

# Fossil Creek Fish Monitoring

2007 Annual Report

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## Pertinent Findings

Fossil Creek was chemically treated in autumn 2004 to eliminate non-native fishes above a constructed fish barrier, and historical flow of about 43 cubic feet per second (cfs) was restored to the stream in summer 2005. We sampled in spring (May) and autumn (September-October) 2007 with baited minnow traps and hoop nets among three stream reaches within the treatment reach. Earlier findings from monitoring in autumn 2005 and spring and autumn 2006 were provided in prior summary reports. The purpose of our surveys was to document post-project composition and status of the fish community, with emphasis on documenting success of the non-native removal. Five fish species, all native, were encountered within the study area: headwater chub *Gila nigra* plus roundtail chub *Gila robusta*,<sup>1</sup> speckled dace *Rhinichthys osculus*, Sonora sucker *Catostomus insignis*, and desert sucker *Pantosteus clarki*. No non-native fish were detected. Results overall were remarkably similar to samples acquired during 2005 and 2006. All species were in upper and middle reaches, and all except speckled dace were in the lower reach. The composite seasonal samples comprised 2,906 individuals (1,478 and 1,428 in spring and autumn, respectively). Adult fish predominated in the catch of all species in both spring and autumn. Seasonal differences in relative abundance within species were small: chubs comprised about 74 & 76%, speckled dace 4 & 8%, Sonora sucker 18 & 13%, and desert sucker 4 & 2% of total numbers in spring and autumn, respectively. Total catch per unit effort (CPE, number of fish per overnight set) was greatest for both seasons and both methods in the middle reach and variably intermediate or lowest in the upper or lower reach. CPE of chubs was about one-to-two orders of magnitude greater in the middle reach than in the other two reaches, while CPE of speckled dace, Sonora sucker and desert sucker differed by up to an order of magnitude among species and across reaches. Non-native northern crayfish *Orconectes virilis* was taken only in the lower and middle reaches. Native Sonora mud turtle *Kinosternon sonoriense* was collected in all reaches, and one native lowland leopard frog *Rana yavapaiensis* tadpole was collected in the upper reach. All animals were released at the site of capture.

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<sup>1</sup> Headwater and roundtail chubs are difficult to differentiate in the field without harm to individual fish; we did not separate the two, and refer here to the two species collectively as “chub.”

## **Introduction**

Background information on Fossil Creek (Fig. 1) and its restoration can be found in a rich and diverse suite of published and unpublished literature including the following: (Minckley and Brooks 1985, Barrett and Maughan 1995, Roberson et al. 1996, APS 1992, Chamberlain 1904, Bouchard and Associates 1995, EnviroNet 1998, FERC 2004, Anon 2005 and abundant references therein, and Weedman et al. 2005). Post-project fish monitoring data are in Marsh et al. (2006, 2007).

This report presents results of 2007 annual post-project (i.e., stream renovation, native fish repatriation, and flow restoration) fish monitoring. The study was implemented specifically to detect the presence of nonnative fishes and assess the status of the repatriated native fish assemblage.

## **Methods**

A standardized fish monitoring protocol was developed by the authors and finalized in cooperation with Reclamation (Marsh 2005). That protocol was first implemented in autumn 2005 (Marsh et al. 2006), and has been followed since with few and minor modifications. The protocol is subject to future refinement as appropriate or required by experience or other considerations, and any such modifications or other changes will be detailed in future reports. The protocol is summarized briefly here as performed during May 21-24 and September 30-October 3, 2007.

Three sample reaches (Fig. 1) were designated along the approximately 11.3 km stream course between the constructed fish barrier and the “High Falls” located about 1.9 km upstream from Irving at RK 18.4. Reaches were designated lower (down-) to upper (upstream) as “Above (constructed) Barrier,” “Below Irving” and “Below High Falls.” Standard gears were deployed throughout each reach, and opportunistically elsewhere. Universal Transverse Mercator (UTM) coordinates (NAD27) were acquired for each reach using a handheld Garmin GPS receiver.

Standard methods were minnow trapping, hoop netting, and snorkeling. Gears were deployed to represent available habitat types and as appropriate for each gear type, and in a consistent manner; 20 baited minnow traps and 10 baited hoop nets were deployed overnight in each reach. These collections were supplemented by other, opportunistic sampling.

Fishes retrieved from collection gears were identified to species, enumerated by age (size) class according to the convention 0 = young-of-year of species that attain relatively large adult body size, and 1 = post young-of-year of fish that attain large body size; fish that remain relatively small throughout life were not aged. For practical purposes, we considered fish shorter than about 10 cm total length to represent age-0 and fish longer than 10 cm to represent age-1. All captured fish were released unharmed near the site of capture.

Fish collections were augmented by visual observations obtained by snorkeling. One large pool in each sample reach, plus a fourth located between lower and middle reaches, were designated for routine evaluation, and 2-4 persons each spent 10 or more minutes inspecting all available habitats and assessing presence, sizes, and subjective abundance of each species encountered. A brief narrative of observations was recorded.

Field data were tabulated and summarized. Mean minnow trap or hoop net set durations did not differ among reaches for the autumn 2005 sample (two-sample t-test,  $df = 9$ ,  $\alpha > 0.10$ ; Noether 1971) and 2006 and 2007 set times were similar, so catch per unit effort (CPE, number of fish per overnight minnow trap or hoop net set) was calculated and presented for each standardized monitoring data set for each reach (see Marsh et al. 2007). No statistical treatment was applied to the 2007 data. Results below are presented separately for each season.

## **Monitoring Results**

### *Spring 2007 minnow traps and hoop nets*

Above Fish Barrier (lower reach, Fig. 1).--The stream upon our arrival on the afternoon of May 21 was at base flow of approximately 43 cfs, and clear. Active travertine formation was noted. Ten minnow traps and 6 hoop nets were set downstream from pool 28 (Fig. 1), 6 minnow traps and 2 hoop nets were set in and immediately upstream of pool 28, and 4 minnow traps plus 2 hoop nets were deployed upstream from pool 26 between 1500 and 1600 hrs.

Minnow traps and hoop nets were retrieved between 0800 and 1030 hrs on May 22; nominal set duration was 17.8 hrs. Chub, Sonora sucker and a single desert sucker were captured; the two suckers were in minnow traps and chub plus Sonora sucker were in hoop nets (Tables 3 & 4). Total minnow trap catch was 87 individuals (range 0-21 per trap) and catch per unit effort (CPE, number of fish per overnight set) was 4.35 (Figs. 2 & 3). There were two, age-0 fish among 86 Sonora suckers, and the single desert sucker was age-0 (Fig. 4). Total hoop net catch was 37 fish (3 chub and 34 suckers; range 0-12 per net) and CPE was 3.70 (Figs. 2 & 4). All chubs were age-1 (Fig. 4), two were males exhibiting breeding coloration, and estimated maximum size was 25 cm.

Northern crayfish also were in 15 of 20 minnow traps and 8 of 10 hoop nets (Table 4). There were 0-3 per minnow trap (16 total, CPE = 0.80) and 0-3 per hoop net (15 total, CPE = 1.50). One adult Sonora mud turtle was in a hoop net.

Below Irving (middle reach, Fig. 1).--Travertine deposition since autumn 2006, particularly in small dams, was notable. In some areas, this has resulted in increased wetted channel width and braiding. Twenty minnow traps and 10 hoop nets were set between 1405 and 1540 hrs.

Minnow traps and hoop nets were retrieved between 0805 and 1000 hrs on May 23; nominal set duration was 16.2 hrs. Chub, specked dace, Sonora sucker, and desert sucker

were captured (Tables 3 & 5), and individuals of at least one species were in all devices except one minnow trap and one hoop net that were empty. All four species were in both minnow traps and hoop nets. Total minnow trap catch (all species combined) was 652 individuals (range 0-67 per trap) and CPE was 32.6 (Figs. 2 & 3). Total hoop net catch (all species combined) was 512 fish (range 0-110 per net) and CPE was 51.2 (Figs. 2 & 5).

Chubs were in all but one minnow trap and in all but one hoop net, and were the most abundant species overall in both gears: minnow traps (93% of catch, CPE = 30.2) and in hoop nets (86% of catch, CPE = 44.1), and were the most abundant species in each individual capture device (Table 5). All chubs were age-1 adults and represented multiple age/year classes; the two largest individuals were 25-30 cm long and exhibited breeding coloration. Speckled dace was the third most abundant fish in minnow traps (total catch = 3, CPE = 0.15), and was absent from hoop nets. Sonora sucker comprised 7% of fish in minnow traps (total catch = 44, CPE = 2.2) and was in all but six of these devices (range 0-6 individuals per trap). It also comprised about 13% of fish in hoop nets (total catch = 65, CPE = 6.5) and was in all but one hoop (range 0-15 individuals per net). All Sonora suckers in both minnow traps and hoop were age-1 adults representing multiple age/year classes. Desert sucker was rare and represented in only one minnow trap (one age-1 fish, CPE = 0.05) and in two hoop nets (2 and 4, age-1 fish, CPE = 0.60).

Northern crayfish was in one minnow trap (one individual) and in one hoop net (8 individuals). A single Sonora mud turtle was in each of three hoop nets.

