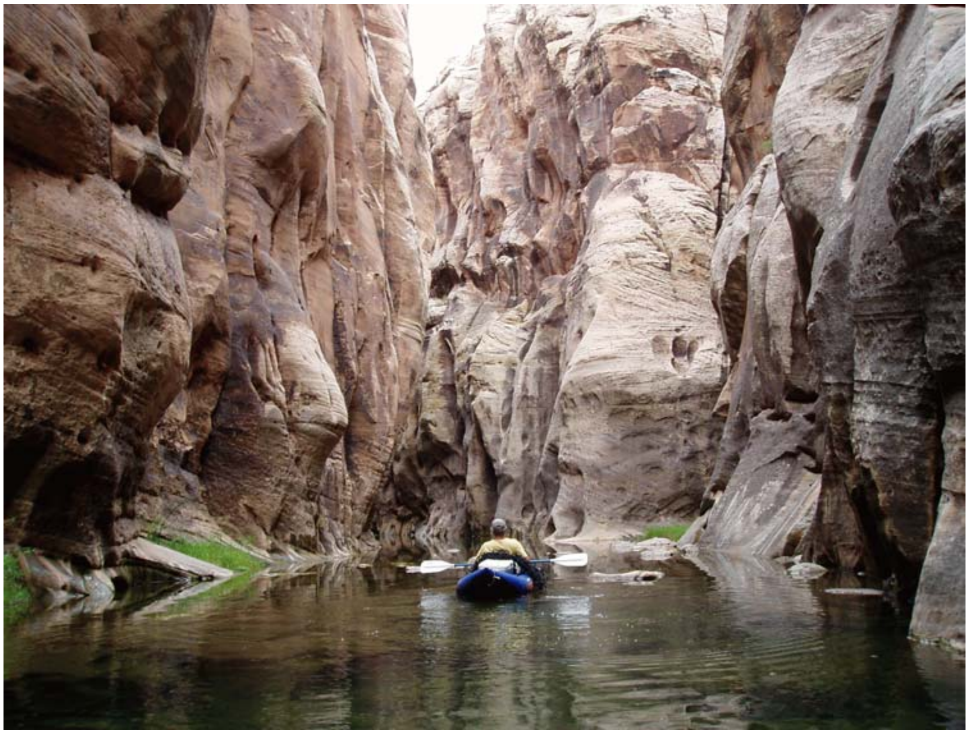
LOWER CLEAR CREEK (LITTLE COLORADO RIVER BASIN) FISH SURVEY, SEPTEMBER 8-10, 2004



Submitted by:

Robert W. Clarkson
Bureau of Reclamation
Phoenix Area Office
PO Box 81169
Phoenix, Arizona 85069-1169

and

Paul C. Marsh
School of Life Sciences
Arizona State University
Tempe, Arizona 85287-4501

Submitted to:

C-Aquifer Study
Federal Team
Attn: Kevin Black

January 25, 2005

INTRODUCTION

As part of a feasibility investigation of a possible C-Aquifer well-field development, Reclamation is investigating potential effects to surface flows in particular drainages in the Little Colorado River basin in northern Arizona. Those investigations include the Clear Creek sub-basin that drains the Mogollon Plateau between the Jacks Canyon and Chevelon Creek watersheds in southern Coconino County and eastern Navajo County. Certain reaches of the Clear and Chevelon creek drainages support populations of federally-threatened Little Colorado spinedace (*Lepidomeda vittata*), a minnow that could be negatively affected by modification of surface flows. Although Little Colorado spinedace distribution has been adequately determined in Chevelon Creek and in the upper Clear Creek watershed, fish surveys in the lowermost part of Clear Creek are lacking. This report provides results of a fish sampling trip on lower Clear Creek, Navajo County, Arizona, conducted September 8-10, 2004.

STUDY AREA

Clear Creek is a Little Colorado River tributary that drains north from headwaters along the Mogollon Rim to enter the Little Colorado River near Winslow, Arizona (Figure 1). Primary tributaries include East Clear Creek, Jacks Canyon, Leonard Canyon, and Willow Creek. Upstream reaches are cold water, perennial streams flowing through Ponderosa pine forest and populated by native cypriniforms (minnows and suckers) and introduced, nonnative trouts and minnows. Middle reaches are seasonally intermittent in deep, steep walled canyons that drain rolling pinyon-juniper grasslands.

