BIO/WEST, Inc.

Resource Management
and Problem Solving Services

ANNUAL SUMMARY REPORT - 1988
FISHERY INVESTIGATIONS OF THE
LOWER JORDAN RIVER
PR 166

Submitted To:

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INTRODUCTION

In 1986, Central Valley Water Reclamation Board (Central Valley) contracted with BIO/WEST, Inc. to perform a fishery and habitat study of the Jordan River in Salt Lake County. The purpose of that study was to document the aquatic resources of the lower Jordan River and to determine how those resources would affect implementation of water quality standards for that portion of the river, and consequently for effluent from the Central Valley Water Reclamation Facility. The study suggested fisheries in the lower Jordan River were habitat-limited rather than water quality-limited, and that lack of habitat plus season of the year may have accounted for the lack of young fish observed during 1986.

Local governmental agencies and the Environmental Protection Agency (EPA) have requested that Central Valley conduct additional studies to help clarify the fisheries potential of the lower Jordan River. In particular, what species of fish are reproducing in the river. This report deals with the first year's results of a multi-year study of fisheries of the lower Jordan River.

OBJECTIVES

Specific objectives of the overall study are as follows:

1. Determine what species of fish spawn in the lower Jordan River with particular emphasis on walleye, white bass, channel catfish, and other game species.

2. Determine when and where spawning occurs, and the types of habitat used by the various species present in the river.

3. Determine the fate of young fish, where they originate, and what habitats they utilize.

4. Continue monitoring macroinvertebrate populations to determine changes that may be occurring in the river.

5. Continue monitoring substrate and habitat of the lower river and canals.

METHODS

Sampling methodology consisted of a series of six standardized sampling trips conducted between April and early October 1988, and two additional field trips in late May and early December. Standardized sampling trips were used to generate the information base for fisheries in the lower Jordan River. In addition to the standardized sampling trips, two additional trips were undertaken during 1988 to investigate areas of special interest or to generate specific data not collected within the framework of the standardized sampling. These extra trips included sampling during early June in specific areas where the presence of reproductively mature adult and larval game fish were suspected, and sampling during early December for the purpose of generating data comparable to previous fisheries work conducted on the river at that time of year. Results of the additional sampling trip in early June were combined with those of the second standardized trip due to the closeness in dates of sampling trips. Results for the December trip are reported as a normal sampling trip.

Because most sampling methods are size specific, in order to collect all size classes of fish present in the river, three different methodologies were used. Electrofishing was utilized primarily for the collection

of adult and juvenile fish. Seining was used to collect young-of-the-year (YOY) fish, larger larval fish, and minnow-type species. Drift nets were the principle means of collecting newly hatched larval fish.

Electrofishing was conducted with two different electrofishing units. The vast majority of electrofishing was conducted using a 18-foot jon boat with a 3500-watt generator and a Coffelt VVP-15. Areas that were not accessible by jon boat due to very shallow water or low bridges and culverts were shocked with a canoe-mounted electrofishing unit. The canoe-mounted unit consisted of a 1000-watt generator and a Coffelt VVP-2C.

Electrofishing sample size was approximately 1 hour (3,600 seconds) at each station during each sample period. Each electrofishing run was conducted within a habitat type based on overall habitat (i.e., run, riffle, and pool and other habitat factors such as presence and type of bank or instream cover). Electrofishing runs were timed for the calculation of catch per unit effort (CPE). All game fish captured were measured for total length, weighed, and checked for spawning condition. Fish over approximately 200 mm total length were tagged with a numbered floy tag. Game fish that escaped capture but were positively identified were included in total numbers of fish observed. Nongame fish were treated differently due to the large numbers involved. The first 50 fish of each species captured at a station were measured for total length, weighed, and checked for spawning condition. Fish over approximately 200 mm total length were tagged with a numbered floy tag. After collection of 50 fish, the remaining fish were counted during each electrofishing run.

Seining was conducted primarily with a 1/16-inch mesh seine in specific habitat types. The size of each seine haul was estimated so that CPE could be calculated. Fish collected were measured for total length until a minimum of 50 fish of a species were measured at each station. Excess numbers of fish were counted for inclusion in CPE statistics.

Larval drift nets were utilized to collect larval fish drifting downstream with river currents. Each net was made of 560-micron mesh netting and was 10 feet long with a 12 by 18-inch opening. The design of the nets was based on Haynes (1985). Four replicate drift samples were collected at each station between sunset and midnight. Drift net sets were run between 30 minutes and 1 hour, depending on the amount of material collected in the nets. An average water velocity at the net openings was calculated by taking an average of the velocities measured at the net mouths at the beginning and end of each set with a Marsh-McBirney current meter. CPE was computed as number of fish per 1000 cubic feet of water using the following formula:

$$N_e = (N/(A \times V_m \times T)) \times 1000$$

where:

N_e = estimated number of fish drifting in 1000 cubic feet of water
N = actual number of fish in drift samples
A = area of net opening in square feet (1.5 ft^2)
V_m = average water velocity in feet per second at the net opening during the set, and
T = total time of net set in seconds

In addition to fisheries sampling, macroinvertebrate samples were collected at each station for analysis by the Salt Lake City-County Public Health Department. Samples were collected in run habitats with a 0.25 ft^2 ponar dredge, and in riffle habitats with a modified Hess sampler. A minimum of four replicate samples were taken at each station utilizing a stratified random sampling design.

STUDY AREA

The study area encompassed the lower Jordan River from approximately 3300 South to 1000 North, the Surplus Canal, and the Goggin Canal. Sampling stations corresponded to stations sampled by Holden and Crist (1987). Location of sampling stations is shown in Figure 1. Four sampling stations were located on the Jordan River and one each on the Surplus and Goggin canals. Stations on the Jordan River included the river above Mill Creek to approximately 3500 South, the river section from Mill Creek to 2100 South, the river section from 1700 South at Raging Waters upstream to the floodgates that regulate flow in the lower river, and the Jordan River from 1000 North to 500 North. One station was located on the Surplus Canal in the vicinity of Salt Lake International Airport. One station was also located on the Goggin Canal at its divergence with the Surplus Canal.

A summary of available dredging and bank modification activities for each station is given in Table 1. Additional data on the sampling stations, including representative cross section data can be found in a the study by Holden and Crist (1987) prepared for the Central Valley Reclamation District.

STATION DESCRIPTIONS

JORDAN RIVER - ABOVE MILL CREEK - This station encompassed the river section from Mill Creek to approximately 1/4 mile upstream of 3300 South. The river in this area is relatively natural, exhibiting some meandering and a variety of depths and substrates. River banks in this section were varied and included areas with riprap, grass, woody riparian vegetation, and eroding silt banks. Riffle habitats with gravel substrates were more common within this river section than in downstream areas. Portions of the river within the sample station have been dredged and channelized, with the most recent activities occurring in 1983 (Table 1).

JORDAN RIVER - BELOW MILL CREEK - This station extended from the confluence of Mill Creek and the Jordan River downstream to 2100 South, where the Jordan River and Surplus Canal diverge. This station combined the stations below Mill Creek and above the Surplus Canal sampled by Holden and Crist (1987). The river within this section was very uniform and canal-like in nature, with runs being the predominate habitat. Substrate within the station was a combination of silt, clay, and gravels. Banks were primarily grass covered, though some riprap was present. The river from the confluence with Mill Creek through the Surplus Canal was originally enlarged during 1960. By 1983, extensive sediment deposition within this section necessitated a large-scale dredging operation. Dredging activities were conducted during 1983-1984 and included all of this station.

This station also included a portion of the drain from Decker Lake. The drain was sampled at intervals up to 150 yards from its confluence with the Jordan River. The predominant habitat present was a slow, shallow run; however, a small riffle was present at the base of a bridge approximately 150 yards up from its confluence with the Jordan River. Substrates in the drain were silt, debris, and some cobble-rubble. Banks were grass covered and emergent macrophytes were present along the margins. The Decker Lake drain, though part of this station, often exhibited temperatures different than the mainstem Jordan River and presumably different water quality due to its source.

JORDAN RIVER - 1700 SOUTH - This station extended from the 1700 South bridge to the gates where the Jordan River and Surplus Canal are split. Flows in the Jordan River are controlled below this point, so that the Jordan River downstream of 1700 South contains only a portion of the total flow present in the upstream areas. The most commonly occurring habitat in this section was a slow run; however, other habitats were present. These included a deep circulating pool (<10 ft.) at the base of the flood control gates near 2100 South, a large, shallow backwater at the boat ramp by Raging Waters, and a riffle at the 1700 South bridge. Bank types were variable within the reach and included grass, riparian, and

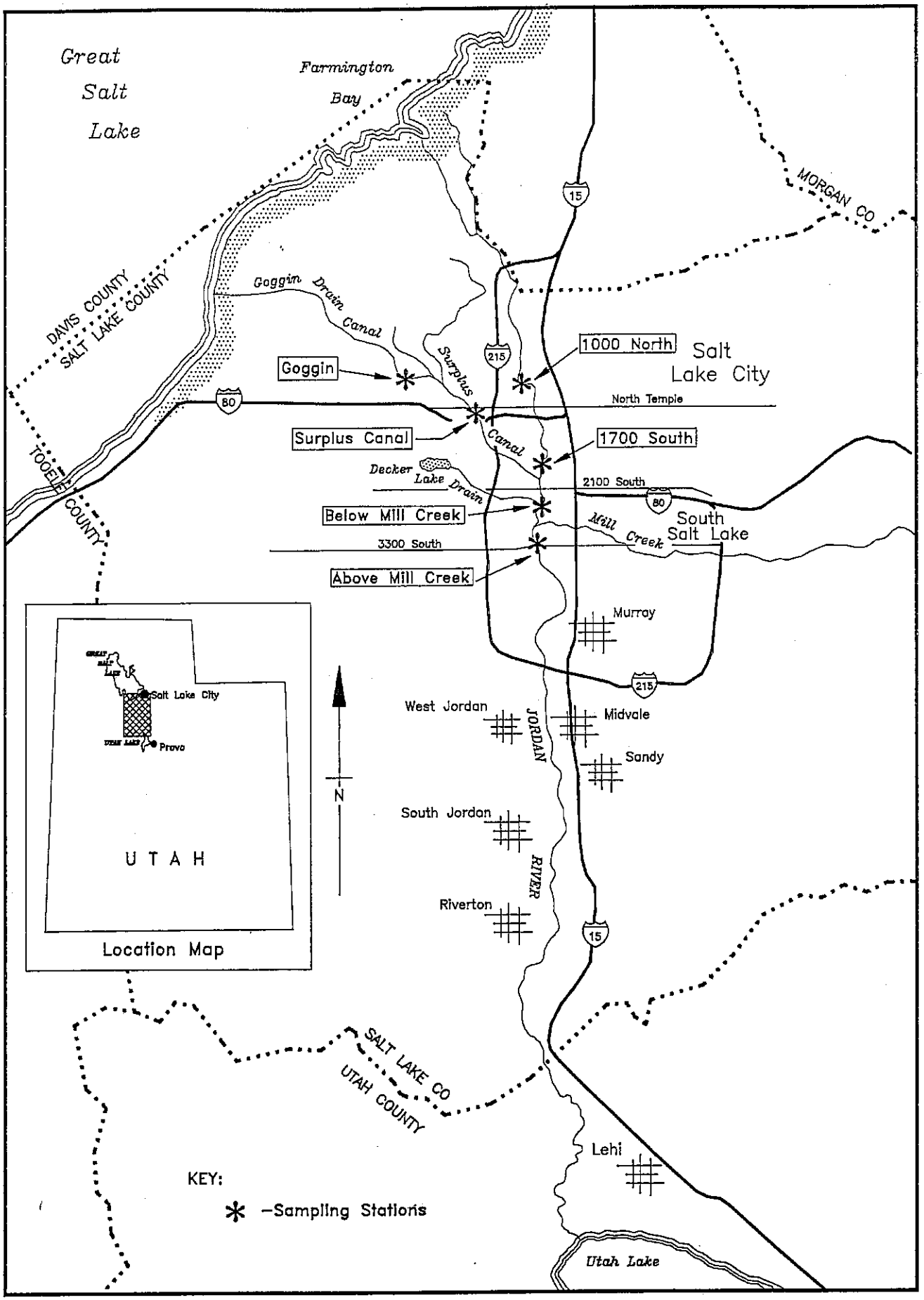

Figure 1. Location of Sampling Stations on the Jordan River and Canals.

Table 1

RECENT HISTORY OF PHYSICAL MODIFICATIONS OF THE JORDAN RIVER.

Station[a]	Jordan River Above Mill Creek	Jordan River Below Mill Creek	Jordan River 1700 South	Jordan River 1000 North	Surplus Canal
Dredging	1983	1983-84	1985[a]	1981-82	1983-84
Channelization	1950's	1960	N/A[b]	1981-82	1960
Bank Modification[c]	1983[f]	1960[d]	N/A	1981-82[e]	1960[d]

[a] This station has been dredged annually for the past five years, excluding 1986.
[b] No information available.
[c] Bank modification records are vague and in many cases recent history is based on dredging/channelization information.
[d] Diked
[e] Levee work
[f] Riprapping

bare banks. Substrate was composed of silt, sand, and gravels in slower stream sections and sand gravels and cobble-rubble in areas of higher velocity such as below the 1700 South bridge, and near the flow regulation structure in the upper station reach.