High Falls (upper reach, Fig. 1).--Conditions on May 23 were unchanged from those noted previously at other reaches. Twenty minnow traps and 10 hoop nets were set between 1345 and 1600 hrs.

Minnow traps and hoop nets were retrieved between 0800 and 0940 hrs on May 24; mean set duration was 17.7 hrs. Chub, speckled dace, Sonora sucker, and desert sucker were captured (Tables 3 & 6), and specimens were in all devices except five minnow traps that were fishless (Table 6). Total minnow trap catch (all species combined) was 84 individuals (range 0-14 per trap) and CPE was 4.20 (Figs. 2 & 3). Total hoop net catch (all species combined) was 106 fish (range 1-56 per net) and CPE was 10.6 (Figs. 2 & 5).

Chub was in four of 16 minnow traps and six of 10 hoop nets, and was the third most abundant species in minnow traps (total catch = 11, CPE = 0.55) and the most abundant in hoop nets (total catch = 37, CPE = 3.7); all chub were age-1 adults (Table 6). Speckled dace was the most abundant fish in minnow traps (60% of total catch, CPE = 2.50) and the least abundant species in hoop nets (total catch = 5, CPE = 0.50). Sonora sucker was rare in minnow traps (total catch = 1 age-0 fish, CPE = 0.05), but in contrast it comprised about 30% of fish in hoop nets (total catch = 32, all age-1; CPE = 3.20) and was in seven hoops (range 1 to 25 individuals per net). Desert sucker was common in minnow traps (total catch = 6 age-0 plus 16 age-1, CPE = 1.10), and in hoop nets (total catch = 32 age-1 fish, CPE = 3.20, range to 8 individuals per net).

Several chubs were estimated to be 20 cm or longer and were brightly colored. Speckled dace included adults plus young-of-year (2007), and the single age-0 Sonora sucker also was young of 2007.

Northern crayfish was absent from minnow traps and from hoop nets in this reach. Native lowland leopard frog *Rana yavapaiensis* tadpoles were present, and one was taken by minnow trap. One muskrat *Ondatra zibethicus* was captured by hoop net.

### *Spring 2007 underwater observations*

We snorkeled four pools during the sample period. One pool was within each of the “Above Barrier,” “Below Irving,” “High Falls” reaches and a fourth was between the two lower reaches. Narratives are provided below, down- to upstream.

The large, deep, steep sided, rock pool at approximately UTM 439526E, 3804165N (designated pool no. 28 in the 2004 AZGFD stream reach 4A treatment protocol; Fig 1) was selected for snorkeling in the “Above Barrier” reach, and it was examined from 1030 to 1050 on May 22 by three persons (1.00 hrs total effort). The entire perimeter of the pool was examined, and the thalweg (channel) was traversed head-to-tail several times. Vi good. The only notable change since the last visit was a greater number of fish. Chubs were uncommon-to-rare and represented by several very large adults. No juvenile or young-of-year chub were recorded, but a large group of small fish in mid-water column could have been chubs. Sonora suckers were common-to-abundant in schools of 5-15 fish that included young-of-year, juveniles, and 2-year olds. Several very large adults 50-cm or longer also were seen near bottom. Desert suckers were rare-to-uncommon and represented by few young-of-year plus several older fish. No other fish species was detected. Northern crayfish was present but few; those seen were large.

We snorkeled the large pool below the FSR 708 bridge crossing downstream of Irving at approximate UTM 442164E, 3805847N (pool no. 16 in AZGFD stream reach 3A; Fig. 1) from 1305 to 1325 hrs (4 persons, total effort 1.33 hrs) on May 22. This pool was clear, and there were no noticeable changes since the last visit. Large (25-35 cm) adult chubs were common and juvenile chub were abundant (1000s). A few young-of-year (2007) chubs were in the riffle at the tail of the pool. Small Sonora sucker were common (100s). Desert sucker was uncommon (10s) and mostly on walls and rock faces where a few adult individuals were actively feeding. Speckled dace was not encountered. Northern crayfish was not observed

We snorkeled in the large, deep, steep sided, rock pool below the falls at Irving (approximately UTM 439526E, 380416N; pool no. 1 in AZGFD stream reach 3A; Fig. 1). It was examined from 1050 to 1115 hrs by four persons (1.67 hrs total effort) on May 23. Visibility was good. There were no noticeable changes since the last visit. Native fishes were represented by all sizes/ages except for young of 2007. Chubs were abundant, mostly in deep water near the bottom. Sonora sucker and desert sucker both were common, while speckled dace was uncommon and observed primarily in swift water of the pool outlet channel. Northern crayfish was not seen.

Four persons (1.33 hrs effort) snorkeled in the large, deep, steep sided, rock pool below the high falls above Irving (approximately UTM 444433E 3808075N; pool no. 24 in AZGFD stream reach 2; Fig. 1) from 1355 to 1415 hrs by on May 23. Visibility was good and there were no noticeable changes since the last visit. Native fishes of all species were represented by all sizes/ages except for young of 2007. Chubs and Sonora sucker both were common and appeared approximately equal in numbers; the largest individuals of both species were near bottom. Desert sucker were common-to-abundant, and some individuals exhibited rosy coloration along the flanks typically associated with breeding condition. Speckled dace was common only in the swift water along the pool margins and in the outlet channel. No other fish species was detected and northern crayfish were not encountered.

Miscellaneous observations.--Adult lowland leopard frog and native frog or toad tadpoles were seen along the stream between Irving and the High Falls. Larvae and small young-of-year (2007) fishes of undetermined species were locally common-to-abundant in quiet, shallow and warm off-channel habitats in the reach.

#### *Autumn 2007 minnow traps and hoop nets*

Above Barrier (lower reach, Fig. 1).--The stream upon our arrival in this reach on the afternoon of September 30 was at base flow and moderately turbid. There were deposits of fines (silts and clays) on the bottom which were taken as evidence of recent runoff and higher flow.<sup>2</sup> Ten minnow traps and 6 hoop nets were set downstream from pool 28 (Fig. 1), 6 minnow traps and 2 hoop nets were set in and immediately upstream of pool 28, and 4 minnow traps plus 2 hoop nets were deployed upstream from pool 26 between 1505 and 1625 hrs.

Minnow traps and hoop nets were retrieved between 0820 and 1020 hrs on October 1; nominal set duration was 18.0 hrs. All equipment had a fine dusting of silty sediment that had settled from the water. Chubs, Sonora sucker, and desert sucker were captured; all species were in both minnow traps and hoop nets (Tables 7 & 8). Total minnow trap catch was 74 individuals (range 0-24 per trap) and CPE was 3.7 (Figs. 2 & 3). Total hoop net catch was 91 fish (0-36 per net) and CPE was 9.1 (Figs. 2 & 5). Chubs were 16% of the minnow trap catch (10 age-0 and 2 age-1; CPE=0.6) and 10% of the hoop net catch (3 age 0 and 6 age 1; CPE=0.9). Sonora sucker was the most abundant species, comprising 69% of the minnow trap catch (CPE=2.55) and 85% of the hoop net catch (CPE=7.70). Approximately 8% of the Sonora suckers were age-0 (Fig. 4). Desert sucker was 15% of the minnow trap catch (CPE=0.55) and 5% of the hoop net catch (CPE=0.50)

Northern crayfish were in half the minnow traps and half the hoop nets (Table 8). There were 0-3 per minnow trap (19 total, CPE = 0.95) and 0-10 per hoop net (25 total, CPE =

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<sup>2</sup> The USGS gage on Verde River below Tangle Creek showed small flood (ca. 380 cfs) on September 25.

2.5). One small adult mud turtle was in a minnow trap, and one juvenile and one adult each was in a hoop net.

Below Irving (middle reach, Fig. 1).—Stream conditions on October 2 were unchanged from those noted above. Twenty minnow traps and 10 hoop nets were set between 1350 and 1515 hrs.

Minnow traps and hoop nets were retrieved between 0750 and 0955 hrs on October 3; nominal set duration was 17.6 hrs. Chub and specked dace were in minnow traps, while these two species plus Sonora sucker and desert sucker were captured in hoop nets (Tables 7 & 9); specimens were in all devices (Table 9). Total minnow trap catch (all species combined) was 661 individuals (range 1-75 per trap) and CPE was 33.05 (Figs. 2 & 3). Total hoop net catch (all species combined) was 387 fish (range 3-92 per net) and CPE was 38.70 (Figs. 2 & 5).

Chubs were in all minnow traps and in all hoop nets, and were the most abundant species overall in minnow traps (94% of catch, CPE = 31.85) and in hoop nets (94% of catch, CPE = 36.30), and were the most abundant species in each individual capture device (Table 9). The great majority of chubs (98% in both minnow traps and in hoop nets) were small, age-1 fish (Fig. 4), but 3 very large adults in breeding color were noted, and age-0 fish also were captured. Speckled dace was absent from minnow traps and represented in hoop nets by only a single specimen. Sonora sucker comprised 4% of fish in minnow traps (total catch = 24, CPE = 1.20) and was in 9 of 20 of these devices (range 0-6 individuals per trap); all were age-1. Similarly, Sonora sucker comprised about 5% of fish in hoop nets (total catch = 21, CPE = 2.10) and was in all but three hoops (range to 13 individuals per net). All but one Sonora sucker were age-1 fish (Fig. 4). Desert sucker was rare and represented in only one hoop net (two age-1 fish, CPE = 0.20).