Lower Clear Creek is highly incised (canyon-bound) with precipitous, often vertical, canyon walls that descend 60-90 m to the narrow (10-30 m) channel bottoms (Figure 2). The 9.6 km reach we surveyed between NW ¼ Section 2, R 15 E, T 17 N and the head of Clear Creek (McHood) Reservoir in NE ¼ Section 20, R 16 E, T 18 N, lies entirely within Navajo County. Fishes of the reservoir are dominated by nonnative centrarchids (black basses and sunfishes) and cyprinids (minnows). Topography above the canyon rim in the lower Clear Creek reach is relatively flat and populated by sparse juniper and extensive grassland. As far as we could determine, foot access into this reach was available only through a side canyon at the immediate head of our study reach and from an unmarked trail we discovered from within the canyon in Section 35, R 15 E, T 18 N.

Surface water in the study reach is intermittent in the upper few kilometers, but perennial flows are gradually sustained toward the lower end. At the head of Clear Creek Reservoir, surface discharge approaches a few cubic feet (tenths of cubic meters) per second, although the stream is ungaged. Debris piles were evident perhaps 10 m up on the canyon walls at some localities, testament to historical high flows likely in the tens of thousands of cubic feet (hundreds of cubic meters) per second. Channel substrates are bedrock-dominated, but locally include boulders, gravels, sands, and organic detritus. Instream habitats in perennial reaches run the gamut among pools, riffles, and runs, but many pools are particularly deep (>3 m) and long (>30 m). Water temperature taken at the surface of a large isolated pool at the head of the study reach at 1330 h on September 8 was 19.5 C.

