

**RESULTS OF FISH MONITORING OF SELECTED WATERS
OF THE GILA RIVER BASIN, 1999**

Prepared For

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INTRODUCTION

The Central Arizona Project (CAP) is a series of aqueducts and pipelines that transports Colorado River water from Lake Havasu, Arizona-California, to central and southern Arizona for agricultural, municipal, and industrial uses. The CAP was authorized by Congress in the Colorado River Basin Project Act of 1968, and construction was largely completed by the U.S. Bureau of Reclamation (Reclamation) in 1993. A U.S. Fish and Wildlife Service (FWS) Biological Opinion (BO) on transportation and delivery of CAP water to the Gila River Basin (FWS 1994) determined that the project would jeopardize the continued existence of four threatened or endangered fishes: Gila topminnow *Poeciliopsis occidentalis*, spikedace *Meda fulgida*, loach minnow *Tiaroga cobitis*, and razorback sucker *Xyrauchen texanus*. FWS (1994) also determined that the project would adversely modify designated critical habitat of the latter three species. The primary justification for the jeopardy opinion was the potential for transfers of nonindigenous fishes and other aquatic organisms from the lower Colorado River to various drainages in the Gila River Basin via the CAP, where they could negatively impact threatened or endangered fishes.

A reasonable and prudent alternative (RPA) of the BO directed that Reclamation, in cooperation with the Arizona Game and Fish Department (AZGFD) and FWS, "...develop and implement a baseline study and long-term monitoring of the presence and distribution of non-native fish..." in the CAP aqueduct and selected river and canal reaches in Arizona. The goal of the monitoring plan is "...to establish baseline data on the presence and distribution of non-native fishes in the target reaches and to detect changes in the species composition or distribution" (FWS 1994). Target reaches to be monitored include: 1) CAP aqueduct; 2) Salt River Project (SRP) canals; 3) Florence-Casa Grande (FCG) Canal; 4) Salt River between Stewart Mountain Dam and Granite Reef Dam; 5) Gila River between Coolidge and Ashurst-Hayden dams; and 6) San Pedro River downstream from the U.S.-Mexico border.

The BO directed Reclamation to begin monitoring by October 1994. Monitoring for years 1994 (and earlier) were partially reported in memoranda to files that were distributed to FWS and AGFD (Jakle 1991, 1992, 1993a-b, 1995a-c). Monitoring data for these years were also assembled, summarized, and discussed by Clarkson (1998), who also reported on data for the years 1995 and 1996. Clarkson (1999) and Marsh (1999) reported results of fish monitoring activities during 1997 and 1998, respectively. This report presents results of Reclamation and subcontractor/cooperator monitoring of target streams and canals for 1999 (including January 2000 sampling of the SRP Arizona Canal), which was undertaken according to provisions of the most recent revision (No.2) of the "Long-term monitoring plan for fish populations in selected waters of the Gila River basin, Arizona" (Clarkson 1996).

METHODS

Detailed sampling methodologies were presented in the 1996 monitoring plan and appendices (Clarkson 1996), and will not be reiterated in detail here. In general, streams were stratified according to geomorphology or flow characteristics, and replicate "quantitative" sampling stations were established as the source for distribution and assemblage structure data. The plan calls for electrofishing as the primary gear for this purpose, but use of other methods is encouraged if electrofishing is deemed inadequate. In practice, only the relatively small habitats of the San Pedro River rely nearly exclusively upon electrofishing

for data collection. Other gear types including gill nets, trammel nets, hoop nets, minnow traps, seines, dip nets, trot lines, and angling were deployed to varying extent in other streams and canals. Attempts are made to sample all available habitat within 200 m long stations, but that is only practical in the San Pedro River and certain reaches with "small" habitats in the Gila and Salt rivers. Following collection of quantitative data from fixed stream stations, qualitative sampling is to be performed upstream and/or downstream of each station for the purpose of collecting rare species.

In canals, sampling is more opportunistic, and is usually conducted during low flow or "dry-up" conditions. Sampling reaches are fixed, but only in the CAP canal are fixed stations sampled. For logistical reasons, pumping plant forebays are the primary source of CAP canal fishery data, and sampling there requires the use of a large array of sampling gears to be effective. Sampling in the SRP and FCG canals requires searches for available water and fish concentrations during flow outages, and primarily relies upon seines, dip nets, and entanglement gears for collection of fishes. See Clarkson (1998) for more detailed descriptions of monitored streams and canals and the methods used to sample them.

Reclamation has sought help from various sources to conduct this work. The Phoenix Area Office of Reclamation has primary responsibility for CAP sampling. AZGFD undertook primary sampling of the Gila, Salt, and San Pedro rivers (now under the direction of the Nongame Branch), and Arizona State University (ASU) conducted primary monitoring of SRP and FCG canals. AZGFD has lead a multi-agency sampling of the SRP canals above the electrical fish barriers since 1990. Reclamation's Phoenix Area Office assists all these efforts to varying degrees, and oversees the monitoring program in total.

RESULTS AND DISCUSSION

Monitoring in 1999 was accomplished for all stations identified in the 1996 monitoring plan (Clarkson 1996) as modified by Clarkson (1999), except that the lower station boundary for the Dripping Springs Wash site on the Gila River (site 2-2-1) was moved downstream approximately 125 m from UTM 5727290 E and 3660366 N to 527218 E and 3660225 N to allow a better landmark identification of the site, and to incorporate a greater diversity of habitat types. In addition, it should be noted that the Gila River sampling station at San Pedro River (site 2-3-1) during the time of sampling consists primarily of San Pedro River flows, as Gila River is in a dry-up condition and the site lies immediately downstream of the confluence with San Pedro River. This likely explains the biological affinity of samples there to lower San Pedro River samples.

