

APPENDIX C. Integrated field manual.

STANDARD OPERATING PROCEDURES

INTEGRATED FIELD MANUAL

CANALS, RIVERS AND STREAMS

**REVISION NO. 3, LONG-TERM MONITORING PLAN
FOR FISH POPULATIONS IN SELECTED WATERS
OF THE GILA RIVER BASIN, ARIZONA**

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IN SELECTED WATERS OF THE GILA RIVER BASIN, ARIZONA

INTRODUCTION--This revised standard operating procedures manual is part of an overall quality control/quality assurance program for the *Long-Term Monitoring Plan for Fish Populations in Selected Waters of the Gila River Basin, Arizona* (Monitoring Plan). It was produced to ensure that all field data are gathered according to standardized, repeatable methods. The current version combines earlier separate documents for canals and for rivers and streams, recognizing that due to the unique habitats and sampling challenges presented by canals monitoring there must be opportunistic, varying according to sampling accessibility to structural features that may concentrate fishes. Therefore, many compromises regarding standardization and repeatability may be necessary in canals relative to streams and rivers.

This manual describes specific steps to be taken during all field monitoring activities, and provides background information on objectives, justification, and sampling design. Reclamation intends this manual to be carried in the field at all times by data collectors for reference. It will be updated periodically for clarity and to reflect changes to the Monitoring Plan that may become necessary over time. Reclamation will provide waterproof copies of the manual to all field investigators upon request. In the methods descriptions below, arrows (➔) denote field procedures that must be undertaken explicitly.

OBJECTIVES--Collect information on the status of fish populations at selected sampling sites to determine: 1) presence of species (species richness); 2) species relative abundance (assemblage structure); 3) species distributions; and 4) species annual reproductive success.

SAMPLING CREWS--A sampling crew of at least two (preferably three or more) individuals is required for efficient collection of field monitoring data from canals and three (preferably four) for collection from rivers and streams. Logistical difficulties in sampling the Central Arizona Project (CAP) canal in particular may require additional personnel. These individuals should be experienced in fish collection techniques and identification of the local fish fauna. It is vital that sampling crews be headed by an individual with such proven field experience. The field crew leader must be present during all monitoring exercises.

SAMPLING DESIGN--Canals. CAP Canal sampling reaches were delineated according to the established geopolitical divisions representing the Hayden-Rhodes, Fannin-McFarland, and Tucson aqueducts. Sampling of the Salt River Project (SRP) canals primarily will be limited to the South Canal between Granite Reef Diversion Dam and the junction of the Tempe and Consolidated canals (Triple Junction), and the Arizona (North) Canal between Granite Reef Diversion Dam and Indian Bend Wash. Other areas of the SRP canal system should be opportunistically sampled where possible. The reach of concern in the Florence-Casa Grande (FCG) canal extends from Ashurst-Hayden Diversion Dam to the Pima Lateral Feeder Canal. See Table 1 for canal sample locations and travel routes.

Due to logistical difficulties of sampling the deep, high current-velocity habitats characteristic of the CAP aqueduct, CAP Canal stations are located at structural features that facilitate sampling (pumping plant forebays). Because annual dry-up procedures vary from year to year on the SRP canals, no fixed sampling stations are established there except between the electrical fish barriers and Granite Reef Dam on the Arizona and South canals. For this reason, sampling below the electrical fish barriers in the SRP canals will be opportunistic, varying according to sampling accessibility to structural features that may concentrate fishes. FCG canal sampling will also follow this pattern (no fixed sampling stations). Precise descriptions of sampling sites must be recorded by canal investigators.

SAMPLING DESIGN--Rivers and Streams. Because native and nonnative fishes respond in different ways to environmental disturbances (e.g., flooding) in different geomorphic reach types (e.g., highly confined canyons vs. poorly confined valleys), sampling reaches are stratified according to geomorphology. This should facilitate an understanding of the variance of fish species richness, distribution, and assemblage structure.

Two or three fixed, systematic sampling stations are permanently established within each geomorphic river or stream reach to estimate within-reach variance of monitored parameters. A systematic sampling design can substantially reduce data variability, and thus the sample size required to obtain a given level of precision. Systematic sampling should also provide a reasonable expectation that stations are representative of the reach, and will ensure a wide spatial distribution of sampling

sites. See Table 2 for river and stream station locations and travel routes.

Fixed station sampling consists of a combination of intensive quantitative sampling over a 200 m reach of stream, and extensive opportunistic sampling of uncommon habitats in contiguous reaches. Data from each 200 m quantitative sample will determine assemblage structure of common species, and extensive opportunistic samples will enhance the ability to determine species richness and presence of rare species.