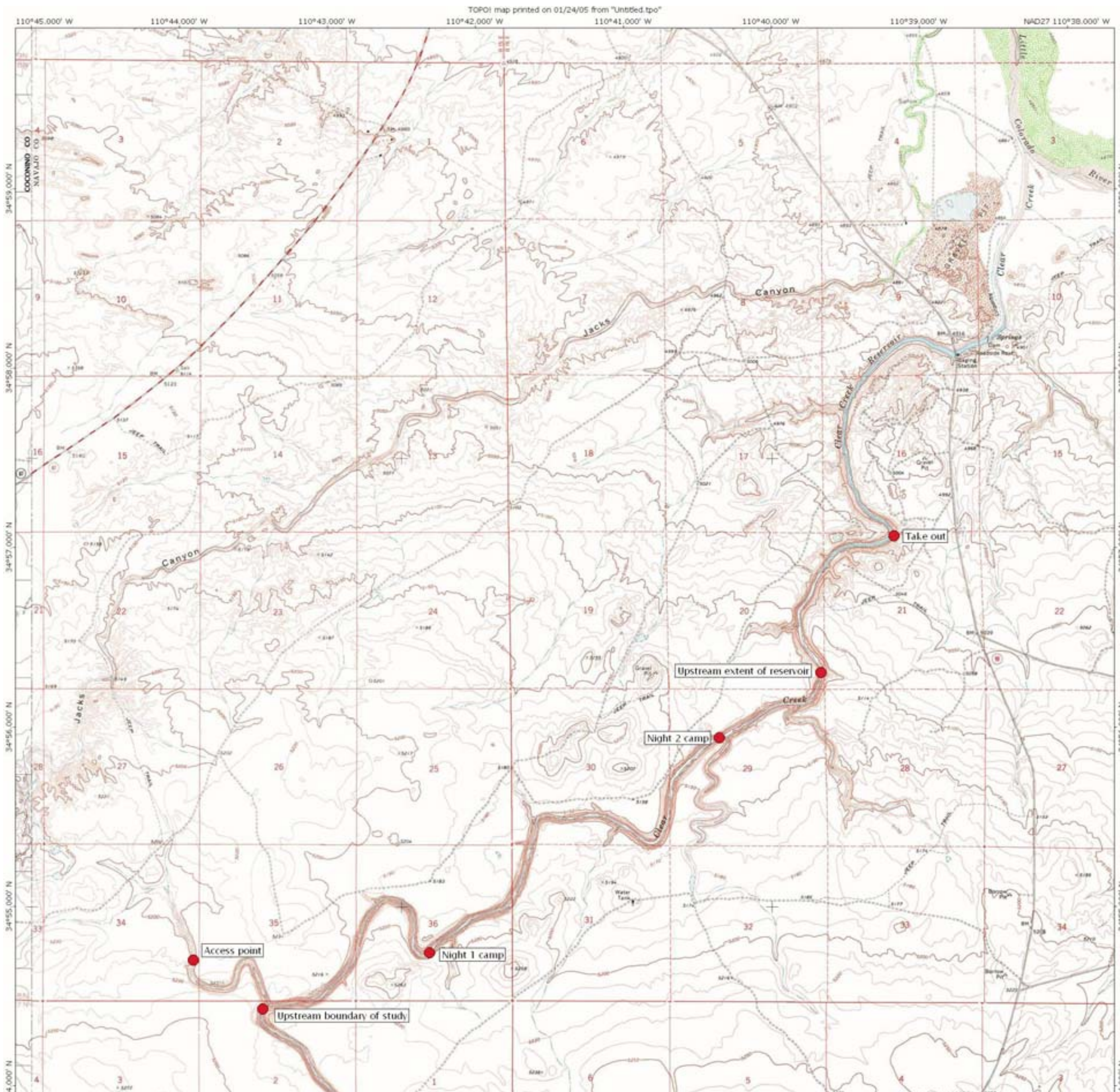


Figure 1. Map of lower Clear Creek, showing the upper and lower limits of the study area and other noted features.

The vertically-dominant riparian tree within the stream channel is ash (*Fraxinus* sp.), which occurs in relatively low densities throughout the study reach. Where fine sediments accumulate, giant cane (*Phragmites* sp.), cattail (*Typha* sp.), and bullrush (*Scirpus* sp.) are common. Salt cedar (*Tamarix* sp.) was

Figure 2. Photograph of a “typical reach” of lower Clear Creek.

sparse but common in middle reaches where seeps and springs contributed high salt loads to the surface and sub-surface flows. Aquatic macrophytes were *Potamogeton* sp., *Cara* sp., and either a *Myriophyllum* or *Ceratophyllum* species.

METHODS

We searched the Arizona State University SONFISHES fish collection database and contacted the Arizona Game and Fish Department (AZGFD) for historical collection records from lower Clear Creek. As AZGFD surveyed the reach downstream of the Coconino National Forest boundary in Coconino County to just downstream of the Coconino-Navajo county boundary in 1999-2000, we limited the reach to be potentially sampled in our survey to the Navajo County portion of Clear Creek.

Sample reaches were determined from a review of published and unpublished information on fishes of Clear Creek, interpretation of topographic maps, aerial survey by helicopter, and on-the-ground reconnaissance. Primary criteria for selection included lack of prior fish sample data, presence and permanence of water, and accessibility. The mouth of Moon Canyon and head of Clear Creek reservoir defined our 9.6 km sample reach. The reach was traversed by foot and inflatable kayaks over a 3-day period to perform the survey.

Sampling methods included electrofishing using a battery powered Smith-Root model 12-B backpack shocker, dip net (⅛ inch [3.2 mm] mesh), seining with a 4 ft x 15 ft x ⅛ in mesh (1.2 m x 4.6m x 3.2 mm mesh) knotless nylon net, and entanglement netting using experimental multifilament gill nets (6-feet [1.8 m] deep, mesh size varied from ½ to 1 ½ in [12.7 to 31.8 mm]). Methods were applied as appropriate to available habitat. Gill nets were set overnight; other techniques were used during daylight. All fishes were identified to species and enumerated. Voucher specimens or photographs were taken to document all records. Fin clips in 95% ethanol were taken for native roundtail chub, *Gila robusta.*

Because of poor access to the study reach and the impossibility of carrying both sampling equipment and camping gear simultaneously without additional personnel, a helicopter dropped sling loads of sampling equipment, food, and camping gear to two locations within the canyon at pre-selected camping sites. Gear was either picked up by helicopter at the end of sampling or transported to Clear Creek Reservoir in kayaks.

RESULTS

Localities sampled and fishes captured during the September 8-10, 2004, survey are shown in Table 1. On occasion, large numbers (in the hundreds) of young-of-year were captured in some samples that were not quantified due to time constraints. In those instances we estimated relative abundance into categories of rare (<10), common (10-100), and abundant (>100). Backpack shocker and seine were deployed in the upper reach, shocker, dip net and gill net in the middle reach, and gill net only in the lower reach.

Table 1. Numbers of fishes captured and vouchered from lower Clear Creek, Navajo County, Arizona, September 8-10, 2004. Sampling gears were backpack shocker and seine (upper), shocker, dip net, and gill net (middle), and gill net (lower). YOY denotes young-of-year, rare denotes fewer than 10, common denotes 10-100, and abundant denotes >100 captured. Dashes (-) denote no captures.

