3.0 FISHERIES INVESTIGATIONS

A description of the fisheries resources in the Project area and downstream areas affected by the Project, is a necessary step in the relicensing process. Therefore, PacifiCorp conducted a general fisheries investigation of the riverine sections and reservoirs within the Project area. While most of the effort in riverine sections focused on rainbow trout and suckers, collections of all other fish species were used to describe the general fish community in each Project reach. The purpose of this investigation was to provide basic information for describing the existing fishery that can be used in conjunction with other information to assess the effects of Project operations on this resource. Similar investigations for trout were performed in the effort for the Salt Cave Hydroelectric Project (City of Klamath Falls, 1990, and several ODFW Progress Reports). A comparison with the results of these earlier studies helped determine whether changes in the fishery have occurred since that time.

3.1 DESCRIPTION AND PURPOSE

Development of study plans for fisheries investigations was an ongoing adaptive process throughout 2002 and 2003, and resulted in several modifications and the addition of several new study elements. This section includes the methods and findings associated with most objectives in the final Study Plan 1.9 (Fisheries Investigations) and all objectives in Study Plan 1.23 (Sampling of Fisheries in Project Riverine and Reservoir Areas). The literature review objectives in Study Plan 1.9 are addressed in Section 2.2.

3.2 OBJECTIVES

The objectives addressed by the fisheries investigations are as follows:

- Provide basic information to describe the existing fish community in the riverine reaches, including relative species abundance and distribution.
- Quantify the growth, length-frequency distribution, condition factor, and age structure of rainbow trout in Project-affected reaches.
- Assess the distribution and relative abundance of trout fry in the J.C. Boyle bypass and peaking reaches.
- Describe the existing fish community in Project reservoirs.
- Characterize the seasonal distribution and fish species composition in open water habitats in Copco and Iron Gate reservoirs.

3.3 RELICENSING RELEVANCE AND USE IN DECISIONMAKING

Results of the fisheries investigations will provide important information for use in interpreting how habitat conditions, including those affected by the Project, influence the health and wellbeing of the existing fish populations and how proposed protection, mitigation, and enhancement measures might alter these populations in the future.

Hydropower peaking below the J.C. Boyle powerhouse can have a major impact on fish habitat and production in this reach of the Klamath River. This study will help, in conjunction with the results of other studies, to describe peaking impacts on trout rearing and growth and provide a basis for predicting peaking effects on anadromous salmonids