Species occurrence and abundance are influenced by availability of habitats. Thus, to minimize bias of assemblage structure estimates and ensure a representative sample, sampling effort should be proportional to the amount of different habitats available. Quantitative fixed-station sampling therefore is stratified to the primary mesohabitat level (attached or isolated pool, riffle, or run) to partition the variance among species collections. Quantification of mesohabitat length provides an estimate of habitat availability, and tracks habitat changes over time. By quantifying sampling effort according to mesohabitat, comparisons of species richness and assemblage structure among mesohabitat types across stations and years may be facilitated.

PERMITS--Current State and Federal collecting permits that authorize all Gila River basin fishes must be in possession of sampling crews when performing monitoring. Subcontractors will be responsible for obtaining their own State and Federal collecting permits.

FISH COLLECTION FIELD FORM--All mandatory data collections must be recorded in pencil on the Fish Collection Form attached (Figure 1). This will ensure that all required information is recorded and compatible with the database structure. The master copy should be photocopied on rite-in-the-rain paper or a similar waterproof bond for use in the field. The fish collection form quantifies gear types, sampling effort, and species abundance data, and provides space for general notes. Each page of the field form has two, identical sections for data entry. At the bottom of each page are places to be initialed by the individual(s) who record field data, check field entries and codes, and enter data into the database.

- Each section of the fish collection form includes fields for stream, reach, and station names (numerically coded for data entry; see Table 3 for complete descriptions), sampling date and time in and date and time out (for passive gears that are deployed for a period of time), habitat type name (connected pool, riffle, run or isolated pool; coded for data entry), a unique number for each mesohabitat encountered within a station, a yes/no fixed-station field, and gear type. All of these variables must be filled in on each form (codes can be recorded at a later time if the text fields are completed properly while in the field). CAP Canal sample location codes are provided in Table 1 and must be filled in on the field form. For SRP and FCG canals the station name code field should be recorded with a vehicle or map mileage from the upper boundary of the canal reach (e.g., miles below Ashurst-Hayden Diversion Dam, or miles below South or Arizona Canal electrical fish barrier); local landmark names should be entered in the text portion of the station name field. Fixed-station codes for river and stream sites are provided in Table 2 and must be filled in (see below). There is no requirement to type canal habitats, and thus the habitat type and habitat number fields need not be filled in. Recording of gear type effort is mandatory (see below). The Fixed Station Y/N field should be entered with a "Y" when sampling quantitatively within fixed stations on streams and the CAP Canal, and for stations above electrical fish barriers on SRP canals. For opportunistic samples outside fixed stream stations, below electrical fish barriers on SRP canals, and on the FCG Canal, the Fixed Station Y/N field should always be entered with an "N" to denote a qualitative sample. If continuation forms are needed to complete recording of data at a particular site, they must be tracked in the notes section of the data sheet. The field crew leader or designated individual should record his/her initials where indicated at the bottom of each field form sheet following review and assurance that the data were filled in properly. It is intended that a separate fish collection form or section of the form be used for each separate gear type and sampling site.
- If **electrofishing**, pulse rate, voltage, output amperage, and stream water temperature must be recorded. Record the number of seconds shocked at each sampling site to quantify effort, and for fixed station samples fill in the percentage habitat sampled field (need not be filled in for canals).
- If **seines or dip nets** are deployed, recording of mesh size and length and width (depth) of the gear is required. Effort shall be quantified by recording the number of seine hauls or dip net sweeps taken at the site sampled (standardize dip net sweeps to 1 m long sweeps). The percentage habitat sampled field must be filled in for all fixed-station samples but need not be filled in for canals.
- If **entrapment and entanglement gears** are used, the mesh size and net length and width (depth) must be filled in. Effort (to the nearest 1/10th hour) is calculated automatically by the data entry routine from date and time in and date and time out, which must be entered for all passive gear types.

- Should sampling by **angling or trot line** be undertaken, bait type (Table 3) and number of hooks should be recorded. Effort (to the nearest 1/10th hour) is calculated automatically by the data entry routine from date and time in and date and time out, which must be entered for these gear types.
- Captured fishes from a single-gear sample from a site should be kept alive in buckets of water or holding nets until ready for processing. Fishes should be sorted to species, then sorted to age class (age-0 or age-1+ categories), and enumerated. Counts for each species and age class should be recorded on the fish collection form for that site sample and gear type. Data that must be recorded from captured fishes include a four-letter code for **species**, consisting of the first two letters of the generic name and the first two letters of the trivial name, an **age** category designation (age-0 or young-of-year, and older, age-1+ fish), and the **number of fish** enumerated for each species and age collected by a particular sampling gear at each sample site (Table 3). It is mandatory that the number of each species/age class preserved for voucher be identified in the **voucher** field (see below). Optional variables such as fish length, weight, sex, reproductive condition, number and kind of external parasites, external anomalies, and other notes should be recorded in the **comments** field.

