490 lots, varying from 3 to 11.9 acres, each with an individual well and septic system. In early 2008, Phase I, 173 lots from 2.92 to 6.58 acres, was presented to and approved by McKinley County. The Geohydrologic Investigation Report prepared for Phase I of the subdivision states “Pumpage is likely to affect flow at Brennan and Tampico springs” (MJDarrconsult, Inc. 2007). Phase I of the subdivision was approved with conditions, including metering of water wells to enforce the 0.3 acre-feet per year per household restriction. McKinley County is encouraging cooperation between the subdivision and the Pueblo of Zuni on watershed issues and NMDGF on wildlife concerns. Potential projects include outreach and education and monitoring of the groundwater and surface waters to establish current conditions and track potential impacts.

The two sections closest to Zuni bluehead sucker habitat owned by Tampico Springs Ranch Subdivision are not intended for development; these areas are currently proposed for sale to the Forest Service. In early 2009, The Trust for Public Lands working with the Forest Service secured Congressional funding for this and the purchase is proceeding, scheduled for completion in June 2009.

In 2008, NMDGF and TNC utilized Natural Lands Protection Act funding to purchase approximately one mile of canyon-bound habitat in the upper Río Nutria for inclusion in the TNC Río Nutria Preserve. The Nature Conservancy has recently completed the management plan for the Río Nutria Preserve, including forest and watershed management actions, as well as those targeted for Zuni bluehead sucker (Río Nutria Management Plan 2009). Zuni bluehead sucker was documented as recently as 1995 in this area (Propst et al. 2001) and surveys are planned in early spring 2009 to determine if the species is still present. If Zuni bluehead sucker are not confirmed, attempts will be made to bring larval fish from downstream canyon-bound habitats to this area.



The Forest Service is reviewing an application to transfer the easement on Forest Road 191D to McKinley County. This road is northwest of occupied Zuni bluehead sucker habitat and will serve the Tampico Spring subdivision. An Environmental Impact Statement is being prepared and suggestions about impacts on the species and mitigation action will be sought.

Isolated Spring Habitats

Agua Remora on Forest Service land was visited multiple times in the summers of 2007 and 2008 for annual monitoring efforts, nonnative removal, and collection of fish for captive rearing investigations. On 2 July 2007, the lower pool at Agua Remora was nearly dry and larval Zuni bluehead sucker were salvaged and moved to the Albuquerque BioPark (Figure 9; see Captive Rearing Investigations, page 17-18). According to a local landowner, decline in water depth and wetted area at the lower pool is common in summer months prior to the monsoons. Deeper areas in the lower pool remained wetted and Zuni bluehead sucker persistence was confirmed in August, when water depth was similar to previous years. In 2008, such drying was not witnessed.

As noted previously, the upper pool at Agua Remora is heavily laden with woody debris and highly organic. To determine if water quality is being affected by amount of decomposition, and potentially a limiting factor for Zuni bluehead sucker persistence in the upper pool, water quality data were collected at three pools in the Agua Remora throughout day and night in July 2007. Dissolved oxygen was similar in the upper and lower pools (20-65% saturation), with the highest values occurring in the middle pool (45-80% saturation). Salinity and conductivity were similar among the three pools and showed little diel fluctuation, ranging from 0.22-0.24 ppt and 359-428 mS, respectively.

Tampico Springs was also visited multiple times in the summers of 2007 and 2008. Habitat was similar to the Agua Remora, consisting of two semi-isolated pools about 1 m wide and 15 m long throughout 2007. However, in 2008, open water was substantially constricted; only one pool was present, approximately 1 m x 15 m.

It is likely that fluctuations in the extent and location of spring habitats is a natural event in the upper watershed area. Reports are often received of remnant spring habitats with Zuni bluehead sucker throughout the upper watershed area. These areas likely represent refuges for the species, which grow and lessen with changing hydrologic conditions. However, given the extremely limited distribution of Zuni bluehead sucker, directed conservation of these habitats may be a necessary recovery action. Renovation of springs to enlarge wetted habitat is a possibility. According to local landowners, the Agua Remora on Forest Service lands was renovated, including digging out the channel, in the late 1970s, but documentation to support this has not been found. Habitat in the Agua Remora may be improved by removing cattails and adding hard substrate. Reductions in siltation may be achieved by installation of silt traps upstream in ephemeral watercourses and appropriate forest management.

Support from the local landowners in conservation for Zuni bluehead sucker is central to recovery of the species. Many landowners have been proud stewards of the species for generations and have been working with the land and species managers to restore the watershed. Forest management on private lands in the upper watershed is ongoing, utilizing a variety of state and federal resources. Working with the Natural Resources Conservation Service and New

Figure 9. Larval fish salvage from drying lower pool at Agua Remora, July 2007.



Mexico State Forestry, a private landowner is attempting to restore forested areas including selective harvesting of timber and installation of wildlife friendly fencing.

Additional contacts have recently been established with landowners in the upper Zuni River watershed for conservation of the species. Most are concerned for the survival of the species, have been willing to allow surveys on their land and are receptive to conservation efforts. Some have expressed an interest in potentially placing a conservation easement on their property in order to assist with recovery efforts should their economic circumstances warrant doing so.