Due to the presence of boat launch facilities, the river between the railroad trestle and 1700 South was dredged annually between 1980 and 1985. Dredging has not occurred since 1985.

JORDAN RIVER - 1000 NORTH - This station extended from the 1000 North bridge upstream to the 400 North bridge. The station is straight and canal-like through much of its length, though it meanders in the upper portion of the station. Predominate habitat is a slow run. Riffles exist at the upper and lower ends of the station at the 1000 North and 400 North bridges. Banks support woody riparian vegetation and grasses. Substrates are primarily composed of silt, except in the riffles where cobble and rubble is present. The entire stream section from North Temple downstream underwent extensive bank modification and dredging during 1981 and 1982.

SURPLUS CANAL - This station encompassed the section of the Surplus Canal from the diversion dam for the North Point Consolidated Canal downstream to where the flume for the North Point Canal crosses the Surplus Canal. The Surplus Canal at the base of the diversion dam is a popular walleye fishing area for local fishermen. Occasionally abundant catches of walleye and white bass have been reported for the area, particularly in the spring. The overall habitat in this section appears similar to the Jordan River below Mill Creek. The channel is uniform and straight. Depths, however, are greater and more debris is present in and along the water's edge resulting from riprap operations. In addition, spill from the diversion dam for the North Point Canal creates higher velocities at the upper end of the station. Consequently, rubble substrates predominate in this area. Much of the remainder of the station exhibits silt-clay-gravel substrates. Banks support primarily grasses or are bare. Riprap is common in the upper portions of the station.

GOGGIN CANAL - This station included the portion of the canal from its origin on the Surplus Canal to approximately 1.5 miles downstream. Other portions of the canal up to 3.0 miles downstream were also occasionally sampled. The uppermost portion of the Goggin Canal is formed by a low section of the dike along the Surplus Canal where water is allowed to spill down into the Goggin Canal. This area is frequently referred to as the Goggin Gates and was a popular fishing area until 1988, when private vehicular access to the area was restricted.

The Goggin Canal exhibited predominately run habitats with depths of 3 to 5 feet and substrates of silt-clay except in the uppermost section at its divergence from the Surplus Canal. Habitat at the uppermost end of the canal was a deep (<18 ft.) pool with shallow riffle margins where water from the Surplus Canal drops down into the Goggin Canal. Banks along the Goggin consisted primarily of bare silt banks rarely interspersed with small amounts of woody riparian vegetation. Banks in the uppermost section of the canal around the pool were riprapped. Recent dredging history is unknown for the Goggin Canal. During 1988, however, a series of modifications occurred to the dike between the Goggin and Surplus Canals which reduced the flow entering the Goggin Canal.

RESULTS AND DISCUSSION

SPECIES COMPOSITION

Twenty-two species of fish were collected from the Jordan River study area (Table 2). The greatest number of different species occurred on the Jordan River at the 1700 South, where 18 different species were collected (Table 3). The stations above Mill Creek and below Mill Creek also exhibited relatively

Table 2 . Species Captured on the Jordan River 1988.

Common Name	Scientific Name
Walleye	Stizostedion vitreum vitreum (Mitchill)
Yellow Perch	Perca flavescens (Mitchill)
White Bass	Morone chrysops (Rafinesque)
Green Sunfish	Lepomis cyanellus Rafinesque
Black Crappie	Pomoxis nigromaculatus (Lesueur)
Bluegill	Lepomis macrochirus Rafinesque
Largemouth Bass	Micropterus salmoides (Lacepede)
Smallmouth Bass	Micropterus dolomieui (Lacepede)
Rainbow Trout	Salmo gairdneri Richardson
Cutthroat Trout	Salmo clarki Richardson
Rbt X Ctt Trout	Salmo gairdneri X Salmo clarki
Brown Trout	Salmo trutta Linnaeus
Mountain Whitefish	Prosopium williamsoni (Girard)
Channel Catfish	Ictalurus punctatus (Rafinesque)
Black Bullhead	Ictalurus melas (Rafinesque)
Utah Sucker	Catostomus ardens Jordan and Gilbert
Mountain Sucker	Catostomus platyrhynchus (Cope)
Utah Chub	Gila atraria (Girard)
Common Carp	Cyprinus carpio Linnaeus
Goldfish	Carassius auratus (Linnaeus)
Fathead Minnow	Pimephales promelas Rafinesque
Gambusia	Gambusia affinis (Baird and Girard)
Mottled Sculpin	Cottus bairdi Girard
Longnose Dace	Rhinichthys cataractae (Valenciennes)

Table 3. Species List of Fish Collected at Each Station on the Jordan River and Associated Canals by all Methods.

Common Name	Jordan River Above Mill Creek	Jordan River Below Mill Creek	Jordan River 1700 South	Jordan River 1000 North	Surplus Canal	Goggin Canal
Walleye	X	X	X	X	X	X
Yellow Perch	X	X	X	X	X	X
White Bass	X	X	X	X	X	X
Green Sunfish	X	X	X	-	X	X
Black Crappie	X	-	X	-	-	-
Bluegill	-	-	-	-	-	X
Largemouth Bass	X	X	-	-	-	-
Smallmouth Bass	-	-	-	X	-	-
Rainbow Trout	-	X	X	-	X	-
Cutthroat Trout	-	X	X	-	-	-
Brown Trout	X	X	-	X	-	-
Mountain Whitefish	-	-	X	-	-	-
Channel Catfish	X	X	X	-	X	X
Black Bullhead	X	X	X	-	-	X
Utah Sucker	X	X	X	X	X	X
Mountain Sucker	-	-	X	-	-	-
Utah Chub	-	X	X	X	-	-
Carp	X	X	X	X	X	X
Goldfish	-	-	X	-	-	-
Fathead Minnow	X	X	X	X	X	X
Gambusia	X	-	X	X	-	-
Mottled Sculpin	-	-	X	-	-	-
Longnose Dace	X	-	-	-	-	-
Total # Species	**14**	**14**	**18**	**10**	**9**	**10**

high total numbers of species, with 14 occurring at each. Species composition was less varied on the Goggin Canal, where only 10 species were found. Nine species were found at stations on the Surplus Canal and the Jordan River at 1000 North. The number of species that occurred at a station appeared to be related to the diversity of habitats available. The Jordan River at 1700 South exhibited the greatest variety of habitats of any station in the study area. The stations above and below Mill Creek were also relatively diverse, exhibiting a variety of habitats including some not found in the lower river and canal sections, such as tributary streams and drains. The stations on the Surplus and Goggin canals and on the Jordan River at 1000 North exhibited fairly uniform habitats, with some variabilCty. Variability in these habitats was generally the result of man-made hydraulic features. Species that were widely distributed throughout the study area included carp, Utah suckers, fathead minnows, walleye, yellow perch, white bass, and green sunfish.

DISTRIBUTION AND ABUNDANCE

Distribution and abundance of fish was primarily based on electrofishing and to a lesser extent seining. CPE data for each station is summarized in Tables 4 and 5. Table 4 shows average CPE by electrofishing for all collections at a station during 1988 and Table 5 gives the average CPE for all seining collections at each station during the year. Data collected during each sample period at a station is presented in Appendices A, B, and C. Total numbers of fish collected during each sample period at each station is given in Appendix A. CPE by electrofishing for each individual collection period at each station is given in Appendix B. CPE of fish species and life stages collected during each sampling trip in seining collections is given in Appendix C.

NONGAME FISH

CARP - Carp were by far the most abundant and widely distributed fish in lower Jordan River. Average CPE in electrofishing collections for 1988 ranged between 43.18 fish/1000 seconds at the Jordan River 1000 North and 137.87 fish/1000 seconds at the Jordan River 1700 South. Low but consistent numbers of carp, ranging from 0.01 to 0.50 fish/100 ft^2, were collected in seining collections throughout the study area. Absence of young carp in seining collections even though adult fish were extremely abundant is likely due to behavior of young fish. Young carp are seldom collected (Panek 1987), often burrowing in silt and sand or hiding in vegetation to avoid capture.

UTAH SUCKERS - Utah suckers were the second most abundant fish in the lower Jordan River. Average CPE for Utah suckers ranged between 1.14 and 26.58 fish/1000 seconds. Utah suckers were most abundant in the river above Mill Creek and at 1700 South. Relatively low CPE was recorded in the Jordan at 1000 North and in the Surplus and Goggin canals. The abundance of Utah sucker in the Jordan River is apparently related to available substrate. In the present study, the stations above Mill Creek and at 1700 South exhibited more gravel and rubble substrates than other stations. Holden and Crist (1987) found that Utah suckers were the most abundant fish in the upper Jordan River where substrates were primarily cobble and rubble. Reduced abundance occurred in the lower Jordan River over finer substrates. Utah suckers were overall the most abundant fish encountered in seining collections in the Jordan River, but not the Surplus and Goggin canals. Larval and YOY suckers were particularly abundant in backwaters seined.

OTHER NONGAME SPECIES - Other commonly occurring nongame fish in the lower Jordan River system included fathead minnows, gambusia (mosquito fish), and Utah chub. Average densities of fathead minnows in the Jordan River and Surplus Canal ranged between 0.18 and 3.19 fish/100 ft^2. However, the station on the Goggin Canal exhibited a higher average density (14.18 fish/100 ft^2). Gambusia occurred at most stations but were most abundant at 1700 South. Higher abundance of gambusia at 1700 South was primarily due to the presence of several backwaters and embayments with vegetated margins. Gambusia were particularly abundant on the fringes of these habitats in vegetation. Utah

Table 4. Average CPE (Fish/1000 sec) for All Electrofishing Collections at 6 Stations on the Jordan River and Associated Canals.

	Jordan River (Above Mill Creek)	Jordan River (Below Mill Creek)	Jordan River 1700 South	Jordan River 1000 North	Surplus Canal	Goggin Canal
Walleye	.20	1.13	.47	.07	.59	.19
Yellow Perch	.04	.04	.17	.04	.07	.06
White Bass	.55	1.69	.30	.04	.77	.47
Green Sunfish	.24	.16	2.13	-	.91	2.24
Black Crappie	.12	-	.04	-	-	-
Bluegill	-	-	-	-	-	.06
Largemouth Bass	.04	.12	-	-	-	-
Smallmouth Bass	-	-	-	.04	-	-
Rainbow Trout	-	.16	.21	-	.04	-
Cutthroat Trout	-	.04	.08	-	-	-
RbtxCtt Trout[1]	-	-	.34	-	-	-
Brown Trout	.04	.08	-	.04	-	-
Unident Trout	-	.08	-	-	-	-
Mountain Whitefish	-	-	.04	-	-	-
Channel Catfish	.28	.12	.21	-	.04	.03
Black Bullhead	.08	.32	.08	-	-	.03
Utah Sucker	26.25	12.49	26.58	4.31	5.70	1.14
Mountain Sucker	-	-	.04	-	-	-
Utah Chub	-	1.13	16.30	7.73	-	-
Carp	81.78	72.27	137.35	75.87	114.96	43.18
Goldfish	-	-	.08	-	-	-
Fathead Minnow	2.79	1.61	1.75	.22	1.22	13.87
Gambusia	.04	-	.04	-	-	-
Mottled Sculpin	-	-	.04	-	-	-

[1]Rainbow-Cutthroat Hybrid

Table 5. Average CPE (Fish/100 Ft^2) of Fish Species and Life Stages Collected by Seining Jordan River and Associated Canals, 1988.