A comprehensive review of the statistical design, assumptions, and data analysis features of the monitoring program was recently completed (Allison 2000, Abarca and Allison 2000). Recommendations in those reports will be applied to a revision of the monitoring plan and to a comprehensive analysis of 1995-1999 data; only very general conclusions regarding assemblage structure are presented in this report.

Table 1 lists sampling sites, sampling dates, and gears used for stream and canal monitoring during 1999. Table 2 provides a list of common and scientific species names, and their acronyms used in subsequent tabulation. Table 3 is a matrix of recent (since 1970) species occurrences in the target streams and canals.

Monitoring Overview

A total of 28 taxa (considering *Tilapia* spp. as a single taxon) was captured during sampling efforts in 1999 (including the January 2000 samples from the SRP Arizona Canal; Tables 4-5). Species richness was greatest in SRP Arizona (North) Canal above the electrical fish barrier (17), followed by Gila and Salt rivers (16), SRP South Canal below the electrical barrier (14), CAP Canal (13), SRP South Canal above the electrical barrier (12), SRP Arizona Canal below the electrical barrier (11), San Pedro River (9), and FCG Canal above (3) and below (2) the electrical barrier at China Wash (Table 4). Total species richness in the canals with electrical barriers was 18 in the Arizona Canal, 18 in the South Canal, and 3 in the FCG Canal. A total of 4 native species was encountered (roundtail chub, longfin dace, desert sucker, Sonora sucker): 3 each were taken from the Gila (longfin dace, desert sucker, Sonora sucker), Salt (roundtail chub, desert sucker, Sonora sucker), and San Pedro rivers (longfin dace, desert sucker, Sonora sucker) and the SRP canals (roundtail chub, desert sucker, Sonora sucker), and 0 were captured from the CAP and FCG canals. Percentage native fish ranged between 0 (CAP and FCG canals) and 50 (upper San Pedro River).

Channel catfish was encountered within all streams and canals sampled (but not within every sampling reach or station; Table 5). Red shiner was captured from all waters except the Salt River, and green sunfish was found in all waters except the FCG Canal. Goldfish and redear sunfish were found only in the CAP Canal, sailfin molly was captured only from the Salt River, and yellow bass was taken only from the SRP Arizona Canal. Roundtail chub was found only in the Salt River and SRP canals, longfin dace only in the Gila and San Pedro rivers, grass carp only in the CAP and SRP canals, black crappie only in the upper Gila River and SRP Arizona Canal above the electrical barrier, smallmouth bass, rainbow trout and *Tilapia* spp. only in the Salt River and SRP canals, and striped bass only in the CAP and SRP South canals (Table 5). Not surprisingly, assemblage structure was highly variable across streams and canals. No new species were captured in 1999 that had not been previously recorded.

Central Arizona Project Canal

Sampling Notes and Deviations From Protocol--All stations were sampled normally according to protocol.

Species Richness and Distribution--Only two centrarchids and striped bass were captured from the uppermost sampling station (Bouse Hills Pumping Plant) of the CAP Canal, reflecting a continuing decline in species richness (and in general, fish abundance as well) over time as more and more water is transported for storage in Lake Pleasant or delivery downstream. The lower stations of this upper reach supported three cyprinids, additional centrarchids, and channel catfish. Only four of these species were captured at the Salt-Gila Pumping Plant, but additional species (goldfish, redear sunfish, black bullhead, and threadfin shad) were observed at sampling stations further "downstream" (towards Tucson). A maximum of 7 species was taken at any single station, and a total of 13 species was encountered overall. Total species richness was 9 in the upper reach, 5 in the middle reach, and 11 in the lower (Tables 4-5). Common carp, grass carp, largemouth bass, and striped bass were the only species found in all three reaches.

Assemblage Structure--Centrarchids (especially the sunfishes) were numerically dominant fishes overall in the CAP Canal, but red shiner dominated the catch by numbers at the Little Harquahala Pumping Plant station, and common carp dominated the catch at the Brady Pumping Plant (Table 5). As also evidenced in other recent CAP sampling (Clarkson 1999, Marsh 1999), sunfish hybrids (consisting of putative green sunfish X bluegill, redear sunfish X bluegill, redear sunfish X green sunfish, and undetermined hybrids) by far dominated the ichthyofauna at the lowermost San Xavier Pumping Plant sampling station. All species captured from the CAP Canal in 1999 were non-native.

Gila River Between Coolidge and Ashurst-Hayden Dams

Sampling Notes and Deviations From Protocol--Discharge (except leakage) from Coolidge Dam to the Gila River downstream ceased October 22, and sampling commenced October 27 and was completed December 1 (Table 1). All designated sampling stations on the Gila River were monitored in 1999 according to established protocol, except qualitative sampling was not undertaken at Coolidge Dam (site 1-1) and Christmas (site 2-2).