Three northern crayfish were in minnow traps (CPE=0.15) and there were 0-1 per trap (CPE = 0.15). Nine were captured in hoop nets with 0-4 per net (CPE=0.90). Three adult Sonora mud turtles were taken from two hoop nets.

High Falls (upper reach, Fig. 1)--Stream conditions on October 1 were generally unchanged from those noted above; water clarity was fair. Twenty minnow traps and ten hoop nets were set between 1300 and 1530 hrs.

Minnow traps and hoop nets were retrieved between 0925 and 1135 hrs on October 2; average set duration was 20.25 hrs. Chub, specked dace, Sonora sucker, and desert sucker were captured (Table 7 & 10), and specimens were in all devices except four minnow traps and one hoop net. Total minnow trap catch (all species combined) was 151 individuals (range 0-33 per trap) and CPE was 7.55 (Figs. 2 & 3). Total hoop net catch (all species combined) was 64 fish (range 0-28 per net) and CPE was 6.40 (Figs. 2 & 5).

Chub was in nine of 20 minnow traps and six of 10 hoop nets, and was the second most abundant species in minnow traps (total catch = 31, CPE = 1.55), but the most abundant in hoop nets (total catch = 36, CPE = 3.60). Most chub (75%) were age-1 fish (Fig. 4).

Speckled dace was the most abundant fish in minnow traps (75% of total catch, CPE = 7.55). Speckled dace was rare in hoop nets (total catch = 2, CPE = 0.20). Sonora sucker was uncommon (6% of total catch), comprising 3% of fish in minnow traps (total catch = 4, CPE = 0.20) and 20% of fish in hoop nets (total catch = 13, CPE = 1.30), in six hoops (range to 6 individuals per net). Desert sucker was uncommon in minnow traps (total catch = 3, CPE = 0.15) and in hoop nets (total catch = 13, CPE = 1.30, range to 6 individuals per net). The majority of chubs (75%) were age-0 fish, all Sonora sucker were age-1, and most desert sucker (75%) were age-0 fish (Fig. 4).

Northern crayfish was absent from minnow traps and hoop nets in this reach. Two hoop nets each contained a single native Sonora mud turtle.

#### *Autumn 2007 underwater observations*

We snorkeled four pools during the sample period. One pool was within each of the “Above Barrier,” “Below Irving,” “High Falls” reaches and a fourth was between the two lower reaches. Narratives are provided below, down- to upstream.

The large, deep, steep sided, rock pool at approximately UTM 439526E, 3804165N (designated pool no. 28 in the 2004 AZGFD stream reach 4A treatment protocol; Fig 1) was selected for snorkeling in the “Above Barrier” reach, and it was examined from 0940 to 0945 on October 1 by three persons (0.75 hr total effort). Visibility was relatively poor, < 1.5 m, and observing conditions were lousy. One snorkeler saw no fish, another saw fewer than 10 Sonora sucker, and a third saw fewer than 10 small age-1 Sonora sucker plus a few larger individuals. No other fishes and no crayfish were seen.

We snorkeled the large pool below the FSR 708 bridge crossing downstream of Irving at approximate UTM 442164E, 3805847N (pool no. 16 in AZGFD stream reach 3A; Fig. 1). It was examined from 1105 to 1120 hrs by three persons (0.75 hrs total effort) on October 1. Water was turbid and visibility was poor-to-fair (when sunlit). The total number of fish seen was in the hundreds. Large adult chubs (>30 cm long) were common (10s) and smaller chub to ca. 8-20 cm long were abundant (100s); chub smaller than 8 cm were wanting. Speckled dace were not seen. Large adult Sonora suckers (to 50 cm long) were on bottom at the tail of the pool; smaller (25-30 cm) suckers also were common. Small and large desert suckers were uncommon in swift water at the head of the pool. No young of 2007 of any species was observed. No other fish species and no northern crayfish were detected.

We snorkeled in the large, deep, steep sided, rock pool below the falls at Irving (approximately UTM 439526E, 380416N; pool no. 1 in AZGFD stream reach 3A; Fig. 1) from 1315 to 1330 hrs (3 persons, total effort 0.75 hrs) on October 2. Water had a grayish cast, and visibility was poor even though the pool was in full sunlight at the time of our visit. Chub were abundant, followed by common desert sucker; speckled dace and Sonora suckers were uncommon. There were no young of 2007. Small (8-12 cm) age-1 chub were throughout the water column, while both sucker species were associated with



the bottom. Speckled dace were seen only in swift current at the pool tail. No other fishes and no crayfish were seen.

We snorkeled in the large, deep, steep sided, rock pool below the high falls above Irving (approximately UTM 444433E 3808075N; pool no. 24 in AZGFD stream reach 2; Fig. 1). It was examined from 0945 to 1000 hrs by three persons (0.75 hrs effort) on October 2. Visibility was moderate-to-good and water level was ca. 25 cm higher than on prior site visits. Overall fish abundance seemed lower than on prior occasions, but this may have been an artifact of reduced water clarity. Chub were present and represented mostly by fish 8-12 cm long or fish longer than 30 cm; some were very large, perhaps >35 cm long. Speckled dace was not detected. Sonora sucker was uncommon overall, and represented by fish that were intermediate in size, or large adults. Desert sucker was abundant, mostly fish of intermediate size but including some that were much larger, >25 cm in length. No young of 2007 of any fish species was seen. No other fishes were observed, and no northern crayfish were detected.

Miscellaneous observations.—A single minnow trap was set in a shallow (5-8 cm deep) seep in the outfall channel from the abandoned Irving powerhouse. Two juvenile northern crayfish were captured, and these represent the only young crayfish collected during this monitoring event.

### **Sample Comparisons**

Fossil Creek fish monitoring has been conducted five times since completion of the stream restoration project: three times in autumn, (September-October) 2005, 2006 and 2007, and twice in spring (May-June) 2006 and 2007.

#### *Spatial relationships*

Total catch per unit effort (CPE) in both minnow traps and hoop nets has been consistently highest in the middle reach during both spring and autumn. The upper reach had total CPE that was intermediate between middle and lower reaches for 6 of 10 reach/date combinations, while the lower reach had total CPE that was intermediate between middle and upper reaches for 4 of 10 such combinations. However, CPE for upper and lower reaches were more similar to each other, often differing by only a few tenths, than to the middle reach.

CPE for chub, like total catch, always was greatest in the middle reach. Catch in the upper reach generally was much less, and smaller still in the lower reach where chubs were rare.

Speckled dace on the other hand has consistently been most abundant in the upper reach. It has been relatively uncommon in the middle reach, and has not yet been captured in the lower reach.

Sonora sucker is the only species that is generally most abundant in the lower reach, where CPE has been greatest for 8 of 10 reach/date combinations. The other two CPE maxima were in the middle reach. It is notable that CPE for this species has varied relatively little within each gear type, and has been remarkably consistent.

Desert sucker, like speckled dace, has consistently been most abundant in the upper reach where CPE has been greatest for 8 of 10 reach/date combinations. The species has been relatively uncommon in the middle and lower reaches where CPE has exceeded 0.6 fish/set only on one occasion.

Native lowland leopard frog has been encountered on two occasions and only encountered in the upper reach; however, our sample methods do not specifically target this group of amphibians and too few data are available to reliably assess its spatial distribution. Native Sonora mud turtle has been captured in all three reaches. Catch rates generally appear highest in the upper reach and lowest in the lower reach, but such rates typically are low (CPE= 0.1 to 0.7 per unit) and may not reflect true relative abundance among these areas.

Non-native northern crayfish has consistently been most abundant in the lower reach, where CPE ranged from 1.0 to 1.7 per minnow trap and from 1.5 to 9.1 per hoop net. The species has been encountered in the middle reach on 5 of 10 method/date combinations (CPE of 0 to 2.1), but has been collected only once in the upper reach (hoop net CPE=1.3).

#### *Temporal relationships*

Total catch per unit effort (CPE) in the middle reach, where it has been highest among the three reaches, has decreased only slightly over the five sample dates from 2005 to 2007. Minnow trap CPE decreased from a high of 71.5 in autumn 2005 to 47.6 in spring 2006 to a lower but stable value near 33 thereafter (Table 11). In contrast, hoop net CPE was stable near 68 through autumn 2006, then decreased to 51.2 the 38.7 in spring and autumn 2007.

In the upper reach, both annual and seasonal trends are evident. Total CPE has decreased each autumn (from 36.0 in 2005 to 10.8 in 2006 to 7.6 in 2007 for minnow traps and from 14.0 to 8.1 to 6.4 for hoop nets). Catch in springtime was about the same each year for both gears types (4.3 and 4.2 for minnow traps and 9.3 and 8.1 for hoop nets in 2006 and 2007, respectively).