Species	Lifestage	Jordan River Above Mill Creek	Jordan River Below Mill Creek	Jordan River Decker Lake Drain	Jordan River 1700 South	Jordan River 1000 North	Surplus Canal	Goggin Drain
Fathead	Larval	.03	.02	.12	.02	.20	.05	.74
	YOY	.29	.16	.33	.16	.49	.27	7.49
	Juvenile	.68	0	.75	.25	.34	.36	4.11
	Adult	.82	0	1.99	1.78	.43	.29	1.84
	TOTAL	**1.82**	**.18**	**3.19**	**2.21**	**1.46**	**.97**	**14.18**
Gambusia	Larval	.03	0	0	.04	.45	0	0
	YOY	.01	.07	0	9.31	.88	0	0
	Juvenile	.03	0	0	.46	.23	.01	0
	Adult	.06	0	0	.29	.31	0	0
	TOTAL	**.13**	**.07**	**0**	**10.10**	**1.87**	**.01**	**0**
Utah Sucker	Larval	3.12	0	.46	.02	.10	0	0
	YOY	9.22	0	.11	2.63	3.73	0	0
	Juvenile	.91	.02	.01	.02	0	0	0
	TOTAL	**13.25**	**.02**	**.58**	**2.67**	**3.83**	**0**	**0**
Carp	Larval	.07	0	.05	.03	0	0	0
	YOY	.04	.02	.10	.30	.34	0	.10
	Juvenile	0	.02	.02	.17	.03	.01	0
	TOTAL	**.11**	**.04**	**.17**	**.50**	**.37**	**.01**	**.10**
Utah Chub	Larval	0	0	0	0	0	0	0
	YOY	0	0	0	0	.03	0	0
	Juvenile	0	0	0	.12	0	0	0
	TOTAL	**0**	**0**	**0**	**.12**	**.03**	**0**	**0**
Green Sunfish	Larval	0	0	0	0	0	0	0
	YOY	.10	0	.02	.01	0	0	0
	Juvenile	0	0	.01	0	0	0	.06
	Adult	.01	0	0	0	0	0	0
	TOTAL	**.11**	**0**	**.03**	**.01**	**0**	**0**	**.06**
Mountain Sucker	Larval	0	0	0	0	0	0	0
	YOY	0	0	0	0	0	0	0
	Juvenile	0	0	0	.01	0	0	0
	TOTAL	**0**	**0**	**0**	**.01**	**0**	**0**	**0**

Table 5. (Continued)

Species	Lifestage	Jordan River Above Mill Creek	Jordan River Below Mill Creek	Jordan River Decker Lake Drain	Jordan River 1700 South	Jordan River 1000 North	Surplus Canal	Goggin Drain
Channel	Larval	0	0	0	0	0	0	0
Catfish	YOY	0	0	.01	0	0	0	0
	Juvenile	0	.05	.01	0	0	0	0
	TOTAL	0	.05	.02	0	0	0	0
Goldfish	Larval	0	0	0	0	0	0	0
	YOY	0	0	0	0	0	0	0
	Juvenile	0	0	0	0	0	0	0
	Adult	0	0	0	.01	0	0	0
	TOTAL	0	0	0	.01	0	0	0
White Bass	Larval	0	0	.01	0	0	0	0
	YOY	0	.06	.25	.03	.02	.05	.12
	Juvenile	0	0	0	0	0	0	0
	TOTAL	0	.06	.26	.03	.02	.05	.12
Walleye	Larval	0	0	0	0	0	0	0
	YOY	0	0	0	<.01	0	.01	0
	Juvenile	0	0	0	0	0	0	0
	TOTAL	0	0	0	<.01	0	.01	0

chubs were moderately abundant in electrofishing collections in the Jordan River below Mill Creek. No Utah chubs were collected upstream of Mill Creek or in the Surplus and Goggin canals.

Nongame fish which were only sporadically collected and included mountain suckers, mottled sculpin, and goldfish. All three species were collected only on the Jordan River at 1700 South. Mountain suckers and mottled sculpin, which are generally associated with relatively swift water and cobble or rubble substrates, were collected from the base of the diversion at approximately 2100 South where the Jordan River and Surplus Canal are split.

GAME FISH

Several species of game fish were present in the Jordan River and associated canals, though densities were often low. Walleye, yellow perch, and white bass were collected from every sampling station. Green sunfish and channel catfish were collected from every station except the Jordan River at 1000 North. Black bullheads were collected from four of the six stations. Trout, either rainbow, cutthroat, or brown, were collected at every sampling station except on the Goggin Canal. They were most commonly encountered at 1700 South and below Mill Creek. Infrequently occurring game fish included black crappie, bluegill, largemouth bass, smallmouth bass, and mountain whitefish.

WALLEYE - Walleye were widely distributed throughout the lower Jordan River and Surplus and Goggin canals. A total of 71 walleye, including YOY, juvenile, and adults were collected from the study area during 1988. Average CPE for fish collected by electrofishing ranged between 0.19 and 1.13 fish/1000 seconds, with the highest CPE occurring at the station below Mill Creek. The relatively high CPE at the station below Mill Creek compared to other areas was due primarily to a concentration of juvenile and YOY walleye collected from the during late September. CPE for the September sample at the station below Mill Creek (Appendix B) averaged 6.47 fish/1000 seconds, the highest CPE for walleye recorded during 1988. CPE for walleye more typically ranged between 0 and 1.0 fish/1000 seconds for any given sample period. Walleye collected during the September trip at that site were all located in the plume from Mill Creek. Water temperatures in the plume at the time ranged from 19.0°C to 21.0°C, approximately 3.0°C warmer than the main channel temperatures in the Jordan River, which were 17.0°C at the time. Walleye were apparently attracted either by the warmer temperatures or possibly by the presence of prey items present in the plume. Previous and subsequent sample trips did not show concentrations of fish in the Mill Creek plume.

WHITE BASS - White bass were a frequently occurring game fish in the Jordan River and associated canals. A total of 150 white bass were collected during 1988, including larval, YOY, juvenile, and adult fish. Average CPE for white bass collected during electrofishing ranged from 0.04 to 1.69 fish/1000 seconds. Lowest CPE values were from 1000 North on the Jordan River, where a single fish was collected. Highest values were recorded from the station below Mill Creek.

YELLOW PERCH - Yellow perch were widely distributed throughout the lower Jordan River and canals. However, densities as reflected by electrofishing CPE were low, ranging from 0.04 and 0.17 fish/1000 seconds. A total of only 11 yellow perch were collected during 1988, all of which were juveniles and adults.

GREEN SUNFISH - Green sunfish were the most commonly collected game fish in the lower Jordan River system. A total of 167 fish were collected during 1988, including all life stages. The only station from which they were not collected was the Jordan River at 1000 North. Average CPE during 1988 ranged from 0 fish/1000 seconds at 1000 North to a high of 2.24 fish/1000 seconds in the Goggin Canal. The Jordan River at 1700 South also exhibited a relatively high CPE of 2.13 fish/1000 seconds.

CHANNEL CATFISH - Channel catfish occurred sporadically throughout the study area. A total of 21 channel catfish ranging in size from larval fish to a 3.5 lb adult were collected. Average CPE of fish collected electrofishing was relatively low ranging from 0 at the 1000 North station to 0.28 fish/1000 seconds at the station above Mill Creek. Electrofishing CPE may not accurately reflect the abundance of channel catfish relative to other species since they are not as susceptible to capture by electrofishing as many species.

BLACK BULLHEADS - Black bullheads exhibited low densities, and a sporadic but widespread distribution, similar to channel catfish. Average CPE values for electrofishing ranged from 0 to 0.32 fish/1000 seconds. Black bullhead were collected at all stations except the Jordan River at 1000 North and the Surplus Canal.

TROUT - Trout were distributed sporadically at low densities through the study area, except for a small concentration of fish located from the confluence of Mill Creek and the Jordan River to the upper end of the 1700 South station. Species of trout collected from the Jordan River included rainbow, cutthroat, brown, and rainbow x cutthroat hybrids. Trout were collected from every station in the study area except the Goggin Canal. Collections of trout at the stations above Mill Creek, at 1000 North, and at the Surplus Canal, however, were composed of only a single fish each. Trout were most commonly collected from the Jordan River at 1700 South and below Mill Creek. A total of 9 trout representing an average electrofishing CPE of 0.36 fish/1000 seconds were collected at the station below Mill Creek, while 15 trout for an average CPE of 0.64 fish/1000 seconds were collected at the 1700 South station. All trout collected from the 1700 South station occurred near the culvert and deep pool at the top of the station where the Jordan River and Surplus Canal diverge.

BLACK CRAPPIE - Black crappie rarely occurred within the study area. Fish were collected only at the Jordan River above Mill Creek and at 1700 South. One fish was collected just above the confluence of Mill Creek and the Jordan River. Two fish were collected from the pool at the base of the culvert located at the top of the 1700 South station.

BLUEGILL - Bluegill were collected from a single location on the Goggin Canal. Two fish were collected from a brush pile in the Goggin Canal during the December sample trip.

LARGEMOUTH BASS - Largemouth bass also exhibited extremely low densities and limited distribution in the study area. During the final sampling trip in December, one YOY was collected from the station above Mill Creek and three YOY were collected from the station below Mill Creek. No adult fish were collected.

OTHER SPECIES - The occurrence of mountain whitefish and smallmouth bass was based on the capture of a single fish each. One smallmouth bass, a previously unsuspected species in the Jordan River was collected from the Jordan at 1000 North. The fish measured 8.5 inches total length and weighed 5 oz. One mountain whitefish was collected from the Jordan River at 1700 South.

REPRODUCTION

Evidence of reproducing fish populations in an area was based primarily on two criteria. The most important was the presence of early life stages of a species such as larval and YOY fish. Collections of early life history stages of fish are frequently used to determine nursery areas and delimit spawning grounds and seasons (Snyder 1983). In addition the presence of reproductively mature adults in a likely spawning area was considered indicative of at least attempted reproduction.

Larval and YOY fish were primarily collected by a combination of drift netting for larval fish and seining with a small mesh seine for larval and YOY fish. Additional YOY were also occasionally collected during

electrofishing runs. Table 5 presents summary seining data for the various species and life stages of fish collected at each station. Seining data for each species and life stages of fish collected at each station during each sample period is given in Appendix C. Table 6 shows drift rates of larval fish observed during the study. Total numbers of larval, YOY, and juvenile game fish collected by all gear types including electrofishing is shown in Table 7.

NONGAME FISH

CARP - The three most abundant nongame fish, carp, Utah suckers, and fathead minnows, all appear to be reproducing within the study area. Carp apparently reproduce throughout the lower Jordan River and its associated canals. Larval carp were present in drift samples at each station and were by far the most abundant fish in the drift. YOY carp, though not abundant in seine hauls were present throughout the study area. Larval carp first appeared in the drift on the Goggin canal in late May when mean water temperatures were approximately 17.5°C (fig 2). Peak drift rates were observed during late June when water temperatures were averaging approximately 24.8°C and subsided in early July. Highest densities (37.80 fish/1000 ft^3) of larval carp were observed in the Surplus Canal during late June. The area of the Jordan exhibiting the lowest overall densities of drifting larval carp was the station above Mill Creek.

UTAH SUCKERS - Utah suckers also appear to be reproducing in the study area although not over as wide an area as carp. Reproduction by Utah suckers appears to be occurring primarily above Mill Creek on the Jordan River, though perhaps not exclusively.

During May 1988, a number of reproductively mature male and female fish were collected while spawning on a shallow gravel bar upstream of Mill Creek. Also during May and June low densities (0.04-0.16 fish/1000 ft^3) of larval Utah suckers were collected in the drift only at the station above Mill Creek. In addition, larval and YOY suckers were most abundant in seine hauls at the station above Mill Creek, averaging a total of 13.25 fish/100 ft^2. Each of these factors indicates significant reproduction of Utah suckers upstream of Mill Creek. Reproduction of Utah suckers may also be occurring on the Jordan River in selected areas downstream of Mill Creek. Larval and YOY suckers were collected at the 1700 South and 1000 North stations. Reproductively mature males were also collected in those areas.

No larval or YOY Utah suckers were collected in the drift or with seines in the Surplus Canal or Goggin Canal. The lack of young fish in these areas is probably due to several factors. Observations of habitat usage by larval and YOY suckers during this study indicate that young Utah suckers congregate in backwater habitats. No backwater habitats existed which would serve to concentrate young suckers at the Surplus Canal or Goggin Canal stations. At least marginal backwater habitats did exist at the other stations. In addition, Utah suckers spawn over gravel and sand (Sigler and Sigler 1987). Fish observed spawning during this study were utilizing a shallow gravel bar. Gravel substrates are relatively common upstream of Mill Creek, their occurrence, however, decreases greatly downstream of Mill Creek. Some gravel-rubble substrates occur at constrictions such as under bridges and at culverts on the Jordan below 2100 South. Gravel-rubble substrates on the Surplus Canal and Goggin Canal, however, are practically nonexistent, occurring only in riprapped areas and at the base of man-made hydraulic features such as diversion or flow regulation structures.

FATHEAD MINNOWS - Fathead minnows were common and apparently reproduce in appropriate habitats throughout the Jordan River and associated canals. Observations of breeding habitat of fathead minnows in the Jordan made during this study indicated a preference for backwaters, embayments, drains and even slow runs with some vegetation or debris for cover. Sexually mature males and females, larval, YOY, and juvenile fish were collected at all stations.