Species Richness and Distribution--Sixteen identified species were collected from the Gila River during 1999 monitoring, with a maximum of 12 and a minimum of 2 taken at any one station (Tables 4-5). The upper reaches had the greatest number of species, and the Kearny site (3-2) had the fewest. Threadfin shad, black crappie, and flathead catfish were encountered only in the uppermost sampling reach, black bullhead only in the upper middle reach, largemouth bass and bluegill only in the upper 2 reaches, and desert sucker only in the upper middle and lowermost reaches (and from only single stations within those reaches). Common carp, red shiner, channel catfish, and yellow bullhead were captured in every reach (but not at every station), while mosquitofish was the only species captured at every station. Sonora sucker was found only at a single station in the upper middle reach and in the lowermost reach; longfin dace was found only in the two middle reaches. Percentage of native species found in sampling reaches ranged from 8 to 38 (Table 4), but a maximum of only two native species were found at any given site.

Assemblage Structure--Red shiner, green sunfish, and mosquitofish numerically dominated the Gila River fish assemblage at most sites during 1999 (Table 5); all other species with few exceptions were captured in relatively low numbers where found. Red shiner and green sunfish were especially dominant in the upper reaches, while overall numbers of fish captured tended to diminish in lower reaches where these two species were not as common. Native species were sporadic and mostly rare when found, although longfin dace and Sonora sucker were common at single sites near perennial tributaries (San Pedro River and Dripping Spring Wash, respectively). Highest relative abundances of native species was 23%, accounted for solely by longfin dace at the San Pedro River site, and 9%, accounted for solely (except for a single desert sucker) by Sonora sucker at Dripping Spring Wash. Fish populations in the upper two reaches were substantially higher than in the lower two reaches (Table 5).

San Pedro River

Sampling Notes and Deviations From Protocol--All San Pedro River stations identified and modified by Clarkson (1996, 1999) were sampled during 1999. All sites were monitored October 12-14, except for the

Soza Wash (2-2) site, which was monitored December 16 (Table 1). No qualitative sampling was performed at Lewis Springs (site 1-2), Aravaipa Creek (site 3-1), Swingle Wash (site 3-2), and the mouth (site 3-3). All San Pedro River flow at the Aravaipa Creek site was confined to the channel sampled (i.e., in some prior years, some or all flows were within a split channel that AZGFD did not have legal access to).

Species Richness and Distribution--A total of 9 species was captured from the San Pedro River among the 8 stations monitored in 1999 (Tables 4-5). A maximum of 8 species was taken from the Swingle Wash site (3-2), and a minimum of 2 from the Lewis Springs (1-2), Hughes Ranch (2-1), and Soza Wash (2-2) sites. Native longfin dace was taken at all sites except Lewis Springs, and yellow bullhead was taken from all sites except Soza Ranch. Mosquitofish was found at all sampling stations in the upper and lower reaches, but was absent from captures in the middle reach. Red shiner was confined to the lowermost reach (taken at all stations). Native suckers were taken sporadically and only in low numbers; Sonora sucker was found only at the Swingle Wash site, while desert sucker was present at Charleston (1-3), Aravaipa Creek, and Swingle Wash (Tables 4-5). Green sunfish and channel catfish were taken only at Swingle Wash, and black bullhead was taken only at Soza Wash. Native species comprised a maximum 50% of the ichthyofauna, and the three extant native species were found together only at the Swingle Wash site (Table 5).

Assemblage Structure--No single species numerically dominated the ichthyofauna across all sites, but longfin dace by far was most abundant (absolutely and relatively) in the middle reach, although only two other species were found in that reach (Table 5). Mosquitofish was generally numerically dominant in the upper reach of San Pedro River, but longfin dace, desert sucker, and yellow bullhead were co-dominant at single stations in the upper reach. Longfin dace and red shiner tended to dominate the assemblage structure in the lower reach, where other species were sporadically present, but they never exhibited large population sizes. The Soza Wash site exhibited nearly an order of magnitude more fish numbers than other sites, which was accounted for nearly exclusively by longfin dace (Table 5).

Florence-Casa Grande Canal

Sampling Notes and Deviations From Protocol--Monitoring of the Florence-Casa Grande (FCG) Canal in 1999 was conducted October 24, the day the headgates at Ashurst-Hayden Dam were closed (Table 1). No significant deviations from written protocol were noted.

Species Richness and Distribution--A total of only 3 species (red shiner, young-of-year channel catfish, and mosquitofish) was captured from the FCG Canal in 1999; all 3 were taken from above the electrical fish barrier at China Wash in abundance, but only 2 (red shiner and mosquitofish) from below and only in low numbers (Tables 4-5). No native species were found in either reach.

Assemblage Structure--Red shiner, mosquitofish and channel catfish comprised the fish fauna above the electrical barrier in decreasing order of abundance, and much lower numbers of red shiner (7) and mosquitofish (11) accounted for all fish captures from below the barrier (Table 5).

Salt River Between Stewart Mountain and Granite Reef Dams

Sampling Notes and Deviations From Protocol--Monitoring of the 3 Salt River stations occurred November 9, 10, and 23, 1999 (Table 1). A canoe-mounted electroshocker and entanglement nets were the primary sampling gears at all stations, supplemented with a backpack shocker in shallow habitats at the upper and middle sites. No significant deviations from sampling protocol were noted during 1999 sampling.