RIVER AND STREAM FIXED STATION LOCATION AND IDENTIFICATION--Travel routes to and UTM locations for fixed sampling stations are shown in Table 2. Downstream station boundaries are to be verified on site using Global Positioning (GPS).

- Record the stream name, reach name, and station name on each fish collection form used at a given monitored sampling station (Table 2). Also record the date and time the station mesohabitat sampling was begun on each form.
- Upstream station boundaries will be 200 stream meters above the downstream boundary. Measure along the thalweg (the deepest part of the channel) with either a tape measure or hip chain. Some upstream boundary locations may vary depending on changes in channel sinuosity over time, and therefore they should not be permanently marked. Temporarily mark the station up- and downstream boundaries with a flagged stake.
- Photo-documentation of upper and lower station boundaries is required. Fill in the appropriate **station identifier form** (provided) with station boundary (upper or lower), boundary view (up or down), and the sampling date (month in Roman numerals, day, and four-digit year) with a dry-erase marker. Include this form in the lower left corner of each photo (and in focus) to ensure the image is permanently identified. Take one color digital image of the stream reach facing upstream while standing at the lower station boundary, and one facing downstream. Repeat for the upper station boundary.

RIVER AND STREAM MESOHABITAT IDENTIFICATION--Sampling stations must be partitioned to the primary mesohabitat level (attached pool, riffle, run, or isolated pool as defined in Table 3).

- Prior to fish sampling (below), mesohabitat unit boundaries should be temporarily identified with flagged stakes. The type name of the habitat unit must be recorded on the fish sampling form along with a unique consecutive number (starting at 1) designating the longitudinal position of the unit in the sampling reach, beginning from the downstream boundary.
- Once all mesohabitat information has been collected (including fish collections), remove all boundary flags.

RIVER AND STREAM FISH COLLECTIONS--Unless habitats absolutely are not conducive to electrofishing sampling, it is required that data obtained by electrofishing be used as the primary descriptor of assemblage structure at each fixed, quantitative 200 m station. Standardization of sampling by this technique therefore requires that electrofishing be employed first through each mesohabitat. Electrofishing gears should be standardized to electrical configuration and power output, if possible. Fixed Station Y/N on the collection form must be filled in as "Y" for all quantitative sampling in rivers and streams.

- Mesohabitats should be sampled in an upstream progression with single-pass **electrofishing**. Pools should be sampled in an upstream direction, while swift-flowing mesohabitats should be sampled in a downstream direction into blocking nets. Two persons should closely attend the electrofisher with fine-meshed dip nets to capture stunned fishes when sampling pools. Every attempt should be made to sample the entire available habitat and capture all fishes possible. Voltage, output amperage, mode switch (e.g., A-P, 1-13 on the S-R Model 12-A electrofisher) or other settings, and water temperature should be recorded. Record both the number of seconds shocked in the mesohabitat and the estimated percentage of the available mesohabitat that was sampled.

Other methods should also be employed if the investigator considers sampling of a particular habitat inadequate by

electrofishing. Whenever possible, gear-type combinations should be consistently applied to a site over time, unless habitat changes dictate sampling modifications.

- If **seines or dip nets** are deployed, recording of mesh size and length and width (depth) of the gear is required. Effort shall be quantified by recording the number of seine hauls or dip net sweeps taken within the mesohabitat (standardize dip net sweeps to 1 m long sweeps), and the estimated percentage of the available mesohabitat sampled.
- Data unique to **entrapment and entanglement** gears that must be recorded include mesh size and net length and width (depth), with effort in hours soaked or deployed (to the nearest 1/10th hour) computed automatically in the database from date and time in and date and time out, which must be recorded in the field.
- Should sampling by **angling or trot line** be undertaken, bait type (Table 3) should be recorded, and effort should be identified as the number of hooks; effort in hours soaked or deployed (to the nearest 1/10th hour) is computed automatically in the database from date and time in and date and time out, which must be recorded in the field.
- Captured fishes from a single-gear sample from a mesohabitat should be kept alive in buckets of water or holding nets until ready for processing. Fishes should be sorted to species, then sorted to age class, and enumerated. Counts for each species and age class should be recorded on the fish collection form for that mesohabitat and gear. Data that must be recorded from captured fishes at quantitative stations include a four-letter code for **species**, consisting of the first two letters of the generic name and the first two letters of the specific name, an **age** category designation (age-0 or young-of-year, and older, age-1+ fish), and the **number of fish** enumerated for each species and age collected by a particular sampling gear within each mesohabitat (Table 3). It is mandatory that the number of each species/age class preserved for any voucher be identified in the **voucher** field. Optional variables such as fish length, weight, sex, reproductive condition, number and kind of external parasites, external anomalies, and other notes should be recorded in the **comments** field.
- Vouchers (see below) may be taken from a sample of each species collected at each station.
- Following completion of quantitative sampling at each fixed station, extensive qualitative sampling with various gear types may be conducted to search for species that were not collected in the 200 m quantitative reach. This search should concentrate on unusual habitats upstream and/or downstream from the quantitative reach, where detection of novel species might be expected. All individuals of new species should be enumerated (as for quantitative samples) on a separate form (Fixed Station Y/N = N on the fish collection form). Recording of sampling effort is not required for qualitative samples. Vouchers (below) may also be taken for any species not found in quantitative samples.