Catch in the lower reach has been relatively stable for both gear types and neither annual nor seasonal trends are evident. CPE has ranged across seasonal samples only from 3.7 to 5.0 for minnow traps and from 3.7 to 9.4 for hoop nets.

Desert sucker made its first appearance in the lower reach in spring 2007 and persisted into autumn 2007. We expect that numbers of this species in this reach will increase into the future. Speckled dace has not been taken in the lower reach.

Trends in catch of individual species either mimic those for total catch per unit effort (above; speckled dace, and Sonora sucker) or are equivocal (chub and desert sucker; for the last due in part to relatively small sample sizes). The substantial decrease in CPE after the initial autumn 2005 survey was especially pronounced in the upper reach for speckled dace in minnow traps, and in the same reach for Sonora sucker in hoop nets.

No annual or seasonal trends are evident in CPE of native lowland leopard frog or Sonora mud turtle, likely due at least in part to a general paucity of capture data. However, the frog has been absent from autumn samples and encountered only in spring 2006 and 2007. This may simply reflect the species life history and seasonal presence of tadpoles. The turtle, on the other hand, has been present in some reaches in some seasons, absent in others reaches or at other times of year, and no trends are apparent.

Non-native northern crayfish has been consistently encountered only in the lower reach, and seasonal/annual trends are equivocal. Highest hoop net CPE (9.1) was in autumn 2005, and then decreased thereafter to somewhat lower values of 1.5 to 2.5. Crayfish CPE in the lower reach minnow traps has been stable, varying only from 0.8 to 1.7. In the middle reach, crayfish were present in 2005 (hoop nets CPE=2.1), then absent from spring and autumn samples in 2006. The species appeared again and was captured in both minnow traps and hoop nets in spring and autumn 2007, but CPE was low and ranged only from 0.1 to 0.9. Finally, crayfish were present in our autumn 2005 upper reach sample (hoop net CPE=1.3), but have been absent since that time.

In 2005, crayfish in our samples included a suite of sizes from small juveniles only 2-3 cm long to large adults exceeding 10 cm in overall length (we have not acquired data on standard carapace lengths). More recently, juveniles have largely been absent from our collections and only large adults have been taken; as a result we conclude that crayfish recruitment has been reduced throughout the portion of the stream that we sample. While available data are insufficient to determine a cause with certainty, it is tempting to speculate that predation by increased chub populations have curtailed crayfish recruitment (see for example Lenon et al. 2002).

### **Summary**

No non-native fishes were detected in the treatment reach of Fossil Creek during monitoring surveys performed May and September-October 2007, and we are not aware of any verifiable reports of any non-native fish in the stream since it was treated in autumn 2004. Five native fishes, headwater chub plus roundtail chub, speckled dace, Sonora sucker, and desert sucker were present. Populations of all species were recruiting and appeared healthy; we have not noted any external parasites or indications of disease. Native lowland leopard frog and Sonora mud turtle also were encountered. Non-native crayfish are present but appear stable or decreasing.

Speckled dace was absent from the lowermost reach, and desert sucker was found there for the first time in autumn 2007. Numbers of chubs and desert sucker were fewer than

in the two upstream reaches, while numbers of Sonora suckers were similar or greater than in upper reaches.

We again note the absence from collections of longfin dace, which was known to occupy Fossil Creek historically and at the time of project implementation. Fewer than two dozen longfin dace were repatriated into Fossil Creek post treatment (extrapolated from data in Weedman et al. 2005, see Table 12) and the species has not been found during three consecutive monitoring events spanning two spawning seasons over a period of more than a dozen months. However, more than 300 additional fish from nearby Tangle Creek were stocked into Fossil Creek in February 2008 (Carter 2008), and these may establish a new population.

Reintroductions of other species including threatened loach minnow *Tiaroga cobitis* and spikedace *Meda fulgida* and endangered Sonora (Gila) topminnow *Poeciliopsis occidentalis* were implemented in November 2007, after the current monitoring period, and if encountered during our monitoring these fishes will be discussed in a subsequent annual report.

### **Acknowledgements**

R. W. Clarkson provided valuable field assistance during our spring 2007 monitoring of Fossil Creek fishes and we appreciate his hard work and camaraderie. Collections were under permit authorization of the State of Arizona.

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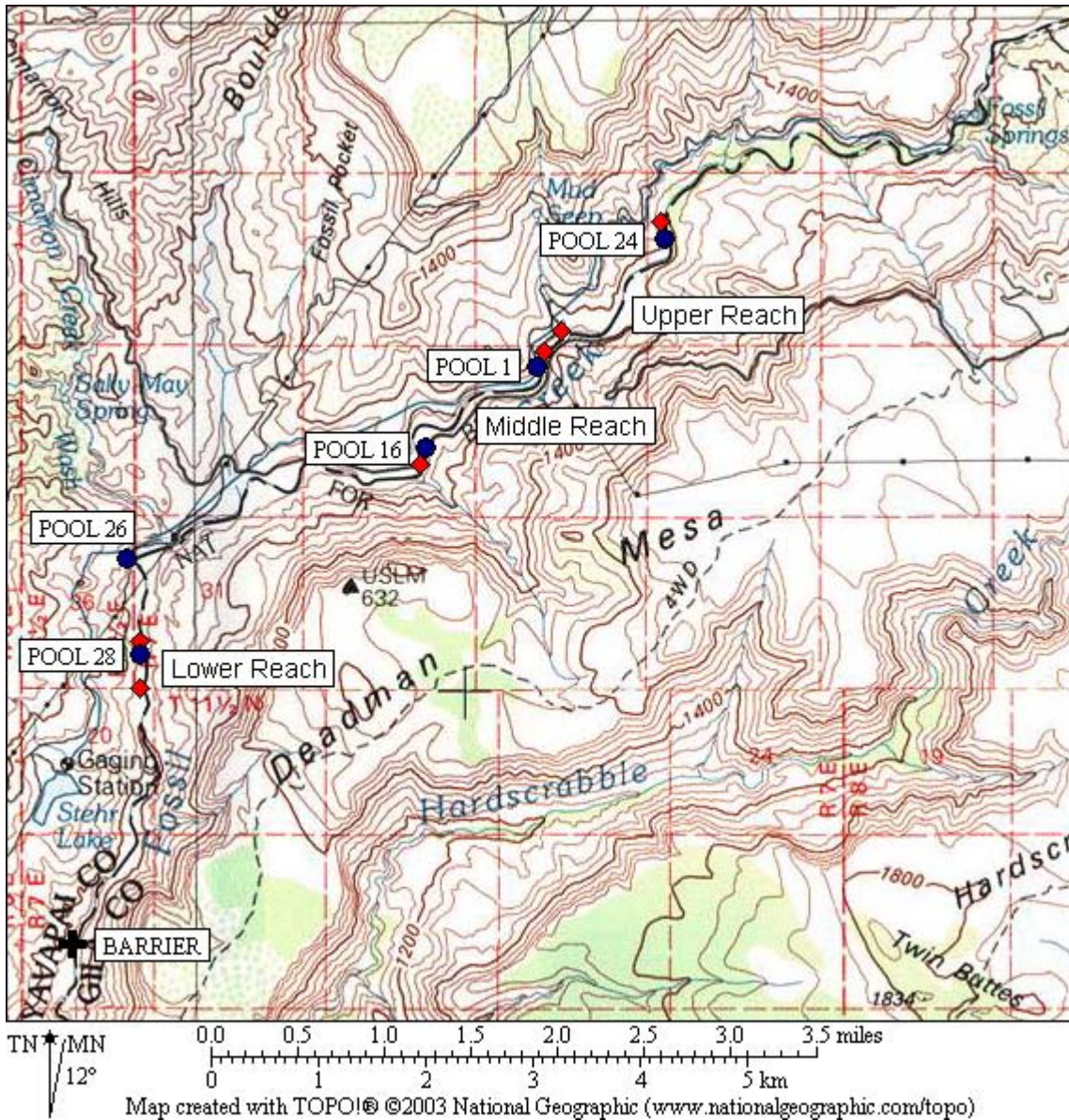


Figure 1. Map of Fossil Creek, Gila and Yavapai counties, Arizona, from Fossil Springs downstream to a constructed fish barrier (+), showing approximate upper, middle, and lower reach boundaries (red diamonds) and pools (blue circles) related to fish monitoring May and September-October 2007. See text and Table 2 for additional information, reach designations, and boundary coordinates.