Species Richness and Distribution--Sixteen species were captured in the Salt River sampling stations in 1999, with 11 taken at the upper site, 10 at the middle, and 8 at the lower (Tables 4-5). The upper station was the only station that recorded capture of native roundtail chub, smallmouth bass, and channel catfish. The middle sampling station uniquely recorded *Lepomis* hybrids, mosquitofish, and sailfin molly, while flathead catfish and rainbow trout were species unique to the lower station. Native suckers were common at the upper two stations, but were rare (Sonora sucker) or absent (desert sucker) at the lowermost station. Common carp, Sonora sucker, largemouth bass, green sunfish, and bluegill were the only species found at all stations. Native species comprised 19% (3 of 16) of the total number of species captured from all stations.

Assemblage Structure--With the exception of a large collection of mosquitofish from Blue Point (site 1-2), largemouth bass was the single most common species captured among all three stations during 1999. Native suckers were the next most abundant species at the upper two stations, *Tilapia* spp. were common at the upper and lower stations, and yellow bullhead was common at the middle station. Green sunfish was the only remaining species that comprised more than a rare occurrence within the ichthyofauna of the Salt River during 1999 sampling (Table 5).

Salt River Project South Canal

Sampling Notes and Deviations From Protocol--The South Canal "dry-up" began on October 29, and sampling of the reach below the barrier occurred on November 13 (Table 1). The reach above the electrical barrier was "censused" following draining on November 15. It should be noted that the dry-up is not really a complete dry-up as had been historically practiced, but flows through the canal for the most part are ceased, and water is now typically held above weirs to facilitate SRP's grass carp salvage operations. Thus sampling of the canal below the electrical barrier is highly opportunistic, and is increasingly dependant upon boat electrofishing within pools above selected weirs, accompanied by seining and dip netting where possible. Sampling above the electrical barrier is with long bag seines. No major deviations from established sampling protocol were noted during 1999.

Species Richness and Distribution--Eighteen species were taken in total from the SRP South Canal (above and below the electrical barrier) in 1999. Twelve species were captured above the barrier, and 14 below (Tables 4-5). Red shiner, grass carp, green sunfish, yellow bullhead, striped bass, and threadfin shad were unique to the canal below the barrier, while common carp, a sunfish hybrid, smallmouth bass, and rainbow trout were found only above the barrier. Roundtail chub, Sonora sucker, desert sucker, largemouth bass, bluegill, flathead catfish, channel catfish, and *Tilapia* spp. were common to rare in both reaches. Striped bass and threadfin shad were species found in the South Canal but not in the Salt River immediately

upstream. Native species comprised 25% of the ichthyofauna within the South Canal above the electrical barrier, and 21% below the barrier (Table 4).

Assemblage Structure--The three native species, channel catfish, and *Tilapia* spp. for the most part dominated the assemblage structure of the South Canal fish community both above and below the electrical barrier during 1999, followed by largemouth bass (Table 5). Common carp was also conspicuous in numbers from above the electrical barrier, while red shiner was common below the barrier. Grass carp, green sunfish, bluegill, smallmouth bass, flathead catfish, yellow bullhead, rainbow trout, striped bass, and threadfin shad were relatively rare. Total numbers of fishes from the short reach of the canal above the electrical barriers were three times larger than captures from below, but note that captures from above the barrier represent a near-complete census of the fauna, while samples from below are sporadic and opportunistic. In addition, as fishes enter the canal through Granite Reef Diversion Dam, they tend to become concentrated above the barrier due to the presence of the electrical field downstream. Degree of concentration likely varies across species, further compounding interpretation and comparisons of fish assemblage structure.

Salt River Project Arizona Canal

Sampling Notes and Deviations From Protocol--The dry-up period for the Arizona Canal began January 7, 2000, and sampling of the canal both above and below the electrical barrier occurred that day. This was due to the "dry-up" schedule of SRP, where little actual dry-up occurred. Sampling gears were as described for the SRP South Canal. No major deviations from established sampling protocol were noted during 1999 (actually 2000).

Species Richness and Distribution--The Arizona Canal had the highest species richness of any stream or canal reach monitored during 1999, with 17 species recorded above the electrical barrier and 11 below (Tables 4-5). In both reaches, a total of 18 species was captured. Red shiner was the only species taken below the barrier but not also from above, while roundtail chub, black crappie, bluegill, sunfish hybrids, smallmouth bass, flathead catfish, and yellow bass were only taken above the barrier. Common carp, grass carp, Sonora sucker, desert sucker, largemouth bass, green sunfish, channel catfish, rainbow trout, and *Tilapia* spp. were common to the reaches above and below the electrical barriers. Note especially the incursion of grass carp above the electrical barrier; an electrical failure of the barrier occurred July 23, 1999, for 1 hour and 42 minutes. Red shiner, grass carp, black crappie, striped bass, and threadfin shad were species captured from the canal but not from the Salt River immediately upstream. Native species accounted for 18% of the total fish fauna from both below and above the electrical barrier on the Arizona Canal during 1999 (Table 4).

Assemblage Structure--The two native suckers, flathead and channel catfishes, rainbow trout, *Tilapia* spp., and yellow bass comprised the greatest percentages of fishes captured in the Arizona Canal above the electrical barrier in 1999 (Table 5). Downstream, Sonora sucker, red shiner, and common carp were most abundant (in rank order). Cautions made for the SRP South Canal regarding comparisons of fish assemblage structure above and below the electrical barrier apply equally to the Arizona Canal.