VOUCHER COLLECTIONS--New species records for a site, or unusual or anomalous specimens of each permitted species encountered at each sampling station or reach should be preserved for museum vouchers, when possible. Quality photo-documentation of species not permitted for take should be made. Vouchers will provide scientific credibility to the monitoring project, ensure the accuracy of species identifications in the field, and scientifically document species occurrence and distribution.

- Voucher specimens should be preserved in 10% formalin immediately following recording of pertinent field data. If specimen body depths are greater than approximately 3 cm (1¼ in), specimens should be cut along the right, lower body wall or injected with 10% formalin into the peritoneal cavity and major muscle masses to ensure adequate tissue fixation. Specimens should be retained in labeled, leakproof plastic jars or buckets and submitted to Reclamation, who will deposit them at the Arizona State University Collection of Fishes or other accredited museum. The contractor should use **collection labels** provided by Reclamation copied on right-in-the-rain paper to ensure that taxonomic identification (if possible), date, time, and method of collection, locality, number of specimens, and collector name(s) are recorded for each sample. Use pencil only to record data – never pen. The number and age class of each species preserved at each site must be recorded on the fish collection form in the voucher field.

QUALITY CONTROL--Prior to leaving a sampling station or site, the field crew leader should review all data sheets used at the site to ensure that all appropriate fields, including data codes if entered, have been filled in properly, and that there are no missing data. The crew leader should then enter his/her initials at the bottom of each page.

FIELD NOTES--An important aspect of data sampling is recording of field notes. Field forms do not allow the type of narrative description of sampling site conditions, sampling problems, or other observational data that may be important to document

sampling procedures or physical conditions at a particular site. Submission of field notes to Reclamation is mandatory.

STEPWISE MONITORING PROCEDURES FOR CANALS--The following itemization describes the recommended ordered procedures, in abbreviated form, for conducting monitoring at a canal site:

- 1) Record header information on the fish collection form
- 2) Begin sampling, collecting all fish possible
- 3) Store fishes alive in a bucket filled with canal water, in holding nets, or in a boat live well
- 4) Sort and enumerate fishes according to species and age class, and record on the fish collection form
- 5) Select specimens to be preserved for voucher, store in container with 10% formalin and a completed collection tag, and record the number preserved on the appropriate fish collection form
- 6) Return remaining fishes alive to canal to an area that will not be resampled
- 7) Record gear information and sampling effort on the appropriate fish collection form
- 8) If the sample is considered inadequate for the canal area just sampled, resample with different gear type(s), repeating steps 1-7 as appropriate
- 9) Review and correct all data sheets for omissions, legibility, and obvious mistakes, and record initials in space provided at the bottom of each form
- 10) Record field notes for the sampling station or reach site, and proceed to the next station
- 11) Proceed to the next sampling area, and repeat steps 1-10 for each until the reach or station is adequately sampled

STEPWISE MONITORING PROCEDURES FOR RIVERS AND STREAMS--The following itemization describes the recommended ordered procedures, in abbreviated form, for conducting monitoring at a station:

- 1) Locate lower station boundary, mark with flagged stake
- 2) Record header information on fish collection form
- 3) Begin measuring upstream along thalweg with tape or hipchain
- 4) Record mesohabitat type names and sequential numbers on fish collection form, marking mesohabitat boundaries with flagged stakes
- 5) End measurement and mark upper boundary with flagged stake at 200 m
- 6) Measure and record stream temperature fish collection form
- 7) In an area below the lower station boundary, adjust electroshocker settings so that fishes are captured effectively
- 8) Record electroshocker settings (volts, amps, switch settings, etc) on fish collection form for habitat #1
- 9) Begin single-pass electrofish sampling of lowermost mesohabitat, collecting all fish possible
- 10) Store fishes alive in a bucket filled with stream water
- 11) Sort and enumerate fishes according to species and age class, and record on the appropriate fish collection form
- 12) Select specimens of each species to be preserved for voucher, store in container with 10% formalin and a completed collection tag, and record the number preserved on the appropriate fish collection form
- 13) Return remaining fishes alive to stream below the mesohabitat just sampled
- 14) Record sampling effort (seconds electroshocked and percent mesohabitat sampled) on the appropriate fish collection form
- 15) If electrofish sample is considered inadequate for the mesohabitat, resample with different gear type(s), repeating steps 10-14 as appropriate
- 16) Proceed upstream to the next mesohabitat, and repeat steps 9-15 for each until the 200 m sample is completed
- 17) Fill out the appropriate station identifier form and photograph the upper and lower station boundaries
- 18) Fill out header information on a new fish collecting form, to be used for qualitative sampling
- 19) Sample unusual habitats with appropriate gear types in areas upstream and downstream from the 200 m station, looking for species that were not found previously
- 20) Record numbers and preserve vouchers for any new species found during qualitative sampling on the appropriate fish collection form
- 21) Review and correct all data sheets for omissions, legibility, and obvious mistakes, and record initials in space provided at the bottom of each page
- 22) Record field notes for the sampling station
- 23) Remove all flagged stakes and hip chain string from the site, and proceed to the next station

Table 1. Travel routes to CAP pumping plants and SRP and FCG canal origins, and USGS 7.5' topographic quadrangle map names. All directions are from Phoenix, Arizona. Numbers in parentheses for CAP pumping plants refer to stream, reach, and station codes, respectively; single numbers refer to stream codes (see Table 3).

Canal	Travel route	USGS Quadrangle
CAP Canal		
Bouse Hills (4-1-1)	I-10 west to Exit 45 (Vicksburg), N 8 mi to AZ 72, NW 19 mi to Bouse, R on Main St., L on Rayler Rd. 2 mi, veer R 4.5 mi to canal, R thru gate	Bouse Hills West
Little Harquahala (4-1-2)	I-10 west to Exit 53 (Hovatter Rd.), L over highway and canal, R thru gate	Hope SW
Hassayampa (4-1-3)	I-10 west to Exit 109 (Sun Valley Pkwy), R to MP 120.1, make U-turn 0.5 mi, R on dirt road 1.5 mi over canal, L 1 mi thru gate	Daggs Tank
Salt-Gila (4-2-1)	AZ60 east to Power Rd, N 1.5 mi past Thomas Rd, R thru gate	Granite Reef Dam (not shown)
Brady (4-3-1)	I-10 east to Exit 211B (North 87), N on AZ 87 3.9 mi to Houser Rd, R 5.3 mi to Brady Pump Rd, L 2.7 mi to canal, L thru gate	Picacho Reservoir
Red Rock (4-3-2)	I-10 east to Exit 219 (Picacho Peak Rd), E on frontage road 5.0 mi to Park Link Dr, L 0.4 mi to paved road, R thru gate	Red Rock (not shown)
San Xavier (4-3-3)	I-10 east to I-19, exit Ajo Way W to San Joaquin Rd (MP 163.5), L on Snyder Hill Rd, R ~0.5 mi to paved turn on R, thru gate	Brown Mountain (not shown)
SRP Canals		
Arizona (5)	AZ 60 E to AZ 87, N 2 mi past Gilbert Rd, L on S bank of canal 1.5 mi to head	Granite Reef Dam
South (6)	AZ 60 E to Power Rd., N 8.5 mi (0.4 mi past CAP canal), diagonally L on Granite Reef Dam Rd. 0.3 mi, L over bridge and canal, veer R to South Canal bridge, R on S bank of canal to head	Granite Reef Dam
FCG Canal (7)	AZ-60 east to Florence Junction, S on AZ 89 to Diversion Dam Rd., L 9.6 mi to Ashurst-Hayden Diversion Dam	North Butte

Table 2. Fixed sampling stations, travel routes, approximate UTM coordinates for lower station boundaries, and USGS 7.5' topographic quadrangle map names. Numbers in parentheses refer to stream, reach, and station codes, respectively; single numbers refer to stream codes (Table 3). Directions are from Phoenix, Arizona. UTM coordinates are NAD83/WGS84 Zone 12. Information current as of January 1, 2011.

