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Habitat use by the humpback chub, Gila cypha, in the Little Colorado River and other tributaries of the Colorado River

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GCES Phase II Research

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ABSTRACT

The objective of USFWS research for Phase II Glen Canyon Environmental Studies is to determine habitat use by humpback chub and other native fishes in the Little Colorado River (LCR) and other tributaries of the Colorado River in the Grand Canyon, evaluate the potential for establishing a second spawning aggregation of humpback chub, and from the perspective of habitat requirements, evaluate how native fishes are affected by the operation of the Glen Canyon Dam. Because field research by USFWS commenced in July 1991, only preliminary results are available. Field work in 1991 was conducted only in the LCR. Aquatic habitat in the lower 21 km of the LCR has been mapped (confluence to Blue Springs) from more than 20,000 sample points. Habitat use data has been collected from 64 seine sample locations and from more than 500 hoopnet and more than 200 minnow trap sets. Observations of habitat use were recorded from more than 100 sample points. Data from our 1991 research is presently being analyzed. Our research has revealed that humpback chub are relatively abundant and are the predominant species in the LCR, that there is a large summer resident population of adult chub, and that young-of-year chub appear to reside in the LCR for their first year. These general patterns indicate that the lower 14 km of the LCR may represent habitat critical to the existence of the chub in the Grand Canyon area.

INTRODUCTION

Overview

The humpback chub (*Gila cypha*) was described in 1946 from a single specimen from an unknown location in the Grand Canyon (Miller 1946). This species has been a long term resident of the Colorado River as evidenced by remains in Indian ruins near Hoover Dam (Miller 1955). Humpback chub historically reached their greatest abundance in inaccessible canyon areas of the mainstream Colorado, and the Green, Yampa, White, and Little Colorado rivers (Smith 1960; Sigler and Miller 1963; Holden and Stalnaker 1970, 1975; Vanicek et al. 1970).

Within its native range, the humpback chub is now restricted to the Green River in Desolation, Gray, and Labyrinth Canyons (Holden and Stalnaker 1975; Holden 1978; Tyus et al., 1982a, 1982b, 1987), in Dinosaur National Monument (Miller 1964; Holden and Stalnaker 1975; Holden and Crist 1980; Miller 1982a; Tyus 1982b), the Yampa River within Dinosaur National Monument (Miller 1964; Holden and Stalnaker 1975; Seethaler et al. 1979; Miller et al. 1982b; Tyus et al. 1982a, 1987), in the Colorado River at Black Rocks, Westwater, and De Beque Canyons (Kidd 1977; Valdez and Clemmer 1982; Valdez et al. 1982; Archer et al. 1985), in Marble and Grand Canyons (Suttkus et al. 1976; Suttkus and Clemmer 1977; Minckley et al. 1981), and in the lower 13 km of the Little Colorado River (Minckley et al. 1981; Kaeding and Zimmerman 1983; Minckley 1987). The reduction in areas of occurrence and population densities have led to the species being declare endangered by the Fish and Wildlife Service.

Much of the habitat use information available for the humpback chub concerns juveniles and adults taken from April through October (Valdez et al. 1987). Adult humpback chub have been reported to be associated with fast current and/or deep channels (Holden and Stalnaker 1975; Kidd 1977; Seethaler et al. 1979). However, Valdez et al. (1982)and the Fish and Wildlife Service (1986) reported preferred habitat of adults to be waters less than 9.1 m deep, over silt, sand, boulder or bedrock, and at water velocities less than 30 cm/s. In the Little Colorado River, Minckley et al. (1981) reported that the species was taken from a variety of habitats, including pools adjacent to eddies, large pools with little or no current, and areas below travertine dams.

Previous studies have concentrated on locating and describing the extent of humpback chub populations; limited information has been collected on the life history and ecology of the species. In the lower Colorado River most, if not all of the successful spawning takes place in the Little Colorado River (Kaeding and Zimmerman 1983; Minckley 1987). Continued survival of the populations in the lower river appear contingent upon the survival of this population.

Research objectives

The objective of USFWS research for Phase II Glen Canyon Environmental Studies is to determine habitat use by humpback chub and other native fishes in the Little Colorado River (LCR) and other tributaries of the Colorado River in the Grand Canyon, evaluate the potential for establishing a second spawning aggregation of humpback chub, and from the perspective of habitat requirements, evaluate how native fishes are affected by the operation of the Glen Canyon Dam.