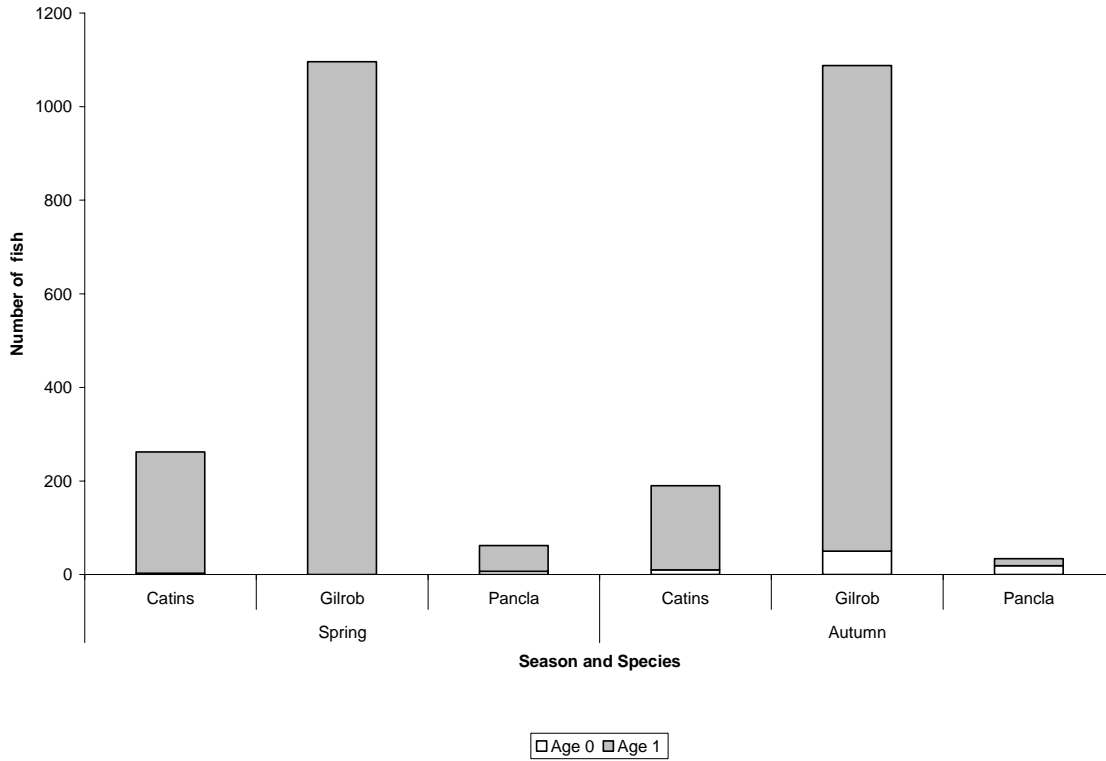


Figure 2. Total fish catch (number) of age-0 and age-1 fish by season (spring = May 2007; autumn = September-October 2007) and species, Fossil Creek, Arizona.

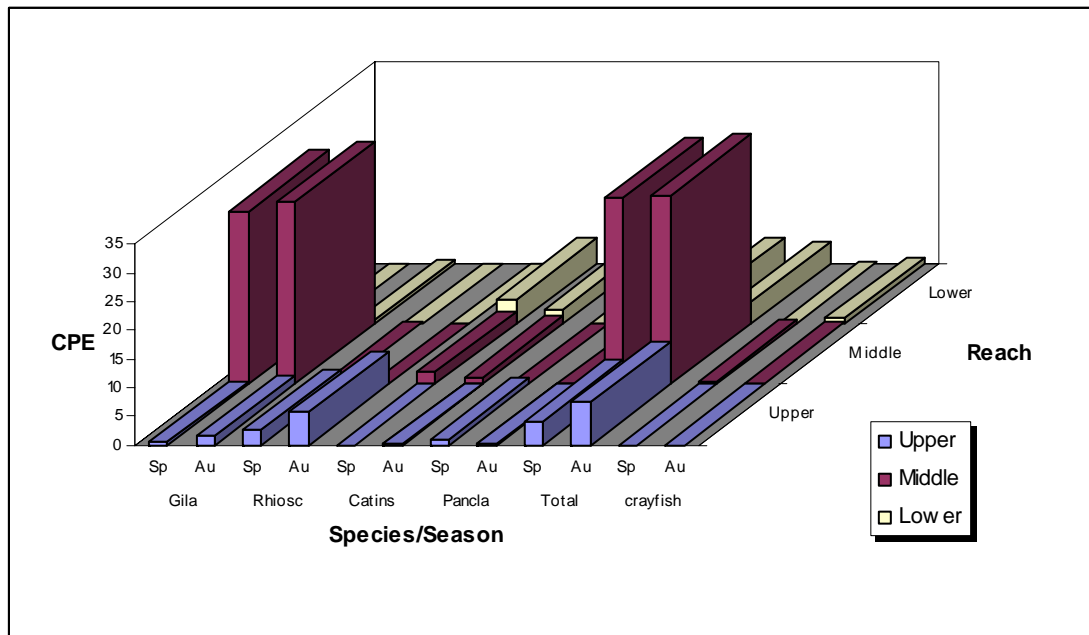


Figure 3. Minnow trap catch per unit effort (CPE, number per set) in 2006 by species and season (spring = May 2007; autumn = September-October 2007) for upper, middle, and lower reaches of Fossil Creek, Arizona.

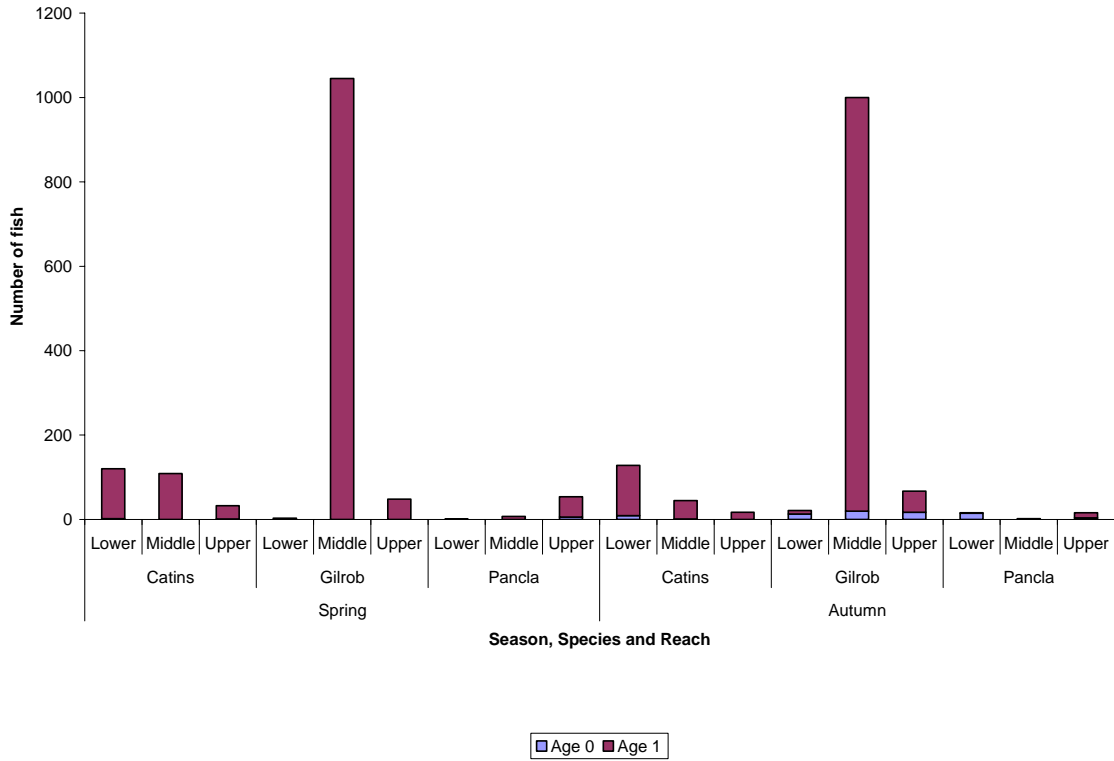


Figure 4. Total catch (number of fish) by species of Age-0 and Age-1 individuals by season (spring = May 2007; autumn = September-October 2007) among lower, middle, and upper reaches of Fossil Creek, Arizona.

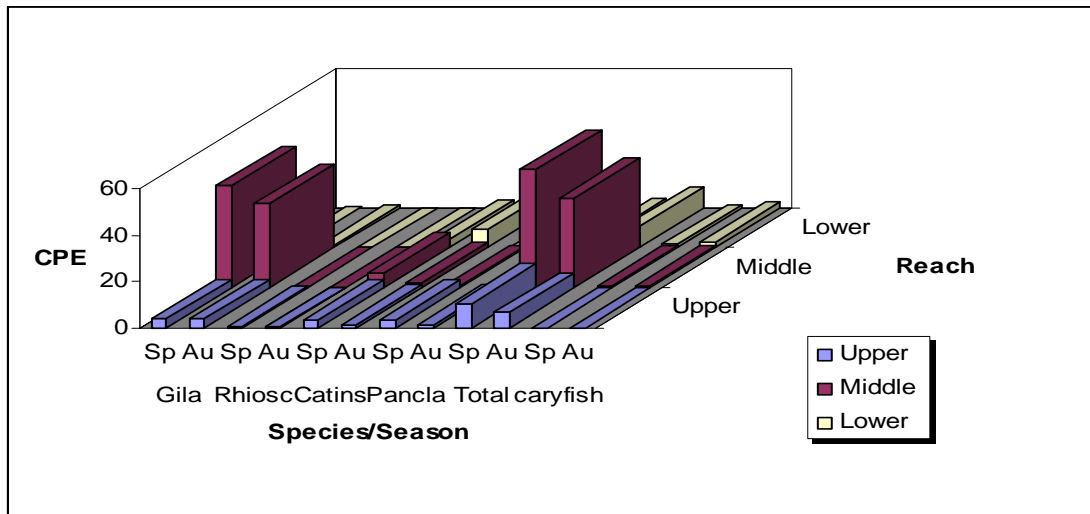


Figure 5. Hoop net catch per unit effort (CPE, number per set) in 2006 by species and season (spring = May 2007; autumn = September-October 2007) for upper, middle, and lower reaches (sites) of Fossil Creek, Arizona.