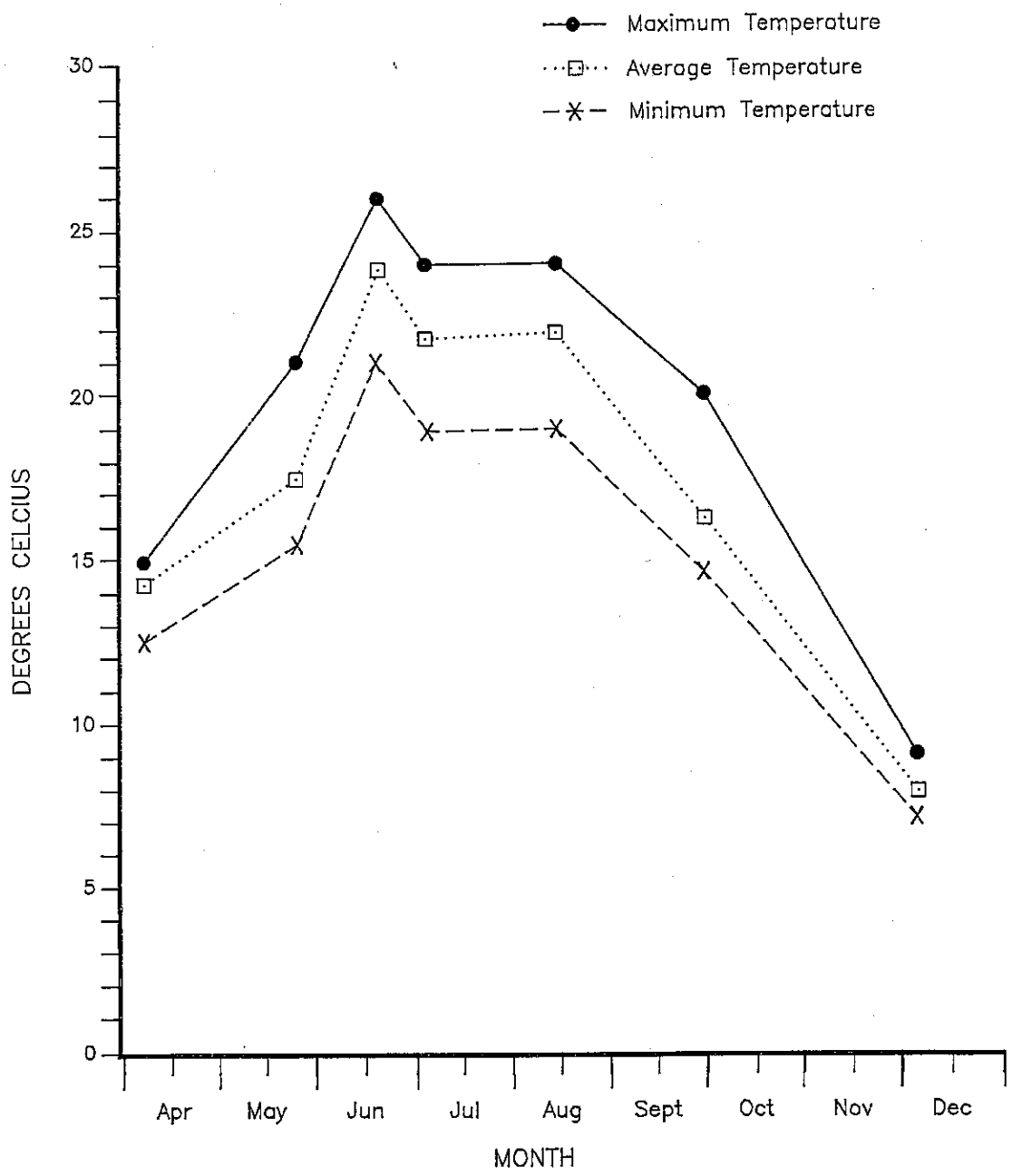

Figure 2. Maximum, Minimum and Mean Temperatures Observed on the Jordan River April–December 1988

Table 6. Mean (n=4) Larval Fish Drift Rates (Fish/1000 Ft^3), on the Jordan River and Associated Canals.

	Jordan River Above Mill Creek					Jordan River Below Mill Creek					Jordan River 1700 South					Jordan River 1000 North				
	4/6	5/26	6/22	7/5	8/16	4/6	5/26	6/22	7/5	8/16	4/6	5/25	6/22	7/5	8/15	4/8	5/29	6/25	7/6	8/16
Common Carp	0	0	1.37	.46	0	0	0	4.28	1.77	0	0	0	3.44	1.15	0	0	0	.81	.40	0
Fathead Minnow	0	0	0	0	0	0	0	0	0	0	0	0	0	.16	0	0	0	0	0	.15
Utah Sucker	0	.04	.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Channel Catfish	0	0	0	0	0	0	0	0	.11	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	.04	1.53	.46	0	0	0	4.28	1.88	0	0	0	3.44	1.31	0	0	0	.81	.40	.15

	Surplus Canal					Goggin Canal				
	4/8	5/27	6/25	7/6	8/17	4/8	6/3	6/23	7/8	8/17
Common Carp	0	.22	37.8	19.7	0	0	4.50	1.22	9.36	0
Fathead Minnow	0	0	0	0	.21	0	0	.07	.11	1.66
TOTAL	0	.22	37.8	19.7	.21	0	4.50	1.27	9.47	1.66

Table 7.

Total Number Of Larval, YOY, And Juvenile Gamefish Captured By All Gear Types.

Species	Lifestage	Jordan River Above Mill Creek	Jordan River Below Mill Creek (Main Channel)	Jordan River Below Mill Creek (Decker Drain)	Jordan River 1700 South	Jordan River 1000 North	Surplus Canal	Goggin Canal	Total # Of Fish
		SAMPLE STATION							
Walleye	YOY	0	3	0	5	0	7	2	17
	Juvenile	5	18	1	3	0	6	1	34
	TOTAL	5	21	1	8	0	13	3	51
Yellow Perch	YOY	0	0	0	0	0	0	0	0
	Juvenile	1	0	0	4	1	2	2	10
	TOTAL	1	0	0	4	1	2	2	10
White Bass	Larval	0	0	1	0	0	0	0	1
	YOY	4	9	34	4	1	11	4	67
	Juvenile	1	3	0	2	0	1	0	7
	TOTAL	5	12	35	6	1	12	4	75
Green Sunfish	YOY	8	0	1	1	0	0	10	20
	Juvenile	1	0	2	3	0	1	17	24
	TOTAL	9	0	3	4	0	1	27	44
Largemouth Bass	YOY	1	3	0	0	0	0	0	4
	Juvenile	0	0	0	0	0	0	0	0
	TOTAL	1	3	0	0	0	0	0	4
Channel Catfish	Larval	0	1	0	0	0	0	0	1
	YOY	0	0	1	0	0	0	0	1
	Juvenile	2	1	3	3	0	0	0	9
	TOTAL	2	2	4	3	0	0	0	11
Black Bullhead	YOY	0	1	0	0	0	0	0	1
	Juvenile	0	0	0	0	0	0	0	0
	TOTAL	0	1	0	0	0	0	0	1
TOTAL BY STATION		23	39	43	25	2	28	36	196

GAMBUSIA - Gambusia also appear to reproduce throughout the Jordan River system, wherever appropriate habitats exist. In the Jordan River, Gambusia typically inhabit and breed in small backwaters or embayments with vegetation or debris. Reproductively mature adults and early life stages were observed at the stations above Mill Creek, at 1700 South, and at 1000 North. Lack of apparent reproduction at other sites appeared to be due primarily to lack of suitable habitats

UTAH CHUB - Utah chubs probably reproduce in the lower Jordan River. However, only low densities of YOY fish were encountered, and only at the 1000 North station. Numerous juvenile and adult fish, however, were collected while electrofishing in the Jordan River from 1700 South to 1000 North. Spawning in the Jordan River potentially could be occurring downstream of present sampling areas. with fish migrating upstream as they mature.

GAME FISH

Several species of game fish exhibited at least limited reproduction in the Jordan River and its associated canals during 1988. They included, walleye, white bass, green sunfish, black bullhead, and channel catfish. Game fish that occurred in the river, but apparently did not reproduce, included rainbow trout, cutthroat trout, brown trout, mountain whitefish, smallmouth bass, and black crappie.

WALLEYE - There appeared to be at least limited reproduction by walleye in the lower Jordan River system, though the extent and magnitude is still uncertain. Potential sites of reproduction include the Surplus Canal at the North Point diversion, the Goggin Canal at its divergence from the Surplus Canal and the Jordan River upstream of 1700 South.

No reproductively mature male or female fish were collected at any station during 1988. However, based on conversations with fishermen, it appears that a brief spawning run of walleye occurs in the Surplus Canal in early spring. Sampling during spring 1988 did not collect any ripe male or female fish since it apparently did not coincide with walleye spawning. Walleye spawning occurs at temperatures ranging from 6°C to 11°C during a period of rapid warming and often is concentrated during just a few days (McMahon et al. 1984).

Highest concentrations of young walleye in the study area were found in the Surplus Canal. Seven YOY walleye less than 50 mm total length were collected within 0.5 miles downstream of the North Point Canal diversion dam, indicating at least some reproduction by walleye in the Surplus Canal. Young walleye were collected primarily from a slow run along a riprapped banks and in small embayments.

The North Point Canal diversion structure is a probable spawning area for walleye in the Surplus Canal for several reasons. It is one of the few areas in the canal exhibiting shallow rubble substrates and good water circulation. Preferred spawning habitat for walleye are shallow shoreline areas, riffles and dams with rocky faces and good water currents. In addition, the dam would tend to concentrate any walleye moving upstream to spawn since it is a block to further upstream migration.

Other areas in which YOY were collected included the station at 1700 South, the station below Mill Creek, and the station on the Goggin Canal. YOY collected at the 1700 South station included a fish only 54 mm total length, collected during late June, indicating that it was likely spawned nearby. The most likely area where walleye spawning would occur in the vicinity would be the Jordan River at the base of the culvert where it is split from the Surplus Canal. A large circulating pool with shallow edges and rubble-gravel substrates is present at this location due to the higher water velocities and scour occurring below the culvert. Young walleye were also collected in the Goggin Canal near a similar habitat to that at the 1700 South station. The uppermost portion of the Goggin is comprised of a deep circulating pool with shallow rubble margins and was one of the only areas in the Goggin which exhibited coarse substrate. YOY walleye collected at the station below Mill Creek were all collected late

in the summer and had already obtained a size of approximately 150 mm. Due to the great mobility of walleye of that size, it is uncertain where they would have been spawned.

WHITE BASS - White bass appeared to have reproduced throughout much of the study area during 1988. YOY were collected in low to moderate numbers at every station. Lowest density of YOY white bass was observed at the 1000 North station, where only a single fish was collected. Highest concentrations of young white bass were found in the Decker Drain at the station below Mill Creek, where 34 YOY and one larval white bass were collected. Numerous ripe male adults were also collected from the drain during May 1988. A concentration of 11 reproductively mature male and female white bass were collected while apparently spawning over gravel-rubble substrates in the Goggin Canal at its divergence from the Surplus Canal during May. White bass prefer to spawn in running water over firm substrates 0.5 to 6 meters deep. Fish often spawn in tributaries of larger rivers or reservoirs. Spawning usually begins when water temperatures are 12 to 24°C. Spawning in the Goggin Canal was observed when temperatures were 17.5°C. It appears likely that white bass may be spawning wherever appropriate substrates and water conditions exist.

An important factor in the survival of white bass in the Jordan River may be the occurrence of appropriate nursery habitats. Very young fish in the Jordan River appear to congregate in relatively slow quiet habitats such as drains, backwaters, and embayments in association with cobble, rubble, gravel, or sand substrates. Relatively few fish were found over exclusively silt substrates. Hamilton and Nelson (1984) stated that white bass larva hatched in rivers typically drift downstream to reservoirs or riverine backwaters where they were usually found associated with sandy bottoms. They avoided organic, silt bottoms. Nursery habitat for white bass in the Jordan is limited. Some stations contain no backwaters or other high value nursery habitats such as backwaters. Mortality of young white bass is potentially high due to the absence good rearing habitats for early life stages.

GREEN SUNFISH - Green sunfish also appear to spawn throughout the study area, wherever appropriate spawning substrates exist. YOY and/or reproductively mature adults were collected in low to moderate numbers at all stations except the Jordan River at 1000 North. Highest concentrations of YOY fish occurred along the rocky margins of the large pool at the head of the Goggin Canal. Green sunfish spawning has been recorded at temperatures ranging from 19°C to 31°C with initial spawning usually occurring at 20 to 22°C (Stuber et al. 1982). Spawning typically takes place on a firm substrate of gravel or sand near rocks logs or vegetation (Hunter 1963). Spawning in the Jordan River during 1988 occurred at temperatures ranging from 15.5 to 24.0°C and was usually observed in shallow areas along the water's edge, often in riprap or debris.

CHANNEL CATFISH AND BLACK BULLHEAD - Channel catfish and black bullhead catfish exhibited limited reproduction within the study area. One larval catfish was collected in drift samples at the station below Mill Creek after average river temperatures had peaked at approximately 23.7°C and dropped to 21.6°C. In addition, one YOY and several juveniles were found in the Decker Drain immediately downstream of Mill Creek. A single YOY black bullhead was collected at the station below Mill Creek. Channel catfish and black bullheads both spawn when temperatures reach 20 to 21°C. Nests are generally excavated under old logs, debris, and rocks or in other protected sites (Pflieger 1975, Stuber 1982). Channel catfish in particular require protected nesting sites or they will not spawn (Sigler and Sigler 1987). Lack of suitable spawning areas in the Jordan appears to be an important factor in explaining the limited numbers of young fish observed. In general, the Jordan River exhibits very little instream cover which would be suitable for spawning by channel catfish or black bullheads.

LARGEMOUTH BASS - Largemouth bass also appear to have exhibited limited reproduction in the lower Jordan River. Four YOY largemouth were collected during early December at the stations above and below Mill Creek. No adult fish were collected during 1988.

Largemouth bass spawn at temperatures of 16 of 22°C over a gravel substrate in areas of little or no water velocities. Other substrates such as vegetation, roots, sand, mud, and cobble are used when gravel is not available. Highly silted, mucky bottoms are unsuitable for embryos. In addition, water velocities as low as 40 cm/seconds (1.3 feet/seconds) have been shown to cause mortality among embryos (Stuber et al. 1982).