River or Stream Station	Travel route	UTM and USGS Quad
San Pedro River		
Hereford (1-1-1)	I-10 S to SR 90, S thru Sierra Vista, S on SR 92 to Hereford Rd, L to river. Upper station boundary starts at bridge abutment	584754 E 3478766 N Hereford
Lewis Springs (1-1-2)	I-10 S to SR 90, S thru Sierra Vista, E on SR 90 to 0.2 mi before river, L thru gate (key at Sierra Vista BLM) 0.3 mi to monitoring wells at edge of river. Lower station boundary starts across from middle well	581607 E 3491385 N Lewis Springs
Charleston (1-1-3)	I-10 S to SR 90, S to Sierra Vista, E on Charleston Rd to river. Lower station boundary starts 400 m downstream of bridge	578055 E 3499565 N Fairbank
Hughes Ranch (1-2-1)	US 60 E to SR 177, S to SR 77, S to River Rd (becomes Cascabel Rd) near Mammoth, S 0.2 mi past Hughes Rd, W (R) thru gate 0.3 mi, N (R) thru gate then W (L) to river. Lower station boundary starts where road would cross river	555099 E 3577415 N Soza Canyon
Three Links (1-2-3)	US 60 E to SR 177, S to SR 77, S to River Rd (becomes Cascabel Rd) near Mammoth, S to Cochise Co. MP 13.5, W thru TNC green pipe gate S of rusted silver gate, veer L 0.5 mi to river	566146 E 3560579 N Wildhorse Mountain
Aravaipa Creek (1-3-1)	US 60 E thru Globe, US 70 E to SR 77, S to Aravaipa Rd (MP 124.1), R 0.5 mi to river	526463 E 3633954 N Lookout Mountain
Dudleyville (1-3-2)	US 60 E thru Globe, US 70 E to SR 77, S to Dudleyville Rd (MP 130.1), R 0.9 mi to San Pedro Rd, R across river 0.8 mi to San Pedro River Preserve, R 0.1 mi, L 1.2 mi, R 0.1 mi (beyond, not at, blue tank), R 0.1 mi to end of berm, take trail to river. Lower station boundary at end of trail	523343 E 3644817 N Dudleyville
Mouth (1-3-3)	US 60 E thru Globe, US 70 E to SR 77, S to just less than MP 133.3, R 0.4 mi straight across field to river; short jog S (left) along fence at end of field road. Lower station boundary starts at culvert pipe	522039 E 3647432 N Winkleman
Gila River		
Coolidge Dam (2-1-1)	US 60 E thru Globe, AZ 170 W 11.7 mi to Coolidge Dam, follow road thru gate on river right down to bridge crossing	543555 E 3670085 N Coolidge Dam
Hook & Line Ranch (2-1-3)	US 60 E thru Globe, AZ 170 W to MP 10.6, R on graded dirt road 1.8 mi, R on primitive road 3.6 mi, R over hill 0.7 mi to road crossing. Lower station boundary starts at u/s end of road crossing d/s from concrete bridge pylons	541478 E 3668483 N Coolidge Dam
Dripping Springs (2-2-1)	US 60 E thru Globe, US 70 E to SR 77, S to MP 146.6, L 0.3 mi to wash, R down wash 0.2 mi. Lower station boundary at conglomerate outcrop near downstream end of wash fan	527159 E 3660405 N Christmas
Christmas (2-2-2)	US 60 E thru Globe, US 70 E to SR 77, S to MP 144.7, L then immediately R 0.2 mi along base of highway until road ends. Follow trail downstream 30 m until it enters floodplain	526280 E 3657579 N Christmas
O'Carroll Canyon (2-2-3)	US 60 E thru Globe, US 70 E to SR 77, S to MP 141.4, L then R 0.1 mi to 1st left to parking area (turn right at "The Shores" sign and take road to river). Station across from parking area	524440 E 3653633 N Christmas
San Pedro River (2-3-1)	US 60 E to SR 177 S to MP S to Winkleman, R on Griffin Ave, R on Quarelli St 0.7 mi past Hayden Public Golf Course, L on unmarked dirt road 0.3 mi, veer L (brick building on R 0.1 mi, R at High Voltage substation 0.1 mi, R under railroad tracks, cross river 0.1 mi (veer right at one-way sign), 0.5 mi roads merge veer right	518933 E 3649531 N Winkleman