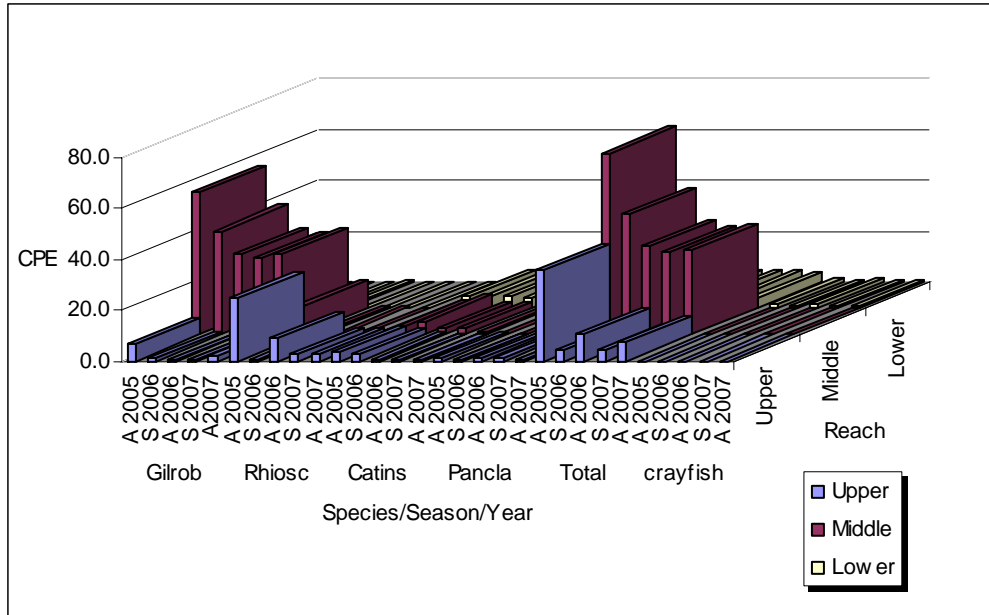


Figure 6. Minnow trap catch per unit effort (CPE, number per set) by species and season (S = Spring, May-June 2006 and May 2007; A = Autumn, September 2005, October 2006, and September-October 2007)) for upper, middle, and lower reaches (sites) of Fossil Creek, Arizona. See Tables 3C, 7C, and 11 for raw data.

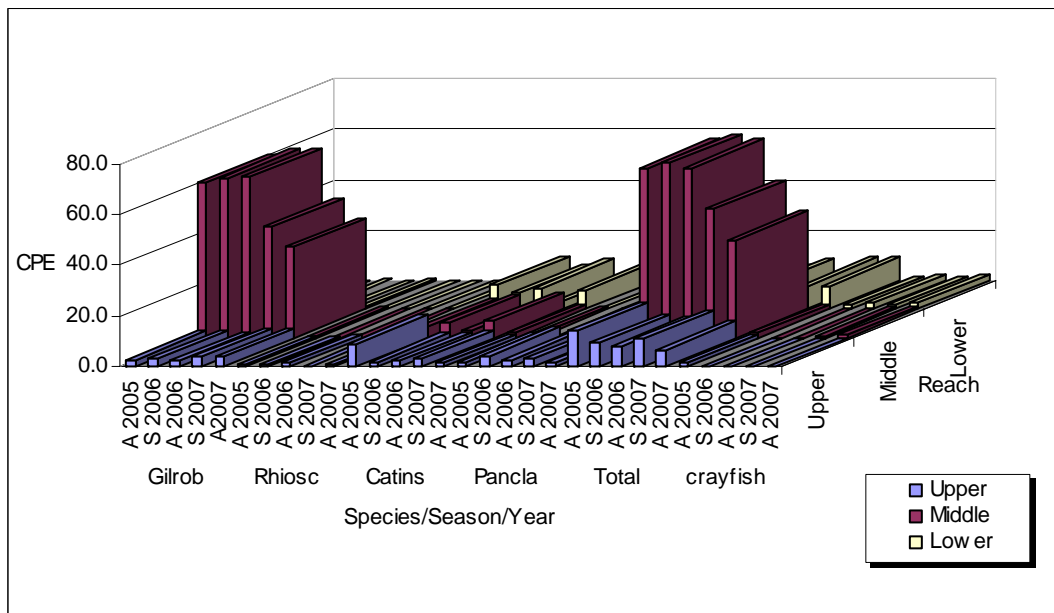


Figure 7. Hoop net catch per unit effort (CPE, number per set) in 2005 and 2006 by species and season (S = Spring, May-June 2006 and May 2007; A = Autumn, September 2005, October 2006 and September-October 2007) for upper, middle, and lower reaches (sites) of Fossil Creek, Arizona. See Tables 3C, 7C, and 11 for raw data.

Table 1. Common and scientific names of families and species of native (indicated by \*) and non-native fishes known from Fossil Creek, Arizona, and abbreviations used in tables. See footnote on page 1 relative to treatment of headwater and roundtail chubs.

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Minnows (Cyprinidae)

- \*Longfin dace, *Agosia chrysogaster*
- Common carp, *Cyprinus carpio*
- \*Headwater chub, *Gila nigra* (Gilasp)
- \*Roundtail chub, *Gila robusta* (Gilasp)
- \*Speckled dace, *Rhinichthys osculus* (Rhiose)

Suckers (Catostomidae)

- \*Sonora sucker, *Catostomus insignis* (Catins)
- \*Desert sucker, *Pantosteus clarki* (Pancla)
- \*Razorback sucker, *Xyrauchen texanus*

Catfishes (Ictaluridae)

- Yellow bullhead, *Ameiurus natalis*
- Flathead catfish, *Pylodictis olivaris*

Livebearers (Poeciliidae)

- \*Gila topminnow, *Poeciliopsis occidentalis*

Basses and Sunfishes (Centrarchidae)

- Green sunfish, *Lepomis cyanellus*
  - Smallmouth bass, *Micropterus dolomieu*
-

Table 2. Approximate lower (downstream) and upper (upstream) limits and approximate lengths of each monitoring reach sampled along Fossil Creek, Pinal and Yavapai counties, Arizona, 19-23 September 2005. Universal Transverse Mercator coordinates (UTMs) in NAD27 datum, Zone 12S.

Reach designation	Lower UTM	Upper UTM	Length (km [mi])
Above Barrier (lower)	439523E-3803732N	439526E-3804165N	0.45 (0.28)
Below Irving (middle)	442157E-3805817N	443295E-3806787N	1.87 (1.16)
High Falls (upper)	443493E-3807060N	444433E-3808074N	1.69 (1.05)

Table 3. Summary of Fossil Creek fish monitoring data, May 21-24, 2007.

	age (0/1)	Upper Reach		Middle Reach		Lower Reach		Total
		mt	hoop	mt	hoop	mt	hoop	
Gilasp	0	0	0	0	0	0	0	0
	1	11	37	604	441	0	3	1096
Rhiosc	n/a	50	5	3	0	0	0	58
Catins	0	1	0	0	0	2	0	3
	1	0	32	44	65	84	34	259
Pancla	0	6	0	0	0	1	0	7
	1	16	32	1	6	0	0	55
Total		84	106	652	512	87	37	1478
crayfish		0	0	1	8	16	15	40
leopard frog		1	0	0	0	0	0	1
mud turtle		0	0	0	3	0	1	4

Table 3B. Total catch by reach, methods combined, all standard samples

	age (0/1)	Upper	Middle	Lower	Total
		Reach	Reach	Reach	
Gilasp	0	0	0	0	0
	1	48	1045	3	1096
Rhiosc	n/a	55	3	0	58
Catins	0	1	0	2	3
	1	32	109	118	259
Pancla	0	6	0	1	7
	1	48	7	0	55
Total		190	1164	124	1478
crayfish		0	9	31	40
leopard frog		1	0	0	1
mud turtle		0	3	1	4

Table 3C. Catch per unit effort (no. fish per standard overnight minnow trap or hoop net set) by reach and by method. mt = minnow trap, hoop = hoop net

	age (0/1)	Upper Reach		Middle Reach		Lower Reach	
		mt	hoop	mt	hoop	mt	hoop
Gilasp	0	0.00	0.00	0.00	0.00	0.00	0.00
	1	0.55	3.70	30.20	44.10	0.00	0.30
Rhiosc	n/a	2.50	0.50	0.15	0.00	0.00	0.00
Catins	0	0.05	0.00	0.00	0.00	0.10	0.00
	1	0.00	3.20	2.20	6.50	4.20	3.40
Pancla	0	0.30	0.00	0.00	0.00	0.05	0.00
	1	0.80	3.20	0.05	0.60	0.00	0.00
Total		4.20	10.60	32.60	51.20	4.35	3.70
crayfish		0.00	0.00	0.05	0.80	0.80	1.50

Table 4. Fossil Creek standard fish monitoring data, Above Barrier (lower) reach, May 21-24, 2007.