Species	Upper Reach (8 Sep)	Middle Reach (9 Sep)	Lower Reach (10 Sep)
Little Colorado sucker, *Catostomus* sp.	rare (yoy)	7 (adult)	5 (adult)
Roundtail chub, *Gila robusta*	1 (yoy)	-	-
Fathead minnow, *Pimephales promelas*	abundant	common	-
Green sunfish, *Lepomis cyanellus*	abundant	common	5 (adult)
Rock bass, *Ambloplites rupestris*	-	-	32 (adult)

The fauna was dominated by the nonnatives fathead minnow and green sunfish, with another nonnative, rock bass, taken and seen in large numbers at the lower end of the study reach. A few young-of-year Little Colorado suckers were captured at the upper end of the study area, but downstream only large adults were taken. A single native roundtail chub (Figure 3) was also captured at the uppermost end of the sampled reach. No Little Colorado spinedace were seen or captured.

Figure 3. Roundtail chub, *Gila robusta*, collected from lower Clear Creek, September 8, 2004.

Figure 4. Shells of *Anodonta* sp. collected from lower Clear Creek, September 9, 2004.

Although they were not captured, the nonnatives largemouth bass, *Micropterus salmoides*, and common carp, *Cyprinus carpio*, were observed at the head of Clear Creek Reservoir and in large pools immediately above. We also captured tadpoles of canyon treefrog, *Hyla arenicolor*, and an undetermined species of fairy shrimp in intermittent pools of the upper reach. Of particular note was our discovery of shells of a freshwater native mussel *Anodonta* sp. (Figure 4), although no living specimens were observed.

DISCUSSION

Poor access and extreme topography of lower Clear Creek dictated innovative methods for ingress and egress, provision of supplies, and transport of sampling gears within the canyon. Both the use of helicopter to establish overnight camps, and provision of inflatable kayaks to exit the canyon from Clear Creek Reservoir, were considered essential to the success of sampling trip. In hindsight, however, the success of the trip could have been improved significantly with the addition of at least a third overnight camp to shorten the reaches sampled each day. Hiking within the canyon was difficult due to absence of established trails within the canyon and presence of long, deep pools that required swimming and floating of sampling gear and supplies to traverse. This difficulty took valuable time away from fish sampling efforts in order to reach the next helicopter-provisioned camp before nightfall. However, it is not certain that additional camps could have been established due to the canyon topography that often precluded even helicopter long-lining.

Because the original helicopter reconnaissance of the canyon was performed during the morning, shadows often prevented a clear look at topography within the canyon. This resulted in establishment of the second campsite in an area generally unsuitable for camping and provision of inflatable kayaks and supporting gear too far upstream of Clear Creek Reservoir. Virtually the entire third day was devoted to portaging of kayaks and supplies over long riffles or large rockfalls where kayaks could not be floated. Physical exhaustion was a serious concern on both days 2 and 3 because of these difficulties, and time devoted to fish sampling was consequently less than we would have preferred. We did, however, discover an unmarked trail at the first campsite that exited the canyon quickly and easily, the head of which was accessible by vehicle. Use of this trail could greatly facilitate future sampling of lower Clear Creek.

If another opportunity becomes available to survey fishes in lower Clear Creek, we recommend hiking into the stream at Moon Canyon and the old road near the first campsite (Figure 1), or other access if available, spending a day sampling up- and downstream of each access site, and then exiting the canyon to a vehicle-based camp. Similarly, the lowermost stream reach and uppermost portion of Clear Creek Reservoir could be accessed via kayak from downstream, and sampling performed effectively in those areas during a one-day excursion. In this way, field personnel need to pack in only the equipment required for fish collection, while heavy and bulky camp supplies and other support gear would reside with the vehicle. We believe this would be more efficient and safer than another hike-through.

Lower Clear Creek was dominated by numbers and biomass of nonnative fishes. This finding unfortunately now is typical in most streams of the American southwest. Green sunfish in particular has invaded nearly all stream systems in this region, and it has been implicated in the demise of numerous native species (Lemly 1985, Dudley and Matter 2000). Fathead minnow is one of the few nonnatives that has not been similarly suspect in the scientific literature, but the large population sizes achieved in Clear Creek undoubtedly have the potential to displace native species. The lack of samples of fathead minnow from the lower reach (Table 1) may reflect use of a sampling gear (gill net) inappropriate for capture of small-bodied fishes, although small-bodied fishes were not conspicuously visible in that reach.