	then immediate R; 0.1 mi L at monitoring well; park near cottonwood stand	
Kearny (2-3-2)	US 60 E to SR 177 S to Kearny, R on Tilbury Rd across railroad tracks, R (W) on Veterans to Emery Rd, L (S) on Emory to S side of City Maintenance Yard to end of yard fence, make u-turn through chain link gate. Follow 2-track to Airfield fence, and follow 2-track to river access point closest to airfield gate (located past access point). Lower station boundary where road would cross river	507861 E 3656465 N Kearny
Kelvin (2-3-3)	US 60 E to SR 177 S, R on Florence-Kelvin Hwy across Gila River, L on Riverside Rd 0.3 mi L at wash to river. Lower station boundary at middle of wash fan	502767 E 3662579 N Kearny
A-Diamond Ranch (2-4-1)	US 60 E to SR 177 S, R on Florence-Kelvin Hwy across Gila River 2.9 mi, R at A-Diamond Ranch sign, L along railroad tracks thru gate 0.3 mi to wash, R on foot under train trestle to river	498138 E 3662779 N Grayback
Cochran (2-4-2)	US 60 E to SR 177 S, R on Florence-Kelvin Hwy across Gila River 15.3 mi, R on Cochran Rd 12.7 mi, cross railroad tracks 0.2 mi. Lower station boundary at upper end of road crossing	486273 E 3663698 N North Butte
Box Canyon Wash (Price) (2-4-3)	Highway 89 to Price Rd (Florence) on N side of Gila River travel E ca 11 mi (cross tracks several times) to sharp curve N then immediate R down wash to tracks. Park and hike 0.5 mi along S side of tracks to Box Canyon Wash, then S down wash 0.1 mi. Lower station boundary at d/s margin of confluence with S-flowing wash	478928 E 3661520 N North Butte
Salt River		
Stewart Mountain Dam (3-1-1)	US 60 or 202 E to Power Rd (Bush Hwy). L thru Mesa, along river to bridge then 2 mi to parking area on R; park & walk to site	449608 E 3712890 N Stewart Mountain
Goldfield Administrative Site (3-1-2)	US 60 E to Power Rd (Bush Hwy) along river to intersection w/ Bush Hwy; L 1.0 mi to electric gate on R; through gate, behind bldgs & downhill to fields and river	443056 E 3713501 N Stewart Mountain
Granite Reef Dam (3-1-3)	US 60 E to Power Rd (Bush Hwy) L thru Mesa to Granite Reef Campground, L through FS gate to dirt launch site at end of rd	436512 E 3708530N Granite Reef Dam
Cienega Creek		
Head Cut (9-1-1)	I-10 S to exit 279, N then immediate R onto Pantano Rd, R 5.7 mi, R before bridge downhill into parking area, d/s bdy under w-most bridge	535470 E 3541896 N Rincon Peak
Three Bridges (9-1-2)	I-10 S to exit 279, N then immediate R onto Pantano Rd, R 13.1 mi, R thru gate onto dirt, 0.5 mi to tracks, R along N side of tracks 0.25 mi, park carefully away from tracks, hike 0.1 mi S across tracks to station	533435 E 3542697 N Vail

Table 3A-E. Descriptions of variables and their codes to be entered on the Fish Collection Form.

Table 3-A. Stream codes, short and long names, and comments used for data entry in the “CAP monitoring.mbd” Microsoft Access database.

CODE	SHORT	LONG	COMMENTS
1	SanP	San Pedro River	
2	Gila	Gila River	
3	Salt	Salt River	
4	CAP	CAP Canal	
5	SRPs	SRP South Canal	
6	SRPn	SRP Arizona Canal	SRP North (alternate name)
7	FCG	FCG Canal	
8	Aravaipa	Aravaipa Creek	
9	Cienega	Cienega Creek	

Table 3-B. Mesohabitat type codes and descriptions used for data entry in the “CAP monitoring.mbd” Microsoft Access database.

HID	TYPE	DESCRIPTION
1	Connected Pool	Area of water column with low current velocity and near zero surface gradient and little or no surface turbulence, often with small substrates; includes eddies/pocket water.
2	Riffle	Area of water column with fast current velocity and steep surface gradient, considerable surface turbulence, often with large substrates, includes cascades and rapids.
3	Run	Area of water column with rapid, non-turbulent flow, usually too deep to be a riffle and too fast to be a pool; includes glides.
4	Isolated Pool	Same as Connected Pool, but no surface water connection to the stream, and therefore no current velocity.

Table 3-C. Gear type numerical codes, letter abbreviations, and names used for data entry in the “CAP monitoring.mdb” Microsoft Access database.

CODE	ABBREVIATION	NAME
1	G	gill net
2	T	trammel net
3	H	hoop net
4	F	fyke net
5	TR	trapnet
6	M	minnow trap
7	SGN	shock/gill net
8	STN	shock/trammel net
9	EXPG	experimental gill net
10	SS	straight seine
11	BS	bag seine
12	KS	kick seine
13	D	dip net
14	SC	spin-cast
15	FR	fly rod
16	DL	drop line
17	TL	trotline
18	Bp	backpack shocker
19	Ef	boat shocker
20	BKS	bank shocker
21	TB	tote barge shocker
22	ES	electric seine
25	TND	trammel net/drifted
26	GND	gill net/drifted
27	VO	visual observation
28	DS	dry site

Table 3-D. Bait type codes, bait types, and bait descriptions used for data entry in the "CAP monitoring.mbd" Microsoft Access database.