Relatively little spawning and nursery habitat for largemouth bass exists in the Jordan River. Most areas which contain gravel for spawning exhibit velocities which are higher than those preferred for spawning. Conversely, those areas in the river which exhibit optimum velocities are often heavily silted and thus unsuitable. Occurrence of YOY largemouth during December indicates that some reproduction did occur in the river; however, by December the fish collected were fairly large and capable of movement within the study area. This potential movement coupled with the lack of capture data on any adult fish does not allow identification of a specific spawning area.

NONREPRODUCING SPECIES - Several species of game fish exist in the river but apparently did not reproduce within the study area during 1988. The species included rainbow trout, cutthroat trout, brown trout, and smallmouth bass. The lower Jordan River is in general more suitable for reproduction and survival of cool and warm-water species than cold-water fish such as trout. Maximum summer temperatures are generally at lethal limits for young trout and little suitable habitat for spawning exists. Smallmouth bass existed in such low densities (one fish collected) that it may well represent a illegal plant, not a population with potential for reproduction. Yellow perch were also collected within the study area. However, because densities were low and collections of young fish were sporadic, their status as a reproducing population within the river is uncertain.

COMPARISONS WITH PREVIOUS STUDIES

Several fishery surveys and studies of the Jordan River have been conducted prior to 1988, including a survey by David Jordan in the summer of 1889 during which he surveyed a portion of the river that was probably near the confluence of Mill Creek and the Jordan River. More recently, aquatic biology studies were conducted by the EPA in 1972, described in Way (1980), fishery surveys were conducted by the Utah Division of Wildlife in 1976, 1985, and 1986 and a fishery and macroinvertebrate study was done by BIO/WEST, Inc. for the Central Valley Water Reclamation District in the fall of 1986. Not all the studies and surveys sampled the same sites on the river, but in general many of the stations used in this study were also sampled by one or more of the previous studies. In particular, the stations in this study correspond to the previous study conducted by BIO/WEST in 1986 (Holden and Crist 1987).

Table 8 shows species occurrence for several different years on the Jordan River where comparable stations existed. In the fall of 1889 Jordan surveyed the Jordan River at a site 4 miles southwest of Salt Lake City in the area which was probably equivalent to the station above Mill Creek in this study, and reported six species as occurring in varying abundance (Jordan 1891). Since 1889 the number of native species in the Jordan River has declined. The mountain whitefish, redside shiner, and mountain sucker have all declined from levels reported by Jordan. The major change in fish species composition since Jordan's survey has been the introduction of a large number of exotic fish to the drainage, including carp, which are now the dominate fish in the lower Jordan River. Occurrence of species in five studies conducted since 1972 indicate an increasing number of fish species are occurring in the lower Jordan River. The EPA reported only four species: carp, Utah suckers, Utah chubs, and redside shiners from the lower Jordan River in 1972. Utah Division of Wildlife surveys indicated only two species, carp and Utah suckers from the Jordan River at 1700 South in 1975, but reported those species plus walleye, white bass, green sunfish, Utah chubs, and mountain suckers for a total of seven species in 1985. Studies by BIO/WEST, Inc. during 1986 showed 14 species as occurring in the lower Jordan River. Subsequent sampling in 1988 indicated the occurrence of a total of 23 species as occurring in the lower Jordan River. Overall trends show a progressive increase in the number of

Table 8. Historic Occurrence of Species at Selected Areas on the Jordan River.

Station	Jordan River Above Mill Creek				Jordan River Below Mill Creek			Jordan River 1700 South				Jordan River 1000 North			Surplus Canal	
Investigator	Jordan	EPA	B/W	B/W	EPA	B/W	B/W	DOW	DOW	B/W	B/W	EPA	B/W	B/W	B/W	B/W
Date	89	72	86	88	72	86	88	76	85	86	88	72	86	88	86	88
Species																
Walleye				X		X	X		X		X			X	X	X
Yellow Perch				X			X				X			X		X
White Bass			X	X		X	X		X	X	X			X	X	X
Green Sunfish			X	X		X	X		X	X	X					X
Black Crappie			X	X		X				X	X					
Bluegill										X						
Largemouth Bass				X			X									
Smallmouth Bass														X		
Rainbow Trout							X			X	X					X
Cutthroat Trout							X			X	X					
Brown Trout			X	X			X							X		
Mountain Whitefish	X										X					
Channel Catfish			X	X		X	X			X	X					X
Black Bullhead			X	X			X			X	X					
Utah Sucker	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Mountain Sucker	X	X							X		X					
Utah Chub	X		X				X		X	X	X	X	X	X		
Carp		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Goldfish											X					
Fathead Minnow			X	X			X				X			X		X
Gambusia			X	X							X			X		
Mottled Sculpin											X					
Speckled Dace	X															
Longnose Dace				X												
Redside Shiner	X											X				
Total # Species	6	3	11	14	2	7	14	2	7	11	18	3	3	10	4	9

Jordan 89 - Report by David Starr Jordan 1891
EPA 72 - Environmental Protection Agency 1972
DOW 76, DOW 85 - Fisheries Surveys by Division of Wildlife 1976 and 1985

species occurring in the Jordan River since 1972. In particular there has been an apparent increase in the number of species present between 1972-1976 and 1985-1986. The increase in the number of species occurring between the BIO/WEST study in 1986 and 1988 is probably largely attributable to the much greater sampling effort in 1988 which netted a number of species of fish which only occur rarely and would probably not be collected in a normal survey.

Table 9 compares average CPE for electrofishing conducted in November 1986 with only the average CPE for electrofishing runs during December 1988. Fish species in 1986 which were not collected in the standardized runs for calculating CPE but were collected in low densities during Mark and Recapture samples are indicated by an X. The comparison is made only between the two months so that the biasing effect of seasonal variation and large differences in sample size is avoided. No dramatic changes in fish populations were noted by comparing the two similar periods, although a number of small shifts in the abundance and occurrence of fish were apparent. Whether these small shifts indicate trends or are the result of random sampling variation is still uncertain. Walleye, particularly juveniles, were somewhat more abundant at most stations in 1988 than 1986. White bass exhibited reduced densities in 1988 relative to 1986. Channel catfish and black bullheads were slightly more abundant in 1988, but the increase was small. Fathead minnows, an important forage fish for game fish populations in the Jordan, also showed increased densities in the 1988 electrofishing data. The total number of species collected at each station was somewhat variable. Above Mill Creek a slight decline in species collected during fall samples between 1986 and 1988. In reality, however those species observed during the fall of 1986 but not the fall of 1988 did occur at that station during other samples, except for Utah chub. Stations below Mill Creek all exhibited slight increases in number of species at each station was due to the more widespread occurrence of low numbers of walleye, yellow perch, largemouth bass, trout, channel catfish, black bullheads, and fathead minnows in the fall 1988 samples. Of particular interest is the fact that most of the game fish collected in 1988 at stations where they were previously unknown were juvenile and YOY fish. The increased occurrence of these young fish is likely due to at least limited reproduction by those species in the study area.

Reasons for the increased numbers of species of fish documented for the Jordan River since 1976 is probably attributable to a combination of factors. Prior to approximately 1980, and in particular before approximately 1970, poor water quality was apparently common in the Jordan River. Hinshaw (1966) documented low dissolved oxygen and high biological oxygen demand in his study. Way (1980) suggested that water quality in the late 1970s would have limited game fish populations. Conversations with Utah Division of Wildlife biologists also indicated that water quality during the 1976 fishery surveys was poor. Hydroqual (1987) modelled the water quality of the Jordan River for the period in the mid-1970s and showed high levels of chlorine approached, if not exceeded, levels toxic to some species of fish. Since 1980, due to a combination of higher than average flows in many years and improved waste treatment, water quality has improved. It appears that a number of species of fish that previously did not occur in the lower Jordan River due to poor water quality were reintroduced to the lower river sections from Utah Lake and the upper Jordan River by the high flows during the mid-1980s. Some of these species such as white bass, green sunfish, and walleye are now reproducing in the lower river on at least a limited basis where habitat is suitable.

SUMMARY

Twenty-three species of fish were collected from the Jordan River during 1988, of which carp and Utah suckers were the most abundant. Several species of game fish, however, including walleye, white bass, and green sunfish were widely distributed through the lower Jordan River and associated canals. Fish reproduction was based on the collection of young fish and reproductively mature adults. Carp,

Table 9. CPE (Fish/1000 sec) for Electrofishing at BIO/WEST Sampling Stations Fall 1986 and Fall 1988.

	Jordan River Above Mill Creek		Jordan River Below Mill Creek		Jordan River 1700 South		Jordan River 1000 North		Surplus Canal	
	86	88	86	88	86	88	86	88	86	88
Walleye	-	.59	.65	.23	X	.94	-	.27	-	1.70
Yellow Perch	-	-	-	-	-	.24	-	-	-	.50
White Bass	5.00	.59	2.00	-	1.10	.24	-	-	X	.25
Green Sunfish	X	-	.65	-	1.10	2.36	-	-	X	-
Black Crappie	X	.59	.25	-	X	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	.30	-	.69	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	-	-	-	-	-	-
Rainbow Trout	-	-	-	.23	-	.24	-	-	-	-
Cutthroat Trout	-	-	-	.23	-	.47	-	-	-	-
RbtxCtt Trout	-	-	-	-	-	.95	-	-	-	-
Brown Trout	X	-	-	.23	-	-	-	-	-	-
Unident Trout	-	-	-	.46	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	-	-	-	-	-
Channel Catfish	X	.59	X	-	X	.71	-	-	-	-
Black Bullhead	X	-	-	1.20	-	.47	-	-	-	-
Utah Sucker	37.20	46.40	22.50	3.20	47.90	49.80	2.80	3.60	2.3	3.70
Mountain Sucker	-	-	-	-	-	-	-	-	-	-
Utah Chub	X	-	-	-	3.40	1.90	.60	-	-	-
Carp	27.10	95.50	19.60	28.90	24.00	83.90	63.10	30.90	60.2	33.60
Goldfish	-	-	-	-	-	.24	-	-	-	-
Fathead Minnow	X	.59	-	-	.23	5.00	-	.27	-	.74
Gambusia	X	-	X	-	X	-	-	-	-	-
Mottled Sculpin	-	-	-	-	-	-	-	-	-	-
Longnose Dace	-	-	-	-	-	-	-	-	-	-
Total # Species	**11**	**8**	**8**	**9**	**10**	**14**	**3**	**4**	**5**	**6**

X Indicates species collected at low densities during mark and recapture sampling but not standardized electrofishing runs in 1986.

fathead minnows and gambusia all reproduced in abundance in at least portions of the study area. Utah suckers reproduced abundantly upstream of Mill Creek and possibly in selected areas downstream.

Walleye, white bass, channel catfish, black bullheads, and largemouth bass all exhibited at least limited reproduction in the lower Jordan River. Suspected spawning sites for walleye include the base of the North Point Diversion dam on the Surplus Canal, the Jordan River at the point where it diverges from the Surplus Canal and the Goggin Canal where it diverges from the Surplus canal. A primary suspected spawning areas for white bass was the Decker Drain and also those areas mentioned above for walleye. Green sunfish appeared to reproduce intermittently throughout much of the study area.

Other species of game fish including largemouth bass, channel catfish, and black bullhead apparently reproduced but there is insufficient data to determine sites of spawning, other than in very general terms.

Preliminary indications are that the primary factor limiting spawning of Utah suckers and most game fish is the lack of suitable spawning habitats. Gravel-rubble substrate with good water circulation and little silt are uncommon in the lower river sections. Water quality does not seem to be adversely affecting spawning fish since most species are apparently spawning in stream sections downstream of Mill Creek. In areas where suitable habitats exist, such as the Decker Drain for white bass, or the Surplus Canal at the North Point Diversion Structure for white bass and walleye, spawning does appear to be occurring.

Other limiting factors may also include the lack of sufficient high quality nursery habitats for young fish such as white bass. Studies during 1988 indicate that habitats such as drains, backwaters, and embayments are utilized by young fish, habitats which are relatively rare in the overall lower Jordan River system.

At present insufficient data exist to predict whether game fish populations will be able to maintain t emselves by reproduction in the lower river alone without the recruitment from upstream areas which occurs during high water years. A program of habitat improvement, however, could increase reproductive success and survival of young fish in the lower Jordan River.

RECOMMENDATIONS

Based on results from the first year's data the following recommendations are made to achieve the overall objectives of the study:

1. Continue sampling as during 1988. Data from the first year of study should make it possible to identify and document more precisely the type and location of spawning and nursery habitats of game fish in the lower Jordan River since general locations and times of spawning of fish have now been identified.

2. Recruitment of fish from the upper to lower Jordan River is still unquantified. Barriers between the upper and lower river areas should be examined to determine whether some contribution of young fish occurs to the lower Jordan River in normal water years.

3. Preliminary studies in the Jordan River indicate that spawning and nursery habitats for game fish are limited in the river and associated canals. In some areas the opportunity exists to create or improve, with a minimum of effort, spawning and nursery areas for game fish. If possible, a pilot program of habitat improvement in a specific location or locations should be implemented and fish use

monitored of these locations. Such a program would provide an important indication of the value of habitat improvement in the Jordan River.