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Table 1. Dates of sampling of target reaches and stations (numeric designations in parentheses) monitored for fish populations in 1999. Note that samples for the Salt River Project Arizona Canal were collected in 2000, but are considered part of 1999 samples. AZ Canal=Arizona Canal; SO Canal=South Canal. Gears: Bp=backpack electroshocker; S=seine; Ef=boat electroshocker; T=trammel net; G=gill net; M=minnow trap; A=angling; TI=trot line; D=dip net; V=visual observation.

STREAM OR CANAL REACH	STATION	GEAR	DATES SAMPLED
San Pedro River			
Hereford to Fairbank	Hereford (1-1)	Bp	October 12
	Lewis Springs (1-2)	Bp	October 12
	Charleston (1-3)	Bp	October 13
Cascabel to Redington	Hughes Ranch (2-1)	Bp	October 13
	Soza Wash (2-2)	Bp	December 16
Aravaipa Creek to Gila River	Aravaipa Creek (3-1)	Bp	October 14
	Swingle Wash (3-2)	Bp	October 14
	Gila River (3-3)	Bp	October 14
Gila River			
Coolidge Dam to Needles Eye	Coolidge Dam (1-1)	Bp, Ef, S	October 27
	Hook & Line Ranch (1-3)	Bp, S, T	October 28
Little Ash Creek to Hayden	Dripping Spring Wash (2-1)	Bp, Ef, T	November 30-December 1
	Christmas (2-2)	Bp	November 30
	O'Carroll Canyon (2-3)	Bp, T	November 30
Hayden to Mineral Creek	San Pedro River (3-1)	Bp	November 17
	Kearney (3-2)	Bp, S	November 17
	Kelvin (3-3)	Bp, S	November 17
Mineral Creek to Ashurst-Hayden Dam	Diamond A Ranch (4-1)	Bp, Ef, T	November 18
	Cochran (4-2)	Bp, S	November 18
	Box O Wash (4-3)	Bp, S	November 19
Salt River			
Stewart Mtn. Dam to Granite Reef Dam	Stewart Mtn. Dam (1-1)	Bp, Ef, T	November 19
	Blue Point (1-2)	Bp, Ef, S, T	November 10
	Granite Reef Dam (1-3)	Ef, T	November 23
CAP canal			
Hayden-Rhodes Aqueduct	Bouse Hills (1-1)	Ef, M, H, T, TI, A	September 21
	Little Harquahala (1-2)	Ef, M, H, T	September 22
	Hassayampa (1-3)	Ef, M, H, T, TI, A	September 23
Fannin-McFarland Aqueduct	Salt-Gila (2-1)	Ef, M, H, T, TI	December 26
Tucson Aqueduct	Brady (3-1)	Ef, M, H, T, TI, A	December 27
	Red Rock (3-2)	Ef, M, H, T, TI, A	December 28
	San Xavier (3-3)	Ef, M, H, T, TI, A	December 29
Florence-Casa Grande canal			
	above barrier (1-1)	S, D	October 24
	below barrier (1-2)	S, D	October 18, 27-28
SRP canals			
	AZ Canal above barrier (1-1)	S	January 7
	AZ Canal below barrier (1-2)	Ef	January 7
	SO Canal above barrier (1-1)	S	November 15
	SO Canal below barrier (1-2)	Ef, S, T	November 13

Table 2. Common names, scientific names, and acronyms for species of fish collected during monitoring of streams and canals in the Gila River basin. Acronyms formed by combining the first two letters of the genus name and specific epithet (except hybrids).

ACRONYM	SCIENTIFIC NAME	COMMON NAME
GIRO	<i>Gila robusta</i>	Gila chub
PIPR	<i>Pimephales promelas</i>	Fathead minnow
CAAU	<i>Carassius auratus</i>	Goldfish
AGCH	<i>Agosia chrysogaster</i>	Longfin dace
CYCA	<i>Cyprinus carpio</i>	Common carp
CYLU	<i>Cyprinella lutrensis</i>	Red shiner
CTID	<i>Ctenopharngodon idellus</i>	Grass carp
CAIN	<i>Catostomus insignis</i>	Sonora sucker
PACL	<i>Pantosteus clarki</i>	Desert sucker
CLIN	<i>Pantosteus clarki</i> X <i>Catostomus insignis</i>	Sucker hybrid
MISA	<i>Micropterus salmoides</i>	Largemouth bass
LEMI	<i>Lepomis microlophus</i>	Redear sunfish
LECY	<i>Lepomis cyanellus</i>	Green sunfish
LEMA	<i>Lepomis macrochirus</i>	Bluegill sunfish
LEPO	<i>Lepomis</i> sp.	<i>Lepomis</i> hybrid
MIDO	<i>Micropterus dolomieu</i>	Smallmouth bass
PONI	<i>Pomoxis nigromaculatus</i>	Black crappie
AMME	<i>Ameirus melas</i>	Black bullhead
PYOL	<i>Pylodictis olivaris</i>	Flathead catfish
ICPU	<i>Ictalurus punctatus</i>	Channel catfish
AMNA	<i>Ameirus natalis</i>	Yellow bullhead
GAAF	<i>Gambusia affinis</i>	Mosquitofish
POLA	<i>Poecilia latipinna</i>	Sailfin molly
ONMY	<i>Oncorhynchus mykiss</i>	Rainbow trout
STVI	<i>Stizostedion vitreum</i>	Walleye
TILA	<i>Tilapia</i> sp.	Tilapia species
MOMI	<i>Morone mississippiensis</i>	Yellow bass
MOCH	<i>Morone chrysops</i>	White bass
MOSA	<i>Morone saxatilis</i>	Striped bass
DOPE	<i>Dorosoma petenense</i>	Threadfin shad

Table 3. Recent (since 1970) occurrence of fishes in target canals and streams in the Gila River Basin. SPR=San Pedro River north of Mexican border, GILA=Gila River between Coolidge Dam and Ashurst-Hayden Dam, SALT=Salt River between Stewart Mountain Dam and Granite Reef Dam, CAP=Central Arizona Project aqueduct, FCG=Florence-Casa Grande canal, SRP=Salt River Project canals. Table updated from Clarkson (1996, 1999).