Capture of nonnative rock bass in Clear Creek upstream of Clear Creek Reservoir appears to represent only the second record of the species in the Little Colorado River drainage. Arizona Game and Fish Department stocking records indicate rock bass were stocked into "East Clear Creek Reservoir" (presumably Blue Ridge Reservoir) in 1962. The only other known localities for the species in Arizona is from Oak Creek Canyon (Verde drainage) and a single collection from the Verde River mainstem near Childs in 1989 (SONFISHES database). It appeared that rock bass displaced green sunfish toward Clear Creek Reservoir.

Low rates of detection of native fishes in the study reach undoubtedly is a reflection of the continuing invasion of southwestern waters by nonnative species. Nonnative species invariably prey upon early life stages of predator-naive natives, and likely outcompete those that are not consumed (Moyle et al. 1986, Minckley 1991, Marsh and Pacey in press). Although habitat modification has played an historic role in the decline of native fishes, their recovery is prevented by the establishment of nonnatives and failure to control them.

Only two species of native fishes were captured, and only a single individual of one—roundtail chub—was taken at the extreme upper end of the study reach. That specimen represents the downstream-most record of roundtail chub in the Little Colorado River drainage (excluding Grand Canyon records) since a 1934 collection from the Little Colorado River near Winslow (SONFISHES database). It was encouraging that our record was of a juvenile, indicating that reproduction by the species in lower Clear Creek continues.

Several young-of-year Little Colorado suckers were also captured at the upper end of our study reach, but only adults were found downstream. This suggests that predation by nonnatives in the perennial reaches downstream is preventing successful recruitment of the species. It is likely that hydrologically-variable conditions above our study area disrupt nonnative fish communities enough to allow sustenance of reproducing populations of natives.

Lower Clear Creek historically likely harbored at least five native fish species including Little Colorado spinedace, bluehead sucker, *Pantosteus discobolus*, and speckled dace, *Rhinichthys osculus*, in addition to roundtail chub and Little Colorado sucker that we detected. All of these species sustain populations further upstream in the Clear Creek drainage, and in other drainages of the Little Colorado River basin.

Our failure to encounter Little Colorado spinedace (and other historically-present species) in Clear Creek cannot be interpreted as definitive evidence that the species no longer occurs in that stream. We sampled only a relatively short reach and our effort was less than intensive because of logistical constraints. In addition, Little Colorado spinedace is known to occur at numerous localities upstream from our sample area, and the species is known to "disappear" from a locality only to "reappear" at a later time (Minckley and Carufel 1967). This pattern also has been demonstrated for other native southwestern stream fishes (Marsh et al. 2003). It thus would be inappropriate to suggest that Little Colorado spinedace was absent from lowermost Clear Creek. We recommend additional sampling of lower Clear Creek, perhaps concentrating in the intermittent reach upstream of our study area, to further search for Little Colorado spinedace.

LITERATURE CITED

Dudley, R.K., and W.J. Matter. 2000. Effects of small green sunfish (*Lepomis cyanellus*) on recruitment of Gila chub (*Gila intermedia*) in Sabino Creek, Arizona. The Southwestern Naturalist 45:24-29.

Lemly, A. D. 1985. Suppression of native fish populations by green sunfish in a first-order stream of Piedmont North Carolina. Transactions of the American Fisheries Society 114: 705-712.

Marsh, P.C., B.E. Bagley, G.W. Knowles, G. Schiffmiller, and P.A. Sowka. 2003. New and rediscovered populations of loach minnow *Tiaroga cobitis* (Cyprinidae) in Arizona. The Southwestern Naturalist 48:666-669.

Marsh, P.C., and C.A. Pacey. In press. Immiscibility of native and nonnative fishes. *In*: Restoring native fish to the lower Colorado River: interactions of native and nonnative fishes. U.S. Fish and Wildlife Service, Albuquerque, NM, and U.S. Bureau of Reclamation, Boulder City, NV.

Minckley, W.L. 1991. Native fishes of the Grand Canyon region: an obituary? Pages 124-177 *In*: Colorado River ecology and dam management. National Academy of Sciences, Washington, D.C.

Minckley, W.L., and L.H. Carufel. 1967. The Little Colorado River spinedace, *Lepidomeda vittata*, in Arizona. The Southwestern Naturalist 12:291-302.

Moyle, P.B., H.W. Li, and B.A. Barton. 1986. The Frankenstein effect: impact of introduced fishes on native fishes of North America. Pages 415-426 *In*: R.H. Stroud, editor. Fish culture in fisheries management. American Fisheries Society, Bethesda, MD.