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APPENDIX A

Table A-1. Total Numbers of Fish Collected Electrofishing - Jordan River Above Mill Creek

Sample Period	1	2	3	4	5	6	7	
Date	4/6	5/26	6/24	7/7	8/18	10/1	12/7	Total
Walleye	-	-	-	-	-	3	2	5
Yellow Perch		-	-	1	-	-	-	1
White Bass	-	4	-	2	3	3	2	14
Green Sunfish	1	-	-	-	2	3	-	6
Black Crappie	-	-	-	-	-	1	2	3
Bluegill	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	1	1
Smallmouth Bass	-	-	-	-	-	-	-	-
Rainbow Trout	-	-	-	-	-	-	-	-
Cutthroat Trout	-	-	-	-	-	-	-	-
RbtxCtt Trout[1]	-	-	-	-	-	-	-	-
Brown Trout	-	1	-	-	-	-	-	1
Unident Trout	-	-	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	-	-	-
Channel Catfish	3	-	-	1	-	1	2	7
Black Bullhead	-	-	-	1	-	1	-	2
Utah Sucker	33	152	36	102	70	121	157	669
Mountain Sucker	-	-	-	-	-	-	-	-
Utah Chub	-	-	-	-	-	-	-	-
Carp	409	215	308	298	301	249	323	2084
Goldfish	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	4	-	4	61	2	71
Gambusia	-	-	-	-	1	-	-	1
Mottled Sculpin	-	-	-	-	-	-	-	-
Sample Size (sec)	2470	3672	4237	3532	3846	4344	3381	25482

[1]Rainbow Cutthroat Trout Hybrid

Table A-2. Total Numbers of Fish Collected Electrofishing - Jordan River Below Mill Creek

Sample Period	1	2	3	4	5	6	7	
Date	4/6	5/26	6/24	7/7	8/18	10/1	12/7	Total
Walleye	1	1	-	-	1	24	1	28
Yellow Perch	-	-	-	-	-	1	-	1
White Bass	-	7	3	-	6	26	-	42
Green Sunfish	-	-	2	2	-	-	-	4
Black Crappie	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	3	3
Smallmouth Bass	-	-	-	-	-	-	-	-
Rainbow Trout	-	-	-	-	-	3	1	4
Cutthroat Trout	-	-	-	-	-	-	1	1
RbtxCtt Trout[1]	-	-	-	-	-	-	-	-
Brown Trout	-	-	1	-	-	-	1	2
Unident Trout	-	-	-	-	-	-	2	2
Mountain Whitefish	-	-	-	-	-	-	-	-
Channel Catfish	-	1	1	-	1	-	-	3
Black Bullhead	-	-	-	-	2	1	5	8
Utah Sucker	2	82	12	29	60	109	14	310
Mountain Sucker	-	-	-	-	-	-	-	-
Utah Chub	-	-	19	2	5	2	-	28
Carp	189	458	290	245	229	238	126	1794
Goldfish	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	1	-	1	37	1	40
Gambusia	-	-	-	-	-	-	-	-
Mottled Sculpin	-	-	-	-	-	-	-	-
Sample Size (sec)	2488	3274	3805	3529	3665	3708	4354	24823

[1]Rainbow Cutthroat Trout Hybrid

Table A-3. Total Numbers of Fish Collected Electrofishing - Jordan River @1700 South

Sample Period	1	2	3	4	5	6	7	
Date	4/7	5/27	6/26	7/6	8/19	9/28	12/8	Total
Walleye	1	2	-	-	2	2	4	11
Yellow Perch	-	2	-	-	-	1	1	4
White Bass	-	-	-	-	1	5	1	7
Green Sunfish	9	16	-	3	6	6	10	50
Black Crappie	-	1	-	-	-	-	-	1
Bluegill	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	-	-	-	-
Rainbow Trout	-	3	-	-	-	1	1	5
Cutthroat Trout	-	-	-	-	-	-	2	2
RbtxCtt Trout[1]	-	2	-	2	-	-	4	8
Brown Trout	-	-	-	-	-	-	-	-
Unident Trout	-	-	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	1	-	1
Channel Catfish	-	1	-	-	-	1	3	5
Black Bullhead	-	-	-	-	-	-	2	2
Utah Sucker	194	63	26	43	65	21	211	623
Mountain Sucker	-	1	-	-	-	-	-	1
Utah Chub	24	59	63	24	171	33	8	382
Carp	288	539	144	365	1328	201	355	3220
Goldfish	-	-	-	-	-	1	1	2
Fathead Minnow	3	2	-	6	2	7	21	41
Gambusia	-	-	-	1	-	-	-	1
Mottled Sculpin	1	-	-	-	-	-	-	1
Sample Size (sec)	2511	4270	1430	3306	3731	3962	4233	23443

[1]Rainbow Cutthroat Trout Hybrid

Table A-4. Total Numbers of Fish Collected Electrofishing - Jordan River @ 1000 North

Sample Period	1	2	3	4	5	6	7	
Date	4/8	5/24	6/27	7/5	8/16	9/27	12/5	Total
Walleye	-	1	-	-	-	-	1	2
Yellow Perch	1	-	-	-	-	-	-	1
White Bass	-	-	-	-	-	1	-	1
Green Sunfish	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	-	1	-	1
Rainbow Trout	-	-	-	-	-	-	-	-
Cutthroat Trout	-	-	-	-	-	-	-	-
RbtxCtt Trout[1]	-	-	-	-	-	-	-	-
Brown Trout	-	-	1	-	-	-	-	1
Unident Trout	-	-	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-
Utah Sucker	27	31	9	28	3	6	13	117
Mountain Sucker	-	-	-	-	-	-	-	-
Utah Chub	54	26	8	43	44	35	-	210
Carp	608	389	185	425	234	107	113	2061
Goldfish	-	-	-	-	-	-	-	-
Fathead Minnow	1	-	-	1	-	3	1	6
Gambusia	-	-	-	-	-	-	-	-
Mottled Sculpin	-	-	-	-	-	-	-	-
Sample Size (sec)	3237	3530	3686	5162	4117	3772	3660	27164

[1]Rainbow Cutthroat Trout Hybrid

Table A-5. Total Numbers of Fish Collected Electrofishing - Surplus Canal

Sample Period	1	2	3	4	5	6	7	
Date	4/8	5/27	6/23	7/8	8/20	9/30	12/9	Total
Walleye	1	1	-	3	1	4	7	17
Yellow Perch	-	-	-	-	-	-	2	2
White Bass	-	-	-	-	14	7	1	22
Green Sunfish	2	2	2	5	3	12	-	26
Black Crappie	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	-	-	-	-
Rainbow Trout	1	-	-	-	-	-	-	1
Cutthroat Trout	-	-	-	-	-	-	-	-
RbtxCtt Trout[1]	-	-	-	-	-	-	-	-
Brown Trout	-	-	-	-	-	-	-	-
Unident Trout	-	-	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	-	-	-
Channel Catfish	1	-	-	-	-	-	-	1
Black Bullhead	-	-	-	-	-	-	-	-
Utah Sucker	21	30	4	17	29	47	15	163
Mountain Sucker	-	-	-	-	-	-	-	-
Utah Chub	-	-	-	-	-	-	-	-
Carp	761	324	698	946	256	169	136	3290
Goldfish	-	-	-	-	-	-	-	-
Fathead Minnow	-	2	-	1	-	29	3	35
Gambusia	-	-	-	-	-	-	-	-
Mottled Sculpin	-	-	-	-	-	-	-	-
Sample Size (sec)	3314	4491	3715	4345	3887	4824	4043	28619

[1]Rainbow Cutthroat Trout Hybrid

Table A-6. Total Numbers of Fish Collected Electrofishing - Goggin Canal

Sample Period	1	2	3	4	5	6	7	
Date	4/7	6/2	6/23	7/9	8/17	9/29	12/6	Total
Walleye	-	1	-	-	1	3	1	6
Yellow Perch	-	2	-	-	-	-	-	2
White Bass	-	11	-	-	2	1	1	15
Green Sunfish	2	11	8	11	7	29	3	71
Black Crappie	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	2	2
Largemouth Bass	-	-	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	-	-	-	-
Rainbow Trout	-	-	-	-	-	-	-	-
Cutthroat Trout	-	-	-	-	-	-	-	-
RbtxCtt Trout[1]	-	-	-	-	-	-	-	-
Brown Trout	-	-	-	-	-	-	-	-
Unident Trout	-	-	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	-	-	-
Channel Catfish	-	1	-	-	-	-	-	1
Black Bullhead	-	-	-	-	-	1	-	1
Utah Sucker	-	15	2	-	16	3	-	36
Mountain Sucker	-	-	-	-	-	-	-	-
Utah Chub	-	-	-	-	-	-	-	-
Carp	481	218	194	180	115	67	115	1370
Goldfish	-	-	-	-	-	-	-	-
Fathead Minnow	3	5	12	9	53	278	70	440
Gambusia	-	-	-	-	-	-	-	-
Mottled Sculpin	-	-	-	-	-	-	-	-
Sample Size (sec)	3830	6492	5960	3918	3425	3920	4186	31731

[1]Rainbow Cutthroat Trout Hybrid

APPENDIX B

Table B-1. CPE (Fish/1000 sec) of Fish Collected by Electrofishing - Jordan River Above Mill Creek

Sample Period	1	2	3	4	5	6	7	
Date	4/6	5/26	6/24	7/7	8/18	10/1	12/7	Station Mean[2]
Walleye	-	-	-	-	-	.69	.59	.20
Yellow Perch	-	-	.28	-	-	-	-	.04
White Bass	-	1.09	-	.57	.78	.69	.59	.55
Green Sunfish	.40	-	-	-	.52	.69	-	.24
Black Crappie	-	-	-	-	-	.23	.59	.12
Bluegill	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	.30	.04
Smallmouth Bass	-	-	-	-	-	-	-	-
Rainbow Trout	-	-	-	-	-	-	-	-
Cutthroat Trout	-	-	-	-	-	-	-	-
Rbtxctt Trout[1]	-	-	-	-	-	-	-	-
Brown Trout	-	.27	-	-	-	-	-	.04
Unident Trout	-	-	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	-	-	-
Channel Catfish	1.22	-	-	.28	-	.23	.59	.28
Black Bullhead	-	-	-	.28	-	.23	-	.08
Utah Sucker	13.36	41.39	8.50	28.88	18.20	27.86	46.44	26.25
Mountain Sucker	-	-	-	-	-	-	-	-
Utah Chub	-	-	-	-	-	-	-	-
Carp	165.59	58.55	72.69	84.37	78.26	57.32	95.53	81.78
Goldfish	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	.94	-	1.04	14.04	.59	2.79
Gambusia	-	-	-	-	.26	-	-	.04
Mottled Sculpin	-	-	-	-	-	-	-	-
Longnose Dace	.40	-	-	-	-	-	-	.04

[1]Rainbow Cutthroat Trout Hybrid

[2]Station Mean = $\frac{\text{Total \# of Fish}}{\text{Total Sample Time (sec)}}$

Table B-2. CPE (Fish/1000 sec) of Fish Collected Electrofishing - Jordan River Below Mill Creek

Sample Period	1	2	3	4	5	6	7	
Date	4/6	5/26	6/24	7/7	8/18	10/1	12/7	Station Mean[2]
Walleye	.40	.30	-	-	.27	6.47	.23	1.13
Yellow Perch	-	-	-	-	-	.27	-	.04
White Bass	-	2.14	.79	-	1.64	7.01	-	1.69
Green Sunfish	-	-	.53	.57	-	-	-	.16
Black Crappie	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	.69	.12
Smallmouth Bass	-	-	-	-	-	-	-	-
Rainbow Trout	-	-	-	-	-	.81	.23	.16
Cutthroat Trout	-	-	-	-	-	-	.23	.04
RbtxCtt Trout[1]	-	-	-	-	-	-	-	-
Brown Trout	-	-	.26	-	-	-	.23	.08
Unident Trout	-	-	-	-	-	-	.46	.08
Mountain Whitefish	-	-	-	-	-	-	-	-
Channel Catfish	-	.30	.26	-	.27	-	-	.12
Black Bullhead	-	-	-	-	.55	.27	1.15	.32
Utah Sucker	.80	25.05	3.15	8.22	16.37	29.40	3.22	12.49
Mountain Sucker	-	-	-	-	-	-	-	-
Utah Chub	-	-	4.99	.57	1.36	.54	-	1.13
Carp	75.96	139.89	76.22	69.42	62.48	64.19	28.94	72.27
Goldfish	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	.26	-	.27	9.98	.23	1.61
Gambusia	-	-	-	-	-	-	-	-
Mottled Sculpin	-	-	-	-	-	-	-	-

[1]Rainbow Cutthroat Trout Hybrid

[2]Station Mean = $\frac{\text{Total \# of Fish}}{\text{Total Sample Time (sec)}}$

Table B-3. CPE (Fish/1000 sec) of Fish Collected by Electrofishing - Jordan River 1700 South