Common name	Scientific name	SPR	GILA	SALT	CAP	FCG	SRP
Roundtail chub ¹	<i>Gila robusta</i>	-	-	+	-	-	+
Fathead minnow	<i>Pimephales promelas</i>	+	+	-	-	+	+
Goldfish	<i>Carassius auratus</i>	-	-	-	+	-	+
Longfin dace ¹	<i>Agosia chrysogaster</i>	+	+	+	-	+	+
Grass carp	<i>Ctenopharyngodon idella</i>	-	-	-	+	-	+
Grass carp X bighead carp	<i>Ctenopharyngodon idella X Aristichthys nobilis</i>	-	-	-	-	-	+
Carp	<i>Cyprinus carpio</i>	+	+	+	+	+	+
Red shiner	<i>Cyprinella lutrensis</i>	+	+	+	+	+	+
Spikedace ¹	<i>Meda fulgila</i>	-	+	-	-	-	-
Razorback sucker ¹	<i>Xyrauchen texanus</i>	-	-	-	+	-	-
Sonora sucker ¹	<i>Catostomus insignis</i>	+	+	+	+	+	+
Desert sucker ¹	<i>Pantosteus clarki</i>	+	+	+	+	+	+
Bigmouth buffalo	<i>Ictiobus cyprinellus</i>	-	-	-	-	-	+
Largemouth bass	<i>Micropterus salmoides</i>	+	+	+	+	+	+
Bluegill	<i>Lepomis macrochirus</i>	+	+	+	+	+	+
Green sunfish	<i>Lepomis cyanellus</i>	+	+	+	+	+	+
Smallmouth bass	<i>Micropterus dolomieu</i>	-	-	+	-	-	+
Redear sunfish	<i>Lepomis microlophus</i>	-	-	-	+	-	+
Sunfish hybrid	<i>Lepomis hybrid</i>	-	+	+	+	-	+
Black crappie	<i>Pomoxis nigromaculatus</i>	-	+	+	+	-	%
Black bullhead	<i>Ameiurus melas</i>	+	+	-	+	-	+
Flathead catfish	<i>Pylodictis olivaris</i>	?	+	+	+	+	+
Channel catfish	<i>Ictalurus punctatus</i>	+	+	+	+	+	+
Yellow bullhead	<i>Ameiurus natalis</i>	+	+	+	+	+	+
Mosquitofish	<i>Gambusia affinis</i>	+	+	+	+	+	+
Sailfin molly	<i>Poecilia latipinna</i>	-	-	+	-	-	-
Rainbow trout	<i>Oncorhynchus mykiss</i>	-	-	+	-	-	+
Walleye	<i>Stizostedion vitreum</i>	-	-	+	-	-	+
Threadfin shad	<i>Dorosoma petenense</i>	-	+	+	+	+	+
Tilapia spp.	<i>Tilapia species</i>	-	-	+	-	-	+
Yellow bass	<i>Morone mississippiensis</i>	-	-	+	-	-	+
White bass	<i>Morone chrysops</i>	-	-	-	+	-	-
Striped bass	<i>Morone saxatilis</i>	-	-	-	+	-	+
Oscar	<i>Astronotus ocellatus</i>	-	-	-	-	-	+

¹Native species

Table 4. Numbers of species captured from target stream and canal reaches in 1999. Stream/canal acronyms as in Table 2, except SRPN=Salt River Project North (Arizona) Canal and SRPS=Salt River Project South Canal. 'Above' and 'below' refer to species occurrences above or below electrical fish barriers.

Reach-Station	SANP	GILA	SALT	CAP	SRPN		SRPS		FCG	
					above	below	above	below	above	below
1-1	3	10	11	3	17	11	12	14	3	2
1-2	2	-	10	7	-	-	-	-	-	-
1-3	4	12	8	7	-	-	-	-	-	-
TOTAL	4	13	16	9	17	11	12	14	3	2
% Native	50	8	19	0	18	18	25	21	0	0
2-1	2	9	-	5	-	-	-	-	-	-
2-2	2	8	-	-	-	-	-	-	-	-
2-3	-	9	-	-	-	-	-	-	-	-
TOTAL	3	12	-	5	-	-	-	-	-	-
% Native	33	25	-	0	-	-	-	-	-	-
3-1	5	7	-	3	-	-	-	-	-	-
3-2	8	2	-	5	-	-	-	-	-	-
3-3	4	3	-	6	-	-	-	-	-	-
TOTAL	8	7	-	11	-	-	-	-	-	-
% Native	38	14	-	0	-	-	-	-	-	-
4-1	-	5	-	-	-	-	-	-	-	-
4-2	-	5	-	-	-	-	-	-	-	-
4-3	-	7	-	-	-	-	-	-	-	-
TOTAL	-	8	-	-	-	-	-	-	-	-
% Native	-	38	-	-	-	-	-	-	-	-
All reaches	9	16	16	13	17	11	12	14	3	2
% Native	33	19	19	0	18	18	25	21	0	0

Table 5. Numbers of fish captured at each sampling station (including qualitative samples) in target reaches during 1999 (except Salt River Project Arizona Canal data, which were collected in January 2000). See Table 1 for species acronyms. Single numbers refer to totals of small-bodied fishes where age was not estimated; paired numbers refer to totals of putative age-0 fish, followed by totals of putative age-1+ fish. Dashes denote no captures of a species at a particular site.