Site: **Lower Reach**  
 Date: 21-24 May 2007

Gear type: **Minnow Traps (n = 20)**  
 Nominal set/run times: 1530-0920      Nominal set duration: 17.8 hours

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10
Catins	0	0	0	0	0	0	0	0	0	0	0
	1	0	2	0	2	0	0	0	1	2	10
Pancla	0	0	0	0	0	1	0	0	0	0	0
Crayfish		0	1	1	2	3	2	1	0	0	2

Species	age (0/1)	11	12	13	14	15	16	17	18	19	20	Total	CPE
Catins	0	0	0	0	0	0	0	2	0	0	0	2	0.10
	1	0	3	6	12	0	0	10	20	17	0	84	4.20
Pancla	0	0	0	0	0	0	0	0	0	0	0	1	0.05
Total		0	5	6	13	1	0	12	21	19	10	87	4.35
Crayfish		1	0	1	0	0	0	1	1	0	0	16	0.80

Gear type: **Hoop Nets (n=10)**  
 Nominal set/run times: 1530-0920      Nominal set duration: 17.8 hours

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10	Total	CPE
Gilasp	1	0	0	0	0	0	0	0	1	1	1	3	0.30
Catins	1	5	0	2	1	2	1	1	9	11	3	34	3.40
Total		5	0	2	1	2	1	1	10	12	4	37	3.70
Crayfish		2	0	1	0	3	2	3	1	2	1	15	1.50
Mud turtle		0	0	0	0	0	0	0	0	0	1	1	0.10

Table 5. Fossil Creek standard fish monitoring data, Below Irving (middle) reach, May 21-24, 2007.

Site: **Middle Reach**  
 Date: 21-24 May 2007

Gear type: **Minnow Traps (n = 20)**  
 Nominal set/run times: 1455-0905      Nominal set duration: 16.2 hr

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10
Gilasp	1	34	32	40	36	32	42	18	34	67	53
Rhiosc	n/a	0	0	1	0	0	0	2	0	0	0
Catins	1	2	1	0	3	1	4	0	6	0	4
Pancla	1	0	0	0	0	0	0	0	0	0	1
crayfish		0	0	0	0	0	0	0	0	0	0

Species	age (0/1)	11	12	13	14	15	16	17	18	19	20	Total	CPE
Gilasp	1	45	60	28	18	1	35	10	7	12	0	604	30.20
Rhiosc	n/a	0	0	0	0	0	0	0	0	0	0	3	0.15
Catins	1	5	2	5	5	0	2	2	0	2	0	44	2.20
Pancla	1	0	0	0	0	0	0	0	0	0	0	1	0.05
Total		86	95	74	62	34	83	32	47	81	58	652	32.6
crayfish		0	0	0	0	0	0	0	0	0	1	0	0.00

Gear type: **Hoop Nets n =10)**  
 Nominal set/run times: 1455-0905      Nominal set duration: 16.2 hr

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10	Total	CPE
Gilasp	1	107	76	34	65	22	0	83	16	14	24	441	44.10
Catins	1	3	9	1	6	15	0	14	3	10	4	65	6.50
Pancla	1	0	0	0	2	4	0	0	0	0	0	6	0.60
Total		110	85	35	73	41	0	97	19	24	28	512	51.20
Crayfish		0	0	0	0	0	0	0	0	8	0	8	0.80
Mud turtle		0	1	0	0	0	0	0	1	0	1	3	0.30

Table 6. Fossil Creek standard fish monitoring data, High Falls (upper) reach, May 21-24, 2007.

Site: **Upper Reach**  
 Date: 21-24 May 2007

Gear type: **Minnow Traps (n = 20)**  
 Nominal set/run times: 1510-0850      Nominal set duration: 17.7 hrs

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10
Gilasp	1	0	0	0	0	0	1	0	0	5	3
Rhiosc	n/a	2	5	0	0	8	0	7	0	2	2
Catins	0	0	0	0	0	0	0	0	0	0	0
Pancla	0	0	0	0	0	6	0	0	0	0	0
	1	0	0	0	0	4	2	0	0	7	0
lowland leopard frog		0	0	0	1	0	0	0	0	0	0

Species	age (0/1)	11	12	13	14	15	16	17	18	19	20	Total	CPE
Gilasp	1	2	0	0	0	0	0	0	0	0	0	11	0.55
Rhiosc	n/a	4	1	5	9	0	3	1	0	1	0	50	2.50
Catins	0	0	1	0	0	0	0	0	0	0	0	1	0.05
Pancla	0	0	0	0	0	0	0	0	0	0	0	6	0.30
	1	0	0	0	0	0	0	0	0	0	3	16	0.80
Total		8	7	5	9	14	4	8	0	8	8	84	4.20
lowland leopard frog		0	0	0	0	0	0	0	0	0	0	1	0.05

Gear type: **Hoop Nets n=10)**  
 Nominal set/run times: 1510-0850      Nominal set duration: 17.7 hrs

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10	Total	CPE
Gilasp	1	4	0	1	1	0	24	4	0	3	0	37	3.70
Rhiosc	n/a	2	0	0	0	1	1	0	0	1	0	5	0.50
Catins	1	1	1	1	2	1	25	1	0	0	0	32	3.20
Pancla	1	5	2	3	8	5	6	0	1	1	1	32	3.20
Total		12	3	5	11	7	56	5	1	5	1	106	10.60

Table 7. Summary of Fossil Creek fish monitoring data, September 30-October 3, 2007.

Table 7A. Total catch by reach and method, all standard samples; mt = minnow trap, hoop = hoop net

	age (0/1)	Upper Reach		Middle Reach		Lower Reach		Total
		mt	hoop	mt	hoop	mt	hoop	
Gilasp	0	16	1	13	7	10	3	50
	1	15	35	624	356	2	6	1038
Rhiosc	n/a	113	2	0	1	0	0	116
Catins	0	0	0	0	1	7	2	10
	1	4	13	24	20	44	75	180
Pancla	0	3	1	0	0	11	4	19
	1	0	12	0	2	0	1	15
Total		151	64	661	387	74	91	1428
crayfish		0	0	3	9	19	25	56
mud turtle		0	2	0	4	1	2	9

Table 7B. Total catch by reach, methods combined, all standard samples

	age (0/1)	Upper	Middle	Lower	Total
		Reach	Reach	Reach	
Gilasp	0	17	20	13	50
	1	50	980	8	1038
Rhiosc	n/a	115	1	0	116
Catins	0	0	1	9	10
	1	17	44	119	180
Pancla	0	4	0	15	19
	1	12	2	1	15
Total		215	1048	165	1428
crayfish		0	12	44	56
mud turtle		2	4	3	9

Table 7C. Catch per unit effort (no. fish per standard overnight minnow trap or hoop net set) by reach and by method. mt = minnow trap, hoop = hoop net

	age (0/1)	Upper Reach		Middle Reach		Lower Reach	
		mt	hoop	mt	hoop	mt	hoop
Gilasp	0	0.80	0.10	0.65	0.70	0.50	0.30
	1	0.75	3.50	31.20	35.60	0.10	0.60
Rhiosc	n/a	5.65	0.20	0.00	0.10	0.00	0.00
Catins	0	0.00	0.00	0.00	0.10	0.35	0.20
	1	0.20	1.30	1.20	2.00	2.20	7.50
Pancla	0	0.15	0.10	0.00	0.00	0.55	0.40
	1	0.00	1.20	0.00	0.20	0.00	0.10
Total		7.55	6.40	33.05	38.70	3.70	9.10
crayfish		0.00	0.00	0.15	0.90	0.95	2.50
mud turtle		0	0.2	0	0.40	0.05	0.20



Table 8. Fossil Creek standard fish monitoring data, Above Barrier (lower) reach, September 30-October 3, 2007.

Date: 30 Sept - 01 Oct  
2007

Gear type: **Minnow Traps (n = 20)**  
Nominal set/run times: 1545-0945 Nominal set duration: 18.0 hours

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10
Gila	0	2	4	0	0	0	1	2	1	0	0
	1	0	0	2	0	0	0	0	0	0	0
Catins	0	0	2	0	0	1	0	0	0	0	1
	1	1	2	19	0	4	3	3	2	0	1
Pancla	0	0	1	0	0	10	0	0	0	0	0
Crayfish		3	0	1	0	3	1	3	1	0	2
Mud turtle		1	0	0	0	0	0	0	0	0	0

Species	age (0/1)	11	12	13	14	15	16	17	18	19	20	Total	CPE
Gila	0	0	0	0	0	0	0	0	0	0	0	10	0.5
	1	0	0	0	0	0	0	0	0	0	0	2	0.1
Catins	0	2	1	0	0	0	0	0	0	0	0	7	0.35
	1	0	0	3	0	1	1	0	0	4	0	44	2.2
Pancla	0	0	0	0	0	0	0	0	0	0	0	11	0.55
Total		5	10	24	0	16	5	5	3	4	2	74	3.7
Crayfish		0	0	0	0	0	0	3	0	1	1	19	0.95
Mud turtle		0	0	0	0	0	0	0	0	0	0	1	0.05

Gear type: **Hoop Nets (n=10)**  
Nominal set/run times: 1545-0945 Nominal set duration: 18.0 hours

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10	Total	CPE
Gilasp	0	2	0	1	0	0	0	0	0	0	0	3	0.30
	1	0	2	1	2	1	0	0	0	0	0	6	0.60
Catins	0	0	0	1	0	0	0	1	0	0	0	2	0.20
	1	1	34	3	2	12	16	3	4	0	0	75	7.50
Pancla	0	0	0	0	0	0	3	0	0	0	1	4	0.40
	1	0	0	0	0	1	0	0	0	0	0	1	0.10
Total		3	36	6	4	14	19	4	4	0	1	91	9.10
Crayfish		3	2	1	0	9	10	0	0	0	0	25	2.50
Mud turtle		1	0	0	1	0	0	0	0	0	0	2	0.20

Table 9. Fossil Creek standard fish monitoring data, Below Irving (middle) reach, September 30-October 3, 2007.