Sample Period	1	2	3	4	5	6	7	
Date	4/7	5/25	6/26	7/6	8/19	9/28	12/8	Station Mean[2]
Walleye	.40	.47	-	-	.54	.50	.94	.47
Yellow Perch	-	.47	-	-	-	.25	.24	.17
White Bass	-	-	-	-	.27	1.26	.24	.30
Green Sunfish	3.58	3.75	-	.91	1.61	1.51	2.36	2.13
Black Crappie	-	.23	-	-	-	-	-	.04
Bluegill	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	-	-	-	-
Rainbow Trout	-	.70	-	-	-	.25	.24	.21
Cutthroat Trout	-	-	-	-	-	-	.47	.08
RbtxCtt Trout[1]	-	.47	-	.60	-	-	.94	.34
Brown Trout	-	-	-	-	-	-	-	-
Unident Trout	-	-	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	.25	-	.04
Channel Catfish	-	.23	-	-	-	.25	.71	.21
Black Bullhead	-	-	-	-	-	-	.47	.08
Utah Sucker	77.26	14.75	18.18	13.01	17.42	5.30	49.85	26.58
Mountain Sucker	-	.23	-	-	-	-	-	.04
Utah Chub	9.56	13.82	44.06	7.26	45.83	8.33	1.89	16.30
Carp	114.70	126.23	100.70	110.40	355.94	50.73	83.86	137.35
Goldfish	-	-	-	-	-	.25	.24	.08
Fathead Minnow	1.20	.47	-	1.82	.54	1.77	4.96	1.75
Gambusia	-	-	-	.30	-	-	-	.04
Mottled Sculpin	.40	-	-	-	-	-	-	.04

[1]Rainbow Cutthroat Trout Hybrid

[2]Station Mean = $\frac{\text{Total \# of Fish}}{\text{Total Sample Time (sec)}}$

Table B-4. CPE (Fish/1000 sec) of Fish Collected by Electrofishing - Jordan River @ 1000 North

Sample Period	1	2	3	4	5	6	7	
Date	4/8	5/24	6/22	7/5	8/16	9/27	12/5	Station Mean[2]
Walleye	-	.28	-	-	-	-	.27	.07
Yellow Perch	.31	-	-	-	-	-	-	.04
White Bass	-	-	-	-	-	.26	-	.04
Green Sunfish	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	-	.26	-	.04
Rainbow Trout	-	-	-	-	-	-	-	-
Cutthroat Trout	-	-	-	-	-	-	-	-
RbtxCtt Trout[1]	-	-	-	-	-	-	-	-
Brown Trout	-	-	.27	-	-	-	-	.04
Unident Trout	-	-	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-
Utah Sucker	8.34	8.78	2.44	5.42	.73	1.59	3.55	4.31
Mountain Sucker	-	-	-	-	-	-	-	-
Utah Chub	16.68	7.36	2.17	8.33	10.69	9.28	-	7.73
Carp	187.83	110.20	50.19	82.33	56.84	28.37	30.87	75.87
Goldfish	-	-	-	-	-	-	-	-
Fathead Minnow	.31	-	-	.19	-	.80	.27	.22
Gambusia	-	-	-	-	-	-	-	-
Mottled Sculpin	-	-	-	-	-	-	-	-

[1] Rainbow Cutthroat Trout Hybrid

[2] Station Mean = $\frac{\text{Total \# of Fish}}{\text{Total Sample Time (sec)}}$

Table B-5. CPE (Fish/1000 sec) of Fish Collected Electrofishing - Surplus Canal

Sample Period	1	2	3	4	5	6	7	
Date	4/8	5/27	6/23	7/8	8/20	9/30	12/9	Station Mean[2]
Walleye	.30	.22	-	.69	.26	.83	1.73	.59
Yellow Perch	-	-	-	-	-	-	.50	.07
White Bass	-	-	-	-	3.60	1.45	.25	.77
Green Sunfish	.60	.44	.54	1.15	.77	2.49	-	.91
Black Crappie	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	-	-	-	-
Rainbow Trout	.30	-	-	-	-	-	-	.04
Cutthroat Trout	-	-	-	-	-	-	-	-
RbtxCtt Trout[1]	-	-	-	-	-	-	-	-
Brown Trout	-	-	-	-	-	-	-	-
Unident Trout	-	-	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	-	-	-
Channel Catfish	.30	-	-	-	-	-	-	.04
Black Bullhead	-	-	-	-	-	-	-	-
Utah Sucker	6.34	6.68	1.08	3.91	7.46	9.74	3.71	5.70
Mountain Sucker	-	-	-	-	-	-	-	-
Utah Chub	-	-	-	-	-	-	-	-
Carp	229.63	72.14	187.89	217.72	65.86	35.03	33.64	114.96
Goldfish	-	-	-	-	-	-	-	-
Fathead Minnow	-	.44	-	.23	-	6.01	.74	1.22
Gambusia	-	-	-	-	-	-	-	-
Mottled Sculpin	-	-	-	-	-	-	-	-

[1]Rainbow Cutthroat Trout Hybrid

[2]Station Mean = $\frac{\text{Total \# of Fish}}{\text{Total Sample Time (sec)}}$

Table B-6. CPE (Fish/1000 sec) of Fish Collected by Electrofishing - Goggin Canal

Sample Period	1	2	3	4	5	6	7	
Date	4/7	6/2	6/23	7/9	8/17	9/29	12/6	Station Mean[2]
Walleye	-	.15	-	-	.29	.76	.24	.19
Yellow Perch	-	.31	-	-	-	-	-	.06
White Bass	-	1.69	-	-	.58	.26	.24	.47
Green Sunfish	.52	1.69	1.34	2.81	2.04	7.40	.72	2.24
Black Crappie	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	.48	.06
Largemouth Bass	-	-	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	-	-	-	-
Rainbow Trout	-	-	-	-	-	-	-	-
Cutthroat Trout	-	-	-	-	-	-	-	-
RbtxCtt Trout[1]	-	-	-	-	-	-	-	-
Brown Trout	-	-	-	-	-	-	-	-
Unident Trout	-	-	-	-	-	-	-	-
Mountain Whitefish	-	-	-	-	-	-	-	-
Channel Catfish	-	.15	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	.26	-	.03
Utah Sucker	-	2.31	.34	-	4.67	.76	-	1.14
Mountain Sucker	-	-	-	-	-	-	-	-
Utah Chub	-	-	-	-	-	-	-	-
Carp	125.59	33.58	32.55	45.94	33.58	17.09	27.47	43.18
Goldfish	-	-	-	-	-	-	-	-
Fathead Minnow	.78	.77	2.01	2.30	15.47	70.92	16.72	13.87
Gambusia	-	-	-	-	-	-	-	-
Mottled Sculpin	-	-	-	-	-	-	-	-

[1]Rainbow Cutthroat Trout Hybrid

[2]Station Mean = $\frac{\text{Total \# of Fish}}{\text{Total Sample Time (sec)}}$

APPENDIX C

Table C-1. CPE (Fish/100 Ft^2) for Jordan River Seine Data 1988

ABOVE MILL CREEK

Species	Lifestage	April	May	June	July	August	Sep-Oct	Dec	Average CPUE
Fathead	Larval	0	0	0	0	.23	0	0	.03
	YOY	0	0	0	0	1.51	.20	.31	.29
	Juvenile	0	.08	0	0	3.72	0	.94	.68
	Adult	0	0	0	0	4.42	1.00	.31	.82
	TOTAL	**0**	**.08**	**0**	**0**	**9.88**	**1.20**	**1.56**	**1.82**
Gambusia	Larval	0	0	0	0	.12	.10	0	.03
	YOY	0	0	.07	0	0	0	0	.01
	Juvenile	0	0	.07	0	.12	0	0	.03
	Adult	0	.08	0	0	0	0	.31	.06
	TOTAL	**0**	**.08**	**.14**	**0**	**.24**	**.10**	**.31**	**.13**
Utah Sucker	Larval	0	1.58	19.40	.86	0	0	0	3.12
	YOY	0	.08	37.90	59.90	4.19	0	0	9.22
	Juvenile	0	0	0	0	4.77	1.60	0	.91
	TOTAL	**0**	**1.66**	**57.30**	**60.76**	**8.96**	**1.60**	**0**	**13.25**
Carp	Larval	0	0	.07	.39	0	0	0	.07
	YOY	0	0	.14	0	.12	0	0	.04
	Juvenile	0	0	0	0	0	0	0	0
	TOTAL	**0**	**0**	**.21**	**.39**	**.12**	**0**	**0**	**.11**
Green Sunfish	Larval	0	0	0	0	0	0	0	0
	YOY	.09	0	.07	0	.12	.40	0	.10
	Juvenile	0	0	0	0	0	0	0	0
	Adult	0	0	0	.08	0	0	0	.01
	TOTAL	**.09**	**0**	**.07**	**.08**	**.12**	**.40**	**0**	**.11**
Monthly Total (All Species)		**.09**	**1.83**	**57.72**	**61.23**	**19.32**	**3.30**	**1.87**	**.11**

Table C-2. CPE (Fish/100 Ft^2) for Jordan River Seine Data 1988

BELOW MILL CREEK

Species	Lifestage	April	May	June	July	August	Sep-Oct	Dec	Average CPUE
Fathead	Larval	0	0	-	.13	0	0	0	.02
	YOY	0	0	-	.67	.28	0	0	.16
	Juvenile	0	0	-	0	0	0	0	0
	Adult	0	0	-	0	0	0	0	0
	TOTAL	**0**	**0**	-	**.80**	**.28**	**0**	**0**	**.18**
Gambusia	Larval	0	0	-	0	0	0	0	0
	YOY	0	0	-	0	0	0	.42	.07
	Juvenile	0	0	-	0	0	0	0	0
	Adult	0	0	-	0	0	0	0	0
	TOTAL	**0**	**0**	-	**0**	**0**	**0**	**.42**	**.07**
Utah Sucker	Larval	0	0	-	0	0	0	0	0
	YOY	0	0	-	0	0	0	0	0
	Juvenile	0	0	-	.13	0	0	0	.02
	TOTAL	**0**	**0**	-	**.13**	**0**	**0**	**0**	**.02**
Carp	Larval	0	0	-	0	0	0	0	0
	YOY	0	0	-	0	.10	0	0	.02
	Juvenile	0	0	-	0	.10	0	0	.02
	TOTAL	**0**	**0**	-	**0**	**.20**	**0**	**0**	**.04**
Channel Catfish	Larval	0	0	-	0	0	0	0	0
	YOY	0	0	-	0	0	0	0	0
	Juvenile	0	0	-	0	0	.33	0	.06
	TOTAL	**0**	**0**	-	**0**	**0**	**.33**	**0**	**.06**
White Bass	Larval	0	0	-	0	0	0	0	0
	YOY	0	0	-	.27	.10	0	0	.06
	Juvenile	0	0	-	0	0	0	0	0
	TOTAL	**0**	**0**	-	**.27**	**.10**	**0**	**0**	**.06**
Monthly Total (All Species)		**0**	**0**	-	**1.20**	**.57**	**.33**	**.42**	**.43**

Table C-3. CPE (Fish/100 Ft^2) for Jordan River Seine Data 1988

DECKER LAKE DRAIN

Species	Lifestage	April	May	June	July	August	Sep-Oct	Dec	Average CPUE
Fathead	Larval	0	.42	.06	.34	0	0	0	.12
	YOY	0	.02	.91	1.36	0	0	0	.33
	Juvenile	.05	.04	0	.24	0	0	4.93	.75
	Adult	0	.11	0	0	0	0	13.80	1.99
	TOTAL	**.05**	**.59**	**.97**	**1.94**	**0**	**0**	**18.73**	**3.19**
Utah Sucker	Larval	0	3.10	.12	0	0	0	0	.46
	YOY	0	0	.30	.49	0	0	0	.11
	Juvenile	0	.04	0	0	0	.04	0	.01
	TOTAL	**0**	**3.14**	**.42**	**.49**	**0**	**.04**	**0**	**.58**
Carp	Larval	0	.25	.06	.05	0	0	0	.05
	YOY	0	0	.06	.58	0	0	.07	.10
	Juvenile	0	0	0	0	.13	0	0	.02
	TOTAL	**0**	**.25**	**.12**	**1.07**	**.13**	**0**	**.07**	**.17**
Green Sunfish	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	0	0	0	0	.13	.02
	Juvenile	0	0	0	0	0	.04	0	.01
	Adult	0	0	0	0	0	0	0	0
	TOTAL	**0**	**0**	**0**	**0**	**0**	**.04**	**.13**	**.03**
Channel Catfish	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	0	0	0	.04	0	.01
	Juvenile	0	.02	0	0	0	.04	0	.01
	TOTAL	**0**	**.02**	**0**	**0**	**0**	**.08**	**0**	**.02**
White Bass	Larval	0	0	.06	0	0	0	0	.01
	YOY	0	0	1.09	.58	.04	.04	0	.25
	Juvenile	0	0	0	0	0	0	0	0
	TOTAL	**0**	**0**	**1.15**	**.58**	**.04**	**.04**	**0**	**.26**
Monthly Total (All Species)		**.05**	**4.0**	**2.66**	**3.64**	**.17**	**.19**	**18.93**	**4.25**

Table C-3. (Continued)