SAMPLING STATION	GIRO	PIPR	CAAU	AGCH	CYCA	CYLU	CTID	CAIN	PACL	MISA
CAP Canal-Upper										
Bouse Hills PP	-	-	-	-	-	-	-	-	-	-
Little Harquahala PP	-	-	-	-	0-2	200	0-3	-	-	-
Hassayampa PP	-	-	-	-	0-4	5	0-16	-	-	1-4
CAP Canal-Middle										
Salt-Gila PP	-	-	-	-	0-6	-	0-9	-	-	0-2
CAP Canal-Lower										
Brady PP	-	-	-	-	0-38	-	0-3	-	-	-
Red Rock PP	-	-	-	-	-	3	-	-	-	5-6
San Xavier PP	-	-	0-2	-	-	-	0-3	-	-	-
Gila River-Upper										
Coolidge Dam	-	-	-	-	0-6	68	-	-	-	4-8
Hook & Line Ranch	-	-	-	-	0-5	200	-	0-4	-	4-6
Gila River-Middle Upper										
Dripping Spring Wash	-	-	-	-	0-24	255	-	0-40	0-1	0-8
Christmas	-	-	-	1	-	193	-	-	-	1-2
O'Carrol Canyon	-	-	-	1	0-2	367	-	-	-	0-2
Gila River-Middle Lower										
San Pedro River	-	-	-	50	0-2	75	-	-	-	-
Kearny	-	-	-	-	-	23	-	-	-	-
Kelvin	-	-	-	-	-	28	-	-	-	-
Gile River-Lower										
Diamond A Ranch	-	-	-	-	0-13	-	-	0-2	-	-
Cochran	-	-	-	-	-	79	-	-	1-0	-
Box O Wash	-	-	-	1	0-22	8	-	0-8 ^a	-	-
San Pedro River-Upper										
Hereford	-	-	-	1	-	-	-	-	-	-
Lewis Springs	-	-	-	-	-	-	-	-	-	-
Charleston	-	-	-	29	-	-	-	-	1-20	-
San Pedro River-Middle										
Hughes Ranch	-	-	-	101	-	-	-	-	-	-
Soza Ranch	-	-	-	1099	-	-	-	-	-	-
San Pedro River-Lower										
Aravaipa Creek	-	-	-	97	-	10	-	-	0-3	-
Swingle Wash	-	-	-	7	-	28	-	1-0	1-0	-
Mouth	-	-	-	23	-	14	-	-	-	-
Florence-Casa Grande Canal										
Above barrier	-	-	-	-	-	177	-	-	-	-
Below barrier	-	-	-	-	-	7	-	-	-	-
Salt River										
Stewart Mtn. Dam	0-1	-	-	-	0-1	-	-	3-30 ^a	7-31	127-16
Blue Point	-	-	-	-	0-5	-	-	20-40	56-9	130-19
Granite Reef Dam	-	-	-	-	0-5	-	-	0-6	-	26-25
Salt River Project Canals										
AZ Canal above barrier	3-15	-	-	-	0-10	-	0-1	57-32	59-62	14-30
AZ Canal below barrier	-	-	-	-	0-8	13	0-1	1-33	0-3	2-2
SO Canal above barrier	0-20	-	-	-	0-27	-	-	6-56	0-18	0-15
SO Canal below barrier	4-61	-	-	-	-	23	0-4	104-9	25-22	8-6
TOTAL	104	0	2	1410	180	1776	40	452	319	473

Table 5. Extended.