Canyon Bound Habitats

Tampico Draw and upper Río Nutria currently represent the stronghold of Zuni bluehead sucker. The habitat, canyon-bound cascading pools over exposed bedrock, is considered the preferred habitat for the species. Flushing spring and monsoon flows are necessary to reduce siltation and pooling, which can lead to declines in Zuni bluehead sucker abundance. Summary data available from the USGS gage on the Río Nutria (#09386900) indicate that large flood events, usually occurring in the early spring (snowmelt) and mid-summer (monsoon), have occurred with less frequency and intensity in the past 10 years (Figure 10). These high volume events are important



in maintaining the clean, hard substrate habitat where Zuni bluehead sucker are most commonly found. However, recent data from the USGS gage are unreliable because of pooling. Repair of this gage should be a priority.

Beaver numbers have increased in the upper Río Nutria since the early 1990s, when the species was restored to Pueblo of Zuni. Loss of wetted habitat in the Río Pescado and Zuni River has led to a surplus of beavers in the area, leading to near-complete impoundment of the Río Nutria below the mouth of the canyon and presence of dams throughout the canyon into Tampico Draw and upper Río Nutria. Beaver control efforts were undertaken by the Zuni Department of Fish and Wildlife in summer 2007, resulting in removal of five beavers from the Río Nutria in the box canyon and willow wetland on Pueblo of Zuni land. In 2007, immediate effects on the habitat were not apparent and removal efforts continued in 2008, with removal of three beavers from the Río Nutria on Pueblo of Zuni land. In 2008, less silt and pooling was observed in Zuni bluehead sucker habitat, possibly a result of fewer beavers and increased flushing flows.

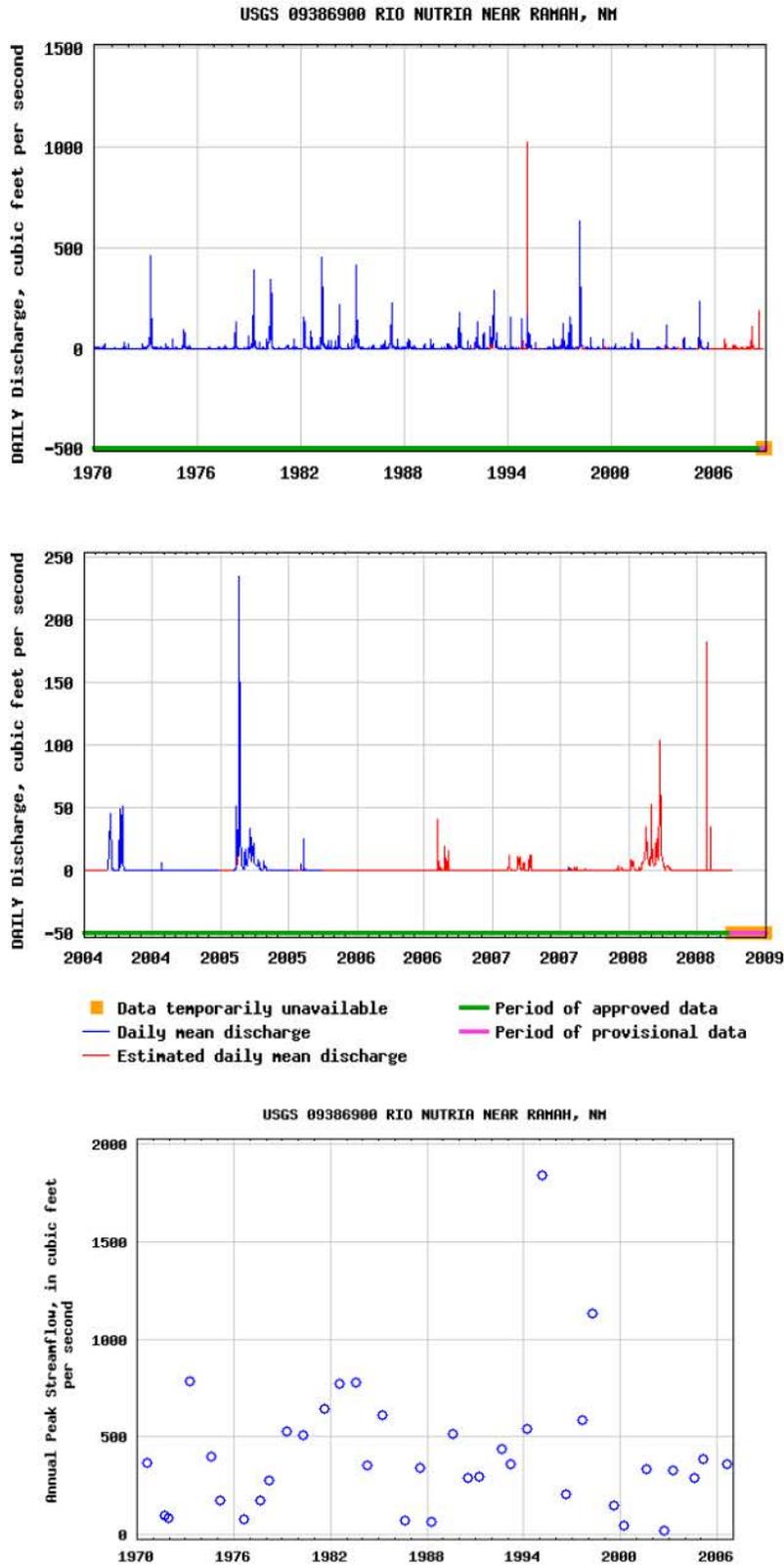
In 2008, NMDGF and TNC completed the purchase of additional acreage in the upper Río Nutria, including the stream segments where a life history study was completed in the early 1990s (Propst et al. 2001). When the site was visited in August 2005, the stream was found wetted, but Zuni bluehead sucker were not visible. In April 2009, the site was again visited and wetted, but again, Zuni bluehead sucker were not visible. Neighboring landowners report that the Río Nutria in this section was subject to drying during the early 2000s, which may explain the current lack of Zuni bluehead sucker present.