BAIT_ID	BAIT_TYPE	BAIT_DESCRIPTION
1	Artificial	Artificial lure
2	Live	Live bait
3	Hot dog	Hot dogs
4	Stink bait	Stink bait
5	Cut bait	e.g., anchovies or sardines
6	Pellet fish	Pellet fish food e.g., Aquamax
7	Pet food	dog or cat food
8	Other	corn, etc.

Table 3-E. Species codes and common and scientific names used for data entry in the "CAP monitoring.mbd" Microsoft Access database.

CODE	COMMON	SCIENTIFIC
AGCH	Longfin dace	<i>Agosia chrysogaster</i>
AMME	Black bullhead	<i>Ameiurus melas</i>
AMNA	Yellow bullhead	<i>Ameiurus natalis</i>
APSP	Spiny softshell turtle	<i>Apalone spinifera (Trionyx spiniferus)</i>
CAAU	Goldfish	<i>Carassius auratus</i>
CAIN	Sonora sucker	<i>Catostomus insignis</i>
COLO	Pacu	<i>Colossoma sp</i>
CTID	Grass carp	<i>Ctenopharyngodon idella</i>
CYLU	Red shiner	<i>Cyprinella lutrensis</i>
CYCA	Common carp	<i>Cyprinus carpio</i>
DOPE	Threadfin shad	<i>Dorosoma petenense</i>
GAAF	Mosquitofish	<i>Gambusia affinis</i>
GIIN	Gila chub	<i>Gila intermedia</i>
GIRO	Roundtail chub	<i>Gila robusta</i>
ICPU	Channel catfish	<i>Ictalurus punctatus</i>
ICCY	Bigmouth buffalo	<i>Ictiobus cyprinella</i>
ICNI	Black buffalo	<i>Ictiobus niger</i>
KISO	Sonora mud turtle	<i>Kinosternon sonoriense</i>
LEPO	Undetermined or hybrid sunfish	<i>Lepomis ?</i>
LECY	Green sunfish	<i>Lepomis cyanellus</i>
LEMA	Bluegill	<i>Lepomis macrochirus</i>
LEMI	Redear sunfish	<i>Lepomis microlophus</i>
LICA	American bullfrog	<i>Lithobates catesbeianus (Rana catesbeiana)</i>
MIDO	Smallmouth bass	<i>Micropterus dolomieu</i>
MISA	Largemouth bass	<i>Micropterus salmoides</i>
MOCH	White bass	<i>Morone chrysops</i>
MOMI	Yellow bass	<i>Morone mississippiensis</i>
MOSA	Striped bass	<i>Morone saxatilis</i>
0000	No fish caught	No fish caught
ONMY	Rainbow trout	<i>Oncorhynchus mykiss</i>
ORAU	Blue tilapia	<i>Oreochromis aureus (Tilapia aurea)</i>
ORMO	Mozambique tilapia	<i>Oreochromis mossambicus (Tilapia mossambica)</i>
PACL	Desert sucker	<i>Pantosteus clarki</i>
HYBR	Hybrid sucker	<i>Pantosteus X Catostomus</i>
PEFL	Yellow perch	<i>Perca flavescens</i>
PIPR	Fathead minnow	<i>Pimephales promelas</i>
POLA	Sailfin molly	<i>Poecilia latipinna</i>
POOC	Gila topminnow	<i>Poeciliopsis occidentalis</i>
PONI	Black crappie	<i>Pomoxis nigromaculatus</i>
PYOL	Flathead catfish	<i>Pylodictis olivaris</i>
RAYA	Lowland leopard frog	<i>Rana yavapaiensis</i>
RHOS	Speckled dace	<i>Rhinichthys osculus</i>

Table 3-E. Continued.

CODE	COMMON	SCIENTIFIC
SAVI	Walleye	<i>Sander vitreus (Stizostedion vitreum)</i>
TICO	Loach minnow	<i>Tiaroga cobitis</i>
TILA	Undetermined cichlid	<i>Tilapia ?</i>
TIZI	Redbelly tilapia	<i>Tilapia zilli</i>
LITH	Undetermined <i>Lithobates</i>	<i>Lithobates ?</i>
FISH	Unknown fish species	Unknown fish species
UNKN	Unknown species	Unknown species