Site: **Middle Reach**  
 30 Sept - 01 Oct  
 Date: 2007

Gear type: **Minnow Traps (n = 20)**  
 Nominal set/run times: 1430-0855      Nominal set duration: 17.6 hr

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10
Gilasp	0	1	0	0	0	2	2	0	0	2	6
	1	40	40	23	49	55	17	35	63	57	34
Catins	1	1	0	0	1	0	0	2	1	1	4
Crayfish		0	0	0	0	0	0	0	0	0	1

Species	age (0/1)	11	12	13	14	15	16	17	18	19	20	Total	CPE
Gilasp	0	0	0	0	0	0	0	0	0	0	0	13	0.65
	1	75	43	13	2	21	25	4	7	20	1	624	31.20
Catins	1	2	3	0	1	6	0	0	2	0	0	24	1.20
Total		119	86	36	53	84	44	41	73	80	45	661	33.05
Crayfish		1	0	0	0	0	0	0	1	0	0	3	0.15

Gear type: **Hoop Nets (n=10)**  
 Nominal set/run times: 1430-0855      Nominal set duration: 17.6 hrs

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10	Total	CPE
Gilasp	0	2	0	1	0	3	0	1	0	0	0	7	0.70
	1	28	15	78	12	75	8	46	27	65	2	356	35.60
Rhiose	n/a	1	0	0	0	0	0	0	0	0	0	1	0.10
Catins	0	0	0	0	0	0	1	0	0	0	0	1	0.10
	1	2	0	13	0	1	1	0	1	1	1	20	2.00
Pancla	1	0	0	2	0	0	0	0	0	0	0	2	0.20
Total		33	15	94	12	79	10	47	28	66	3	387	38.70
Crayfish		0	0	1	1	2	0	1	0	4	0	9	0.90
Mud turtle		0	0	0	0	3	1	0	0	0	0	4	0.40

Table 10. Fossil Creek standard fish monitoring data, High Falls (upper) reach, September 30-October 3, 2007.

Site: **Upper Reach**  
 Date: 21-24 May 2007

Gear type: **Minnow Traps (n = 20)**  
 Nominal set/run times: 1415-1030      Nominal set duration: 20.25 hrs

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10
Gilasp	0	0	6	0	2	0	0	0	0	0	0
	1	0	0	0	0	1	1	12	1	0	0
Rhiosc	n/a	0	27	1	5	16	0	1	0	1	9
Catins	1	0	0	4	0	0	0	0	0	0	0
Pancla	0	0	0	0	0	0	0	0	0	0	0

Species	age (0/1)	11	12	13	14	15	16	17	18	19	20	Total	CPE
Gilasp	0	0	0	2	3	0	0	3	0	0	0	16	0.80
	1	0	0	0	0	0	0	0	0	0	0	15	0.75
Rhiosc	n/a	1	9	5	29	0	1	3	5	0	0	113	5.65
Catins	1	0	0	0	0	0	0	0	0	0	0	4	0.20
Pancla	0	0	0	0	3	0	0	0	0	0	0	3	0.15
Total		1	42	12	42	17	2	19	6	1	9	151	7.55

Gear type: **Hoop Nets (n=10)**  
 Nominal set/run times: 1415-1030      Nominal set duration: 20.25 hrs

Species	age (0/1)	1	2	3	4	5	6	7	8	9	10	Total	CPE
Gilasp	0	1	0	0	0	0	0	0	0	0	0	1	0.10
	1	5	20	2	0	0	1	6	0	0	1	35	3.50
Rhiosc	n/a	0	0	0	0	1	0	0	0	0	1	2	0.20
Catins	1	1	6	1	1	3	1	0	0	0	0	13	1.30
Pancla	0	1	0	0	0	0	0	0	0	0	0	1	0.10
	1	0	2	6	0	0	1	0	0	2	1	12	1.20
Total		8	28	9	1	4	3	6	0	2	3	64	6.40
Mud turtle		1	0	1	0	0	0	0	0	0	0	2	0.20

Table 11. Comparison by species of minnow trap (mt) and hoop net (hoop) total catch per unit effort (CPE; fish per overnight set) between autumn (A: September 2005, October 2006, September-October 2007) and spring (S: May-June 2006 and May 2007) among three reaches of Fossil Creek, Arizona (age classes combined).

		Upper Reach		Middle Reach		Lower Reach	
		Mt	hoop	mt	hoop	mt	hoop
Gila	A 2005	6.7	2.6	56.4	61.5	0.0	0.0
	S 2006	0.8	2.9	40.8	63.4	0.0	0.3
	A 2006	0.4	2.2	31.8	63.9	0.0	0.4
	S 2007	0.6	3.7	30.2	44.1	0.0	0.3
	A2007	1.6	3.5	31.9	36.3	0.6	0.9
Rhiosc	A 2005	25.0	0.8	11.4	0.6	0.0	0.0
	S 2006	0.7	0.7	1.1	0.0	0.0	0.0
	A 2006	8.9	1.4	0.6	0.0	0.0	0.0
	S 2007	2.5	0.3	0.1	0.0	0.0	0.0
	A 2007	2.5	0.5	0.2	0.0	0.0	0.0
Catins	A 2005	3.5	8.8	3.6	4.3	4.6	9.4
	S 2006	2.6	1.7	5.3	6.1	4.4	6.3
	A 2006	0.7	2.0	2.2	2.9	5.0	8.4
	S 2007	0.1	3.2	2.2	6.5	4.3	3.4
	A 2007	0.2	1.3	1.2	2.1	2.6	7.7
Pancla	A 2005	0.8	1.8	0.1	1.1	0.0	0.0
	S 2006	0.2	4.0	0.3	0.0	0.0	0.0
	A 2006	0.8	2.5	0.1	0.5	0.0	0.0
	S 2007	1.1	3.2	0.1	0.6	0.1	0.0
	A 2007	0.2	1.3	0.0	0.2	0.6	0.5
Total	A 2005	36.0	14.0	71.5	67.5	4.6	9.4
	S 2006	4.3	9.3	47.6	69.5	4.4	6.6
	A 2006	10.8	8.1	34.7	67.3	5.0	8.8
	S 2007	4.2	10.6	32.6	51.2	4.4	3.7
	A 2007	7.6	6.4	33.1	38.7	3.7	9.1
crayfish	A 2005	0.0	1.3	0.0	2.1	1.7	9.1
	S 2006	0.0	0.0	0.0	0.0	1.0	1.8
	A 2006	0.0	0.0	0.0	0.0	1.4	2.5
	S 2007	0.0	0.0	0.1	0.8	0.8	1.5
	A 2007	0.0	0.0	0.2	0.9	1.0	2.5

Table 12. Fossil Creek native fish salvage and post-renovation re-stocking by reach.

Species	Number salvaged <sup>3</sup>		Mortalities <sup>4</sup>		Number re-stocked <sup>5</sup>		
	R1+R2	R3+R4	R1+R2	R3+R4	R1+R2	R3	R4
Longfin dace	13	0	1	---	12	0	0
<i>Gila</i> spp. <sup>6</sup>	174	103	17	10	157	93	0
Speckled dace	986	0	80	---	906	0	0
Sonora sucker	44	204	4	20	40	184	0
Desert sucker	344	49	34	5	310	44	0
Total	1561	356	136	35	1425	321	0

<sup>3</sup> From Table 2, page 8 in Weedman, D.A., P. Sponholtz & S. Hedwall. 2005. Fossil Creek native fish restoration project. Final Report, Arizona Game and Fish Department, Phoenix. 53 pages.

<sup>4</sup> Number salvaged times 0.10, except for speckled dace *Rhinichthys osculus* for which the loss of 80 individuals was visually estimated (Weedman et al . 2005)

<sup>5</sup> Number salvaged less mortalities; stocking dates were between October 28 and November 17, 2004; dates and distribution of fish among reaches provided by USFWS (unpublished data).

<sup>6</sup> *Gila* spp. includes unknown proportions of headwater chub *Gila nigra* and roundtail chub *G. robusta*, both of which occur in Fossil Creek but which are difficult to individually discriminate in the field.