MISC. DRAIN SEINING - DRAIN ABOVE MILL CREEK

Species	Lifestage	April	May	June	July	August	Sep-Oct	Dec	Average CPUE
Gambusia	Larval			0					
	YOY			.46					
	Juvenile			.46					
	Adult			0					
	TOTAL			.92					
Utah Suckers	Larval			54.88	0				
	YOY			0	.51				
	Juvenile			0	0				
	TOTAL			54.88	.51				
Carp	Larval				0				
	YOY				.77				
	Juvenile				0				
	TOTAL				.77				
Total All Species				55.88	1.28				

4500 SOUTH

Utah Sucker	Larval			22.20					
	YOY			0					
	Juvenile			0					
	TOTAL			22.20					

Table C-4. CPE (Fish/100 Ft^2) for Jordan River Seine Data 1988

1700 SOUTH

Species	Lifestage	April	May	June	July	August	Sep-Oct	Dec	Average CPUE
Fathead	Larval	0	0	.13	0	0	0	0	.02
	YOY	0	.03	.02	.98	0	.09	0	.16
	Juvenile	0	0	.02	0	0	.09	1.67	.25
	Adult	0	.28	.49	.98	.54	.14	10.00	1.78
	TOTAL	**0**	**.31**	**.66**	**1.96**	**.54**	**.32**	**11.67**	**2.21**
Gambusia	Larval	0	0	.11	.11	0	.05	0	.04
	YOY	0	.02	.09	.54	.29	.93	63.30	9.31
	Juvenile	0	0	0	.54	.16	.33	2.20	.46
	Adult	0	0	.22	0	.58	.14	1.10	.29
	TOTAL	**0**	**.02**	**.42**	**1.19**	**1.03**	**1.45**	**66.60**	**10.10**
Utah Sucker	Larval	0	.02	.13	0	0	0	0	.02
	YOY	0	0	1.70	1.41	0	0	0	2.63
	Juvenile	0	0	.07	0	.04	.05	0	.02
	TOTAL	**0**	**.02**	**1.90**	**1.41**	**.04**	**.05**	**0**	**2.67**
Carp	Larval	0	0	.22	0	0	0	0	.03
	YOY	0	0	.02	2.06	.04	0	0	.30
	Juvenile	0	0	.04	.43	.33	.42	0	.17
	TOTAL	**0**	**0**	**.28**	**2.49**	**.37**	**.42**	**0**	**.50**
Utah Chub	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	0	0	0	0	0	0
	Juvenile	.25	.03	.54	0	0	0	0	.12
	TOTAL	**.25**	**.03**	**.54**	**0**	**0**	**0**	**0**	**.12** .02
Green Sunfish	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	0	0	0	.05	0	.01
	Juvenile	0	0	0	0	0	0	0	0
	Adult	0	0	0	0	0	0	0	0
	TOTAL	**0**	**0**	**0**	**0**	**0**	**.05**	**0**	**.01**
Mountain Sucker	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	0	0	0	0	0	0
	Juvenile	.06	0	0	0	0	0	0	.01
	TOTAL	**.06**	**0**	**0**	**0**	**0**	**0**	**n**	**01**

Table C-4. (Continued)

1700 SOUTH

Species	Lifestage	April	May	June	July	August	Sep-Oct	Dec	Average CPUE
Goldfish	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	0	0	0	0	0	0
	Juvenile	0	0	0	0	0	0	0	0
	Adult	0	0	0	0	.04	0	0	.01
	TOTAL	**0**	**0**	**0**	**0**	**.04**	**0**	**0**	**.01**
White Bass	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	0	.11	.04	.05	0	.03
	Juvenile	0	0	0	0	0	0	0	0
	TOTAL	**0**	**0**	**0**	**.11**	**.04**	**.05**	**0**	**.03**
Walleye	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	.02	0	0	0	0	<.01
	Juvenile	0	0	0	0	0	0	0	0
	TOTAL	**0**	**0**	**.02**	**0**	**0**	**0**	**0**	**<.01**
Monthly Total (All Species)		**.31**	**.37**	**3.82**	**7.16**	**2.06**	**2.33**	**78.27**	

Table C-5. CPE (Fish/100 Ft^2) for Jordan River Seine Data 1988

1000 NORTH

Species	Lifestage	April	May	June	July	August	Sep-Oct	Dec	Average CPUE
Fathead Minnow	Larval	0	0	0	1.40	0	0	0	.20
	YOY	0	0	0	1.50	.89	.89	.17	.49
	Juvenile	0	0	0	0	1.00	1.40	0	.34
	Adult	0	0	0	0	1.10	1.40	.50	.43
	TOTAL	**0**	**0**	**0**	**2.90**	**3.00**	**3.70**	**.67**	**1.46**
Gambusia	Larval	0	0	0	.12	.56	2.50	0	.45
	YOY	0	0	.35	.25	1.60	3.80	.17	.88
	Juvenile	0	0	0	.12	.78	.71	0	.23
	Adult	0	0	0	0	1.30	.89	0	.31
	TOTAL	**0**	**0**	**.35**	**.49**	**4.20**	**7.90**	**.17**	**1.87**
Utah Sucker	Larval	0	0	.61	.12	0	0	0	.10
	YOY	0	0	18.30	7.60	.22	0	0	3.73
	Juvenile	0	0	0	0	0	0	0	0
	TOTAL	**0**	**0**	**18.90**	**7.70**	**.22**	**0**	**0**	**3.83**
Carp	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	1.00	1.40	0	0	0	.34
	Juvenile	0	0	0	.12	.11	0	0	.03
	TOTAL	**0**	**0**	**1.00**	**1.50**	**.11**	**0**	**0**	**.37**
Utah Chub	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	0	0	0	.18	0	.03
	Juvenile	0	0	0	0	0	0	0	0
	TOTAL	**0**	**0**	**0**	**0**	**0**	**.18**	**0**	**.03**
White Bass	Larval	0	0	0	0	0	0	0	0
	YOY	0	0	0	.12	0	0	0	.02
	Juvenile	0	0	0	0	0	0	0	0
	TOTAL	**0**	**0**	**0**	**.12**	**0**	**0**	**0**	**.02**
Monthly Totals (All Species)		**0**	**0**	**20.30**	**12.80**	**7.60**	**11.80**	**.84**	

Table C-6. CPE (Fish/100 Ft^2) for Jordan River Seine Data 1988

SURPLUS CANAL

Species	Lifestage	April	May	June	July	August	Sep-Oct	Dec	Average CPUE
Fathead	Larval	0	-	0	.31	0	0	0	.05
	YOY	0	-	0	.54	1.09	0	0	.27
	Juvenile	0	-	0	0	1.41	.54	.20	.36
	Adult	.10	-	0	0	.27	1.25	.10	.29
	TOTAL	**.10**	-	**0**	**.85**	**2.77**	**1.79**	**.30**	**.97**
Gambusia	Larval	0	-	0	0	0	0	0	0
	YOY	0	-	0	0	0	0	0	0
	Juvenile	0	-	0	0	.05	0	0	.01
	Adult	0	-	0	0	0	0	0	0
	TOTAL	**0**	-	**0**	**0**	**.05**	**0**	**0**	**.01**
Carp	Larval	0	-	0	0	0	0	0	0
	YOY	0	-	0	0	0	0	0	0
	Juvenile	0	-	0	0	.05	0	0	.01
	TOTAL	**0**	-	**0**	**0**	**.05**	**0**	**0**	**.01**
White Bass	Larval	0	-	0	0	0	0	0	0
	YOY	0	-	0	.31	0	0	0	.05
	Juvenile	0	-	0	0	0	0	0	0
	TOTAL	**0**	-	**0**	**.31**	**0**	**0**	**0**	**.05**
Walleye	Larval	0	-	0	0	0	0	0	0
	YOY	0	-	0	.05	0	0	0	.01
	Juvenile	0	-	0	0	0	0	0	0
	TOTAL	**0**	-	**0**	**.05**	**0**	**0**	**0**	**.01**
Monthly Totals (All Species)		**.10**	-	**0**	**1.20**	**2.88**	**1.79**	**.30**	

Table C-7. CPE (Fish/100 Ft^2) for Jordan River Seine Data 1988

GOGGIN DRAIN

Species	Lifestage	April	May	June	July	August	Sep-Oct	Dec	Average CPUE
Fathead	Larval	-	-	-	2.17	.13	.67	0	.74
	YOY	-	-	-	12.50	4.58	12.75	.12	7.49
	Juvenile	-	-	-	6.17	2.35	7.91	0	4.11
	Adult	-	-	-	.17	1.04	6.15	0	1.84
	TOTAL	-	-	-	**21.01**	**8.10**	**19.57**	**.12**	**14.18**
Carp	Larval	-	-	-	0	0	0	0	0
	YOY	-	-	-	.17	0	.22	0	.10
	Juvenile	-	-	-	0	0	0	0	0
	TOTAL	-	-	-	**.17**	**0**	**.22**	**0**	**.10**
Green Sunfish	Larval	-	-	-	0	0	0	0	0
	YOY	-	-	-	0	0	0	0	0
	Juvenile	-	-	-	0	-	.22	0	.06
	TOTAL	-	-	-	**0**	**0**	**.22**	**0**	**.06**
White Bass	Larval	-	-	-	0	0	0	0	0
	YOY	-	-	-	.33	.13	0	0	.12
	Juvenile	-	-	-	0	0	0	0	0
	TOTAL	-	-	-	**.33**	**.13**	**0**	**0**	**.12**
Monthly Totals (All Species)		-	-	-	**21.51**	**8.23**	**20.01**	**.12**	

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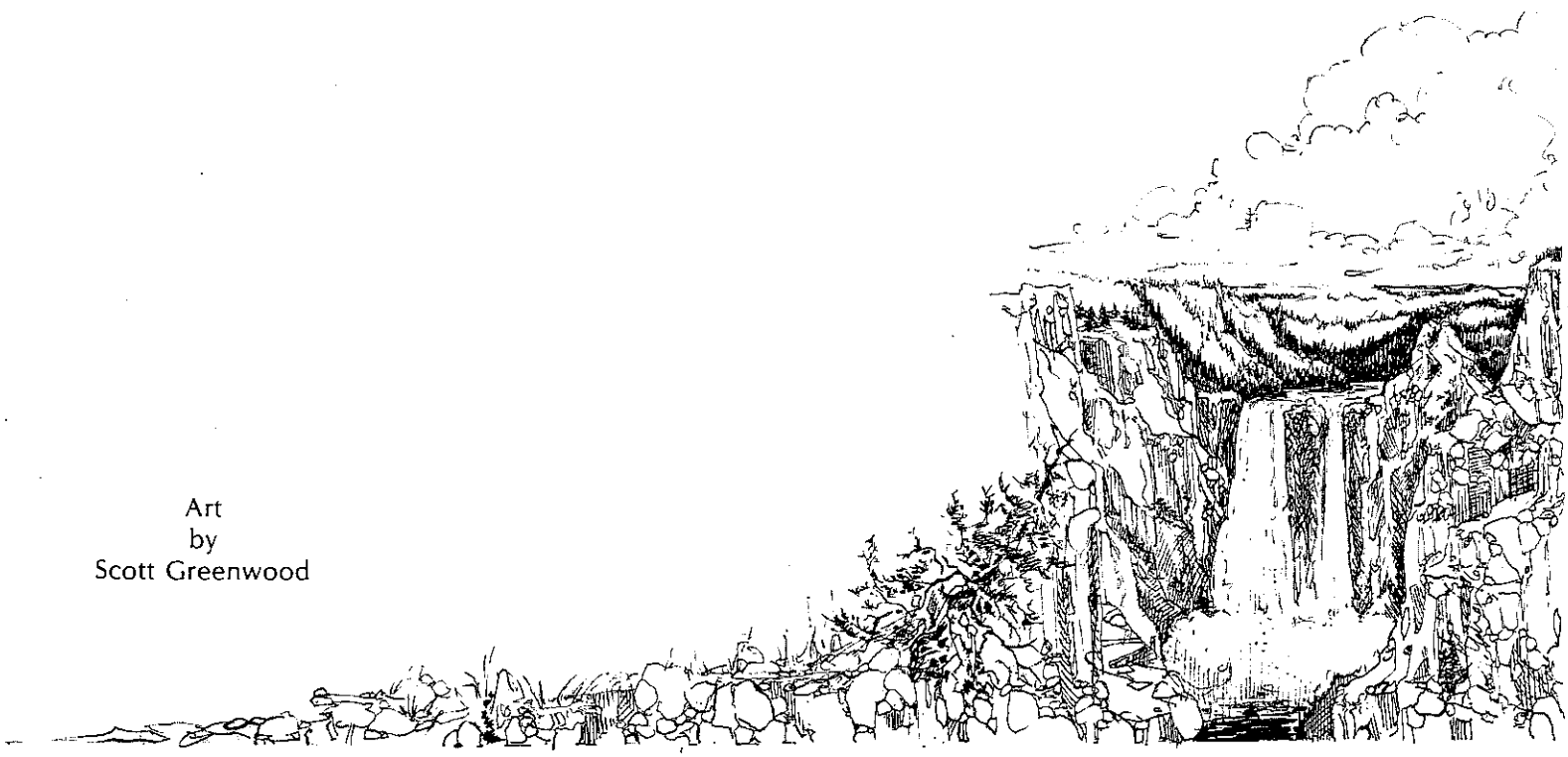

Art
by
Scott Greenwood