SAMPLING STATION	PONI	LEMI	LECY	LEMA	LEPO	MIDO	AMME	PYOL	ICPU	AMNA
CAP Canal-Upper										
Bouse Hills PP	-	-	-	1-14	24-2	-	-	-	-	-
Little Harquahala PP	-	-	5-0	17-0	2-0	-	-	-	0-1	-
Hassayampa PP	-	-	1-0	-	2-0	-	-	-	0-2	-
CAP Canal-Middle										
Salt-Gila PP	-	-	-	-	-	-	-	-	0-2	-
CAP Canal-Lower										
Brady PP	-	-	-	-	-	-	-	-	-	-
Red Rock PP	-	0-32	-	0-15	-	-	-	-	-	-
San Xavier PP	-	-	-	1-2	102-472	-	0-4	-	-	-
Gila River-Upper										
Coolidge Dam	-	-	131-9	10-1	-	-	-	3-3	0-1	1-1
Hook & Line Ranch	0-1	-	209-16	5-0	100-1	-	-	-	5-1	0-3
Gila River-Middle Upper										
Dripping Spring Wash	-	-	88-0	-	-	-	-	-	2-4	0-2
Christmas	-	-	26-0	1-0	-	-	-	-	1-1	1-0
O'Carrol Canyon	-	-	72-1	-	-	-	0-1	-	4-2	0-11
Gila River-Middle Lower										
San Pedro River	-	-	1-0	-	-	-	-	-	11-0	0-4
Kearny	-	-	-	-	-	-	-	-	-	-
Kelvin	-	-	-	-	-	-	-	-	19-0	-
Gila River-Lower										
Diamond A Ranch	-	-	-	-	-	-	-	-	0-3	0-5
Cochran	-	-	-	-	-	-	-	-	5-0	0-2
Box O Wash	-	-	-	-	-	-	-	-	0-1	0-4
San Pedro River-Upper										
Hereford	-	-	-	-	-	-	-	-	-	0-19
Lewis Springs	-	-	-	-	-	-	-	-	-	2-0
Charleston	-	-	-	-	-	-	-	-	-	1-0
San Pedro River-Middle										
Hughes Ranch	-	-	-	-	-	-	-	-	-	2-0
Soza Ranch	-	-	-	-	-	-	2-3	-	-	-
San Pedro River-Lower										
Aravaipa Creek	-	-	-	-	-	-	-	-	-	9-0
Swingle Wash	-	-	4-0	-	-	-	-	-	2-0	3-0
Mouth	-	-	-	-	-	-	-	-	-	1-0
Florence-Casa Grande Canal										
Above barrier	-	-	-	-	-	-	-	-	63-0	-
Below barrier	-	-	-	-	-	-	-	-	-	-
Salt River										
Stewart Mtn. Dam	-	-	1-11	0-2	-	1-1	-	-	1-0	5-1
Blue Point	-	-	2-14	0-5	0-2	-	-	-	-	21-2
Granite Reef Dam	-	-	5-2	7-5	-	-	-	0-1	-	-
Salt River Project Canals										
AZ Canal above barrier	0-1	-	0-1	0-1	0-2	0-1	-	20-79	236-31	-
AZ Canal below barrier	-	-	0-1	-	-	-	-	-	1-0	-
SO Canal above barrier	-	-	-	0-2	0-1	0-1	-	0-5	11-53	-
SO Canal below barrier	-	-	3-0	3-0	-	-	-	2-1	9-0	0-5
TOTAL	2	32	603	92	710	4	10	114	472	105

Table 5. Extended.

SAMPLING STATION	GAAF	POLA	ONMY	STVI	TILA ^b	MOMI	MOSA	DOPE	TOTAL
CAP Canal-Upper									
Bouse Hills PP	-	-	-	-	-	-	0-6	-	47
Little Harquahala PP	-	-	-	-	-	-	-	-	230
Hassayampa PP	-	-	-	-	-	-	-	-	35
CAP Canal-Middle									
Salt-Gila PP	-	-	-	-	-	-	0-2	-	21
CAP Canal-Lower									
Brady PP	-	-	-	-	-	-	0-1	-	42
Red Rock PP	-	-	-	-	-	-	-	4	65
San Xavier PP	-	-	-	-	-	-	-	7	593
Gila River-Upper									
Coolidge Dam	21	-	-	-	-	-	-	62	329
Hook & Line Ranch	241	-	-	-	-	-	-	1	802
Gila River-Middle Upper									
Dripping Spring Wash	36	-	-	-	-	-	-	-	460
Christmas	18	-	-	-	-	-	-	-	245
O'Carrol Canyon	333	-	-	-	-	-	-	-	796
Gila River-Middle Lower									
San Pedro River	71	-	-	-	-	-	-	-	214
Kearny	39	-	-	-	-	-	-	-	62
Kelvin	31	-	-	-	-	-	-	-	78
Gile River-Lower									
Diamond A Ranch	21	-	-	-	-	-	-	-	44
Cochran	24	-	-	-	-	-	-	-	111
Box O Wash	130	-	-	-	-	-	-	-	174
San Pedro River-Upper									
Hereford	51	-	-	-	-	-	-	-	71
Lewis Springs	40	-	-	-	-	-	-	-	42
Charleston	3	-	-	-	-	-	-	-	54
San Pedro River-Middle									
Hughes Ranch	-	-	-	-	-	-	-	-	103
Soza Ranch	-	-	-	-	-	-	-	-	1104
San Pedro River-Lower									
Aravaipa Creek	3	-	-	-	-	-	-	-	122
Swingle Wash	3	-	-	-	-	-	-	-	49
Mouth	4	-	-	-	-	-	-	-	42
Florence-Casa Grande Canal									
Above barrier	111	-	-	-	-	-	-	-	351
Below barrier	11	-	-	-	-	-	-	-	18
Salt River									
Stewart Mtn. Dam	-	-	-	-	0-24	-	-	-	263
Blue Point	277	2	-	-	-	-	-	-	604
Granite Reef Dam	-	-	0-2	-	2-29	-	-	-	115
Salt River Project Canals									
AZ Canal above barrier	-	-	0-56	-	0-454	88-3	-	13	1269
AZ Canal below barrier	-	-	0-1	-	0-1	-	-	1	68
SO Canal above barrier	-	-	0-8	-	346-574	-	-	-	1143
SO Canal below barrier	-	-	-	-	4-11	-	0-1	1	306
TOTAL	1468	2	67	0	1445	91	10	89	10,072

^a Total includes 1 *Pantosteus clarki* X *Catostomus insignis* hybrid

^b Species determinations for *Tilapia* not definitive. Category likely includes *T. aurea* and *T. zilli*