Specific objectives of the study

1. Determine habitat availability for humpback chub and other fish species by measurement and mapping habitat in the LCR and other tributaries of the Colorado River.

2. Determine seasonal patterns of habitat use by juvenile and adult humpback chub and other fish species in the LCR an other tributaries of the Colorado River.

3. Identify preferred and critical habitats of juvenile and adult humpback chub and other fish species in the LCR.

4. Identify humpback chub spawning habitat in the LCR and potential spawning habitat in other tributaries of the Colorado River that may be suitable for recovery efforts.

5. Develop discharge-frequency and flow-duration curves for the LCR to determine how flood stages affect habitat availability for LCR fishes.

6. Identify information and future research required for possible enhancement of environmental conditions to protect and promote fish and wildlife populations in the LCR and other tributaries of the Colorado River.

Hypotheses tested

1. Juvenile and adult humpback chub are uniformly distributed throughout all available habitats; chub show no patterns of habitat specialization.

2. Patterns of habitat use in juvenile and adult humpback chub are not different from other species; there is no habitat segregation among members of the local fish assemblage.

3. There are no seasonal patterns of habitat use by humpback chub and other fish species.

4. There are no ontogenetic patterns of habitat use by humpback chub and other fish species.

5. Habitat availability does not vary seasonally or under different flow regimes.

METHODS

LCR Study Areas

Confluence

River km -.5 to 1. Our research objective for this area is to measure seasonal changes in microhabitat and determine the impact of Glen Canyon Dam releases on physicochemical conditions and microhabitat in the confluence area. Secondarily, we will attempt to determine microhabitat use by humpback chub and other fish species in the confluence area in conjunction with AGF, ASU, and BioWest fish sampling activities. Joint research efforts are anticipated in the spring months when large numbers of chub congregate in the confluence area and ascend the LCR.

The confluence area will be mapped by the transect method (1 or 2m x 20m grid) seasonally for low and high Glen Canyon Dam discharge regimes. Mapping during high flow periods will take place at night (when high flows occur) and use of a motorized craft will be imperative for safe and successful completion of mapping. Additionally, we will map habitat at periods of maximum LCR discharge (e.g., during spring snow melt). At set cross-stream intervals (1 to 2 m) along permanently marked and mapped transect locations, hydrogeophysical measures and habitat variables will be measured. When possible, trammel nets will be set within gridded study areas and values for habitat variables will be recorded for each point of fish capture. It is anticipated that GCES and the National Park Service will conduct a geographic survey of the confluence area at 5 to 10 m resolution during February 1992. The resulting map will be invaluable for overlaying microhabitat transects, fish sampling gear, and radio tracking patterns.

ASU will deploy trammel nets in the confluence area from which point-of-capture habitat data will be collected by USFWS personnel. Biowest personnel will track radio-tagged chub into the confluence area; USFWS will assist in obtaining microhabitat use data from such efforts.

Habitat will be measured along permanent transects on a quarterly basis (winter, spring, summer, fall) in the confluence zone and additional measurements will be taken during unusual events, e.g. spring snow melt, or when released flows from Glen Canyon Dam change. At present, the permanent transects have been located and mapped, and habitat measurements have been taken at summer low flow conditions (4000 cfs, Colorado River; 200 cfs base flow for LCR). Data on fish habitat use has been collected for trammel nets set during the period 21 July-24 August, 1991. Assessment of habitat

use by fishes will be conducted monthly or bimonthly and will be coordinated with sampling activities of AGF, ASU, and BioWest personnel.

Lower base camp (LBC)

The LBC study area is located in the vicinity of the Powell Canyon Camp. Our research objective for this area is to measure seasonal changes in microhabitat and microhabitat use by fishes in the lower 1-7 km of the LCR. Two 500 m reaches with 100 m buffer zones located in the vicinity of the LBC (km 2.25-3.75) provide "exclusive" study areas[1] for microhabitat use assessment of LCR fishes. These 500 m sections include representative macrohabitats of the lower LCR: pools, raceways-tailwaters, riffles, and travertine reefs/dams. At present, habitat in the 0-4 km river reach have been mapped on a 1 x 20 m grid. Typically, one 500 m study area will be sampled per month so that sampling is alternated between the two study areas between months. Within these study areas 15-20 mini-hoopnets will be deployed in a moving sampling grid (explained in a sampling discussion section that follows). In addition, up to 30 minnow traps set in grids will be used to sample shallow edge habitats and will complement the hoopnet sampling. Nets and traps will be run every 12 hours (or twice daily) and moved to new grids every 24 hours in an upstream direction until the entire 500 m study area is sampled. USFWS will PIT tag native species of sufficient size and collect fish capture data for ASU.

When conditions permit, observational surveys (*in situ* or above water) will be conducted through the 500 m study areas. In conjunction with AGF, seine sampling will be conducted seasonally or quarterly in homogenous patches of stream habitat to provide an inventory of species using shallow seinable habitats. Seining and observational surveys will provide comparative data sets for the relative abundance of LCR fishes and gross habitat use patterns.

USFWS will measure habitat at ASU hoopnets set outside the 500 m study areas at least seasonally to detect macrohabitat use patterns in the LCR and in the spring months to identify spawning habitats used by humpback chub. When Humpback chub spawning areas have been identified, USFWS personnel will conduct additional habitat measurements in order to characterize specific spawning microhabitats. This habitat work will be coordinated with ASU fish sampling of humpback chub spawning areas.

[1] "exclusive" means that a USFWS study area is not sampled by other research teams in the same month when sampled by USFWS. During those months that a USFWS study area is not sampled by USFWS, ASU or AGF may sample these areas but should abide by USFWS low-impact sampling methodologies. This arrangement is intended to eliminate duplication of sampling effort and sampling interference among GCES researchers, and to assure that all portions of the LCR are sampled.

Microhabitat use by LCR fishes in 500 m study areas will be assessed on a monthly basis by USFWS from March through October and bimonthly during winter months (November-February). We anticipate that this sampling will take less than one week per month. Seining and observational surveys will be conducted quarterly and will require one week/quarter. Habitat measurements at ASU hoopnets outside 500 m study areas will be conducted seasonally or more frequently if time and personnel permits.

Upper base camp (UBC)

The UBC study area (river km 8-21) is centered in the vicinity of the Salt Trail Canyon camp. Our research objective for this section of the LCR is to measure seasonal changes in microhabitat and microhabitat use by fishes in the upper LCR (km 8-21). The two 500 m study areas will be located in the vicinity of the UBC between river km 10.5 and 11.75. At present, habitat has been mapped on a 1 X 20 m grid between river km 9.75 and 12. Methods and schedule are the same as for the LBC. The upper LCR study reach may be subdivided into three distinct areas: km 8-14, .5 km above Sipapu to Atomizer Falls; km 14-15.5, Atomizer Falls reach; and km 15.5-21, Atomizer Falls to Blue Springs reach.

Sipapu to Atomizer Falls Reach (km 8-14.5): This reach contains the USFWS 500 m study areas and is the focus of ASU hoopnet sampling in the upper LCR. Objectives, methods, and schedule parallel that of the LBC.

Atomizer Falls Reach (km 14-15.5): Our objective in this reach is to measure seasonal changes in physicochemical conditions, microhabitat availability, and microhabitat use by LCR fishes below and above Atomizer Falls. These falls are viewed as the terminus of Humpback chub distribution in the LCR. Methodology will be similar to LBC, but smaller, approximately 200-300 m study areas (one below and one above Atomizer Falls) will be sampled with fewer minihoopnets and minnow traps. Available stream habitat in the study area will be assessed by habitat measurement on a 1 x 20 m grid. Sampling will be conducted one week per quarter (spring, summer, fall, winter). Additional sampling will be scheduled during the peak of chub spring migration and spawning and will be coordinated with ASU hoopnet sampling.

Atomizer Falls to Blue Springs Reach (15.5-21 km): Our objective in this reach is to measure seasonal changes in physicochemical conditions, microhabitat, and microhabitat use by LCR fishes in the perennially flowing portion of the LCR above Atomizer Falls. Our methodology is similar to the Atomizer Falls reach: two study areas will be sampled, one above the Atomizer Falls reach (km 15.5-20), and one in the vicinity of Blue Springs (km 20-21). Available stream habitat in the study areas will be assessed by habitat measurement on a 1 x 20 m grid. Sampling will be conducted one week per quarter (spring, summer, fall, winter) and will be coordinated with ASU hoopnet sampling.

Other USFWS research in the LCR

In 1991, habitat in the entire LCR and Confluence (km -.5 to 21) was mapped on a 1 x 100 m grid. Dr. Vincente Lopes, a USFWS co-investigator from the University of Arizona will conduct river modeling studies of the LCR to determine the impact of normal hydrological events on stream habitat. For this river modeling study we plan to extend habitat transects at 1 km intervals to the canyon walls in order to generate channel cross-sectional profiles. Also, we will conduct a ground survey of the LCR channel to obtain accurate information on channel reach profiles and gradients. The ground survey will also permit generation of accurate maps for locations of study sites within the LCR. These maps will be invaluable for long-term monitoring of humpback chub in the LCR.

Discussion of USFWS sampling methods and protocols

Justification and theoretical discussion of sampling methods are presented in the following papers available through the Pinetop USFWS FAO: "Using hoopnets and other sampling methods to assess microhabitat use by fishes in the Little Colorado River", and "Proposed low-impact fish sampling protocols for Glen Canyon Environmental Studies (GCES) Phase II research in the Little Colorado River".

The study areas for USFWS research should be "exclusive", i.e., no other research groups should sample fish in these areas during the same month. In months that these areas are not sampled by USFWS they may be sampled by ASU or AGF, but these entities should abide by USFWS low-impact sampling protocols. This will assure that the fish in these areas are not excessively impacted by frequent sampling. Mark/recapture data obtained by USFWS from the exclusive study areas will be shared with other GCES research teams. USFWS will PIT tag and collect fish capture data from these study areas for ASU. Coordination of sampling between ASU and USFWS is assured by scheduled joint field trips.

The principal USFWS sampling device will be a 20" x 4' mini-hoopnet with 1/4" mesh. These small nets are designed to sample a wide array of stream habitats and capture the range of species and size classes of fishes present in the LCR. Gee's standard 1/4" mesh minnow traps will complement mini-hoopnets sampling in shallow edge habitats. All nets/traps will be set (soaked) and run (emptied) of fish every 12 hours (or twice daily). Nets will not be run at the same location for more than one day per month. Habitat measurements around each net will reflect pre-net-set conditions. Habitat within study areas will be measured prior to fish sampling on the established habitat transects (1 x 20 m grid) to determine habitat availability. Habitat data from net/trap sampling

devices will be compared to available habitat to determine the proportion and kinds of habitat sampled for fish. Habitat use by individual species can be determined from patterns of capture among the net/trap sets.

Within designated 500 m study areas (with 100 m buffer zones above and below), 10-20 hoopnets will be deployed in a regular grid with a spacing of 5-20 m between hoopnets. Nets will be set in the morning (within 3 hours following sunrise) and run before dusk (within 3 hours before sunset) and run the following morning. Then the nets will be pulled and set in a new grid moving upstream through the study area reach. The border of the new grid should be 40 m above that of the previous grid. Minnow traps will be run in grids of at least 4 traps with a trap spacing of 1 to 2 meters. The minnow trap grid will be contained within the hoopnet grids and will be run simultaneously. In deeper waters, minnow traps and hoopnets can be set in the water column off the bottom or stacked to sample pelagic fishes.

The proposed sampling protocol is designed to have minimal impact on the fish population: fish are retained in nets for short periods of time and fish are sampled relatively infrequently and at low intensity. Overall, the proposed sampling protocol will expose only a small fraction of the fish population to capture and handling. The reason for this approach is to avoid causing changes in fish behavior and ecology as a result of the sampling protocol. The goal is to study the natural ecology of the fishes and reduce all potential sources of sampling bias.

Habitat measurement of ASU hoopnets

Habitat sampling of ASU hoopnet sets will continue at a reduced level after the adoption of the grid/study area approach. Habitat measurement of ASU nets will be conducted on a seasonal basis and take place outside of USFWS study areas. This sampling will provide additional data on macrohabitat use by LCR fishes but because most of these nets are set outside areas with habitat mapped on 20 m transects, there will be no habitat availability data to determine habitat selection/preference patterns. USFWS personnel will measure habitat around ASU hoopnet sets with these idealized conditions (which may or may not be met):

1. Hoopnets should be 1/4" mesh (but a mix of 1/4" and 1/2" mesh is acceptable, but see condition 3). 1/4" mesh nets capture all LCR fishes and provide data comparable to our study area grids where 1/4" sampling devices are used.

2. Nets should be soaked and emptied at 12 hour intervals for the first 24 hours to detect patterns of diurnal activity.

3. Nets are set in pairs within 100 m of each other and should be set to sample

visually different habitat types. Nets of the same mesh size should be paired.

4. The same locations should not be sampled more often than 3 consecutive days per month.

Other sampling methods

Alternatives to hoopnets and minnow traps for sampling fishes in the LCR include trammel nets and seining. Electroshocking is an ineffective sampling method in the LCR because of the high conductivity of the water. We propose to use trammel netting and seining as supplementary sampling methods to determine the composition and relative abundances of LCR fishes. These data will provide useful checks on hoopnet sampling data. Furthermore, some additional habitat use data can be obtained from trammel netting and seining.

Trammel nets are in some ways ideal for larger fish because they provide point-of-capture habitat data. But trammel nets have many problems. Trammel nets are very size selective and do not catch smaller fish. They can not be placed in the array of habitats that hoopnets can be deployed. Trammel nets must be run frequently (at least every 6 hours) and capture by entanglement results in increased physical damage and trauma to the fishes. If large numbers of fishes are captured, handling time by researchers increases greatly. Finally, trammel nets occasionally kill humpback chub which are endangered species with strict incidental mortality limits. An alternative approach to using trammel nets is to drift them through pools. At the end of the pool the net is stopped and checked for fishes. The net can provide information on lateral position, vertical position, and direction of movement into the net. The net should not be dragged to shore like a seine or all capture locations of fishes in the net will become hopelessly confused. For stationary trammel net sets, habitat is measured at every float along the net. Habitat use data can be determined by tieing a flag with species and net position data for each capture to the float line of the net. For drift sampling, the habitat in the pool must be measured prior to sampling. The point of capture for each fish can be grouped with longitudinal sets of habitat sample points.

Seines are relatively safe sampling devices but are very limited in the range of habitats that can be sampled in the LCR. The presence of travertine and abundant boulders makes seining ineffective in most LCR habitats. Thus seining can only be done in a narrow array of edge and shallow habitats in the LCR. Seining is most effective in sampling small and young-of-year fishes in these habitats. Habitat is measured in the area sampled after seining. Ideally, homogeneous areas should be sampled.

RESULTS

Trips completed to date

A 5-day reconnaissance trip into the LCR was conducted during May 1991 prior to the start of field research. Field research for this project commenced on July 1, 1991. Five field research trips totaling 56 days were conducted: 1-13 July, 21 July-3 August, and 11-24 August, 15-22 October, and 9-16 December.

Habitat, Little Colorado River

1. The LCR has been mapped on a 1 x 100 m grid from the confluence to Blue Springs (21 km). Habitat data were recorded at more than 9,000 sample points.

2. USFWS research areas have been mapped on a 1 x 20 m grid (km 0-1, 2-4, 10-12). Habitat data were recorded at more than 15,000 sample points.

3. Habitat data has been collected at approximately 400 ASU hoopnet sets and 150 USFWS minihoopnet sets. These data were collected at more than 11,000 point samples.

4. Habitat data has been collected at approximately 24 ASU trammel net sets. These data were collected at more than 1,200 point samples.

5. Habitat data were collected at 52 minnow trap grids set by USFWS. These data were recorded from more than 1,000 point samples.

6. Habitat data were collected at 64 seine sample locations. These data were recorded from more than 2,500 point samples.

7. Habitat and fish habitat use data were collected from observation surveys of juvenile fishes in shallow edge habitats. Data were recorded from more than 100 point samples.

8. Physico-chemical properties were measured during each field trip: temperature, conductivity, pH, dissolved oxygen, oxidation reduction potential, salinity, turbidity.

Fish samples, Little Colorado River

1. Fish sampled by standard hoopnets and trammel nets were recorded by ASU personnel; these data are not presented here. USFWS personnel sampled 2,489 fish with

minnow traps, seines, and mini-hoopnets; these data are summarized in Table 1.

2. 1,399 fish were recorded from minnow traps set in habitat sampling grids by USFWS personnel.

3. 795 fish were recorded from USFWS seining surveys (employment of the area seining method; area swept is measured and includes habitat sampling).

4. 295 fish were recorded from USFWS mini-hoopnet sampling grids.

5. Point data on habitat use by YOY fishes were obtained from observational studies along stream edge habitats.

Research on other tributaries:

Reconnaissance trips into the Paria River and Bright Angel, Tapeats, Deer, creeks were conducted over the summer of 1991 but no field work has been done to date.

DISCUSSION

The predominant fish species in the LCR below Atomizer Falls (km 14) is the humpback chub (see footnote at the bottom of Table 1). Other abundant species include the speckled dace and the bluehead sucker. Exotic species, the carp and channel catfish, are relatively uncommon in the LCR. Habitat data is presently being analyzed, therefore, we can not describe specific habitat use patterns for humpback chub or other species. At this time we can, however, provide some general observations on chub ecology that extend the findings of Kaeding and Zimmerman (1983)(K & Z) for LCR chubs that may be useful in forming preliminary recommendations for the EIS.

A subpopulation of adult humpback chub are present in the LCR throughout the summer but apparently leave the LCR in the early fall (catch rates of adult chubs plummet after September). This contrasts with the study by K & Z where the presence of adult chub in the LCR appeared to be rather ephemeral and tied to spawning in the spring and early summer. To explain their finding, K & Z hypothesized that food is a limited resource for adult chubs in the LCR. It is likely that most adult chubs overwinter in the Colorado River mainstream.

Like K & Z we found that young-of-year (YOY) chubs are present from the time of hatching through early winter. By December most YOY chub have reached 85-105 mm TL. It is quite possible that most YOY chubs spend their first year in the LCR. In

July-August when YOY chubs reached approximately 65 mm TL we found that they moved from shallow, brightly illuminated edge habitats to deeper water habitats with cover. At this time YOY chubs were caught in the same 1/4" mesh hoopnets that capture adult chubs. The apparent switch in habitat use we observed in YOY chubs appears to be accompanied by a change in temporal activity; YOY in shallow edge habitats are diurnally active while YOY in deepwater habitats are nocturnally active. By August YOY chubs were distributed from the confluence to above km 12. We have circumstantial evidence to indicate that when chubs reach approximately 75 mm TL they begin to move upstream.

Adult chubs were distributed from the confluence to the Atomizer Fall complex at km 14. As with K & Z, we did not find any chubs between this area and Blue Springs at km 21 but we did find speckled dace throughout the permanently flowing portion of the LCR (km 0-21). K & Z experienced higher catch rates of chubs during night sampling. We found that nocturnal activity in chubs appears to peak from sunset to midnight. During this time chubs move from deepwater areas with cover to open water and shallow areas without cover.

Our findings indicate that in addition to humpback chub, speckled dace, bluehead sucker, and flannelmouth sucker reproduce in the LCR. Together with humpback chub these species constitute more than 94% of the fishes in the LCR. Unlike other southwestern streams the fish assemblage in the LCR is dominated by native species.

CONCLUSIONS

The lower 14 km of the LCR and the adjoining reach of the Colorado River are used extensively by the humpback chub; from all the research conducted thus far on the humpback chub it is apparent the whole life history of this species can be completed in this area. Combined research efforts by USFWS, Arizona Game and Fish, and BioWest will determine if chubs are able to successfully utilize other tributaries of the Colorado River within the Grand Canyon. At this time, we can argue that the LCR represents critical habitat for the humpback chub; the LCR is where the most successful spawns of humpback chub take place and where the chub is the predominant species. The LCR may be viewed as containing habitat critical to the survival of the chub in the Grand Canyon; in this sense the LCR may be functioning as a sanctuary for humpback chub and other native species in the Grand Canyon portion of the Colorado River.

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TABLE 1. Summary of fishes sampled by U.S. Fish and Wildlife Service-Pinetop FAO in the Little Colorado River from July through December 1991.

species name	common name	status *	Number handled and released**
SALMONIDAE			
Salmo gairdneri	rainbow trout	introduced exotic	1
CYPRINIDAE			
Cyprinus carpio	carp	introduced exotic	33
Gila cypha	humpback chub	native SE, LE	506[1]
Pimephales promelas	fathead minnow	introduced exotic	2
Rhinichthys osculus	speckled dace	native	1594
CATOSTOMIDAE			
Catostomus discobolus	bluehead sucker	native SC	194
Catostomus latipinnis	flannelmouth sucker	native	48
ICTALURIDAE			
Ictalurus punctatus	channel catfish	introduced exotic	7
CYPRINODONTIDAE			
Fundulus zebrinus	plains killifish	introduced exotic	104
Total fish handled			**2,489**

* SE- state endangered, ST- state threatened, SC state special concern. LE- Federal listed endangered, LT- Federal listed threatened.

** all individuals were captured and released alive. Low-impact USFWS sampling protocols were followed. No voucher specimens were purposely taken. Incidental mortalities consisted solely of two speckled dace, an abundant, non-listed native species.

[1] Humpback chub are numerically predominant in the LCR below Atomizer Falls at km 14; speckled dace are numerically predominant above Atomizer Falls.