Mainstem Habitat

Historical Zuni bluehead sucker habitats in the mainstem Zuni, Pescado and Nutria rivers currently are not suitable for Zuni bluehead sucker. Perennial reaches in these rivers are dominated by nonnative species, including green sunfish. Other areas, such as the Zuni River below the confluence of ríos Pescado and Nutria, are not permanently wetted. Additionally, these sites are dominated by silty substrates and habitat rehabilitation would likely be necessary for Zuni bluehead sucker re-establishment. Repair of the low water crossing at the USGS gage on Río Nutria may help decrease standing water and increase fish passage.



Figure 10. Daily mean (1970-2008 and 2004-2008) and annual peak springflow (1970-2008) discharge in the Río Nutria, from the USGS gaging station #09386900, Río Nutria at the bottom of the box canyon. Data were accessed and graphed on 10 Apr 2009 at <http://waterdata.usgs.gov/nwis/uv?09386900>





OUTREACH AND EDUCATION

Outreach and education on Zuni bluehead sucker greatly increased in 2008. During 2008 monitoring, the NMDGF videographer took footage and interviews of the partnership working for conservation of this fish. The footage is being prepared for inclusion as a segment on the NMDGF Wild! television program. Additionally, articles about the species and the conservation partnership appeared in newspapers throughout the west. These efforts help increase public awareness about the species and will hopefully lead to increased protection and sensitivity.

Figure 11. Photographs from the video recording during 2008 monitoring. Photos: Angela James, USFWS.





2009 MANAGEMENT RECOMMENDATIONS

- Coordination and cooperation among the Pueblo of Zuni, U.S. Forest Service, The Nature Conservancy, U.S. Fish and Wildlife Service, NMDGF, and private landowners should continue and be formalized through the development of a Cooperative Agreement.
- Cooperators should work to ensure that consideration for Zuni bluehead sucker recovery is included in all projects in the watershed. Partnerships with local, state, and federal agencies such as McKinley County and NRCS, should be sought.
- Permanent legal and actual access for monitoring and management purposes should be achieved for all populations, including clearing roads.
- Habitat protection and restoration projects should continue across the watershed. Funding should be sought for both large multi-jurisdictional and small private projects, including through State Landowner Incentive and Tribal Landowner Incentive programs. Potential projects include:
 - Installation of ground and surface water quantity meters, such as pizometers, and repair/re-installation of USGS gage throughout the watershed, especially the upper areas which would be most affected by increased water withdrawals.
 - Installation of surface water quality meters in key habitats to record dissolved oxygen and temperature
 - Physical rehabilitation/improvement of the Agua Remora
 - Sedimentation management in the upper watershed, including forest restoration and sediment traps in ephemeral watercourses
 - Construction of appropriate road crossing near the USGS gage on the Río Nutria to improve water flow and fish passage
- Surveys should be completed to document occurrence of Zuni bluehead sucker and permanence of water in the recent addition to TNC Río Nutria Preserve. If Zuni bluehead sucker is absent and water found pre-monsoonal rains, efforts to move Zuni bluehead sucker from lower Río Nutria (box canyon) should be initiated.
- The programs to remove nonnative species should be continued or initiated:
 - Intensive crayfish removal should be initiated in the Río Nutria
 - Removal of green sunfish in the Agua Remora should continue
- Conservation genetic research should be completed to guide management decisions regarding captive holding and assisted movement of Zuni bluehead suckers in natural habitat.
- Rearing investigations should be continued to assist in maintenance of a refuge population. This includes collections of additional fish from all populations.
- Beaver removal and relocation efforts should be continued to lessen the impacts of stream impoundment in Zuni bluehead sucker habitat in the Río Nutria. With increased water availability in historically occupied areas of the Río Pescado and Zuni River, relocation of beavers into these areas may be appropriate. Water retention through beaver dams in these areas may help with retention of water in downstream reaches, potentially leading to restoration of historical Zuni bluehead sucker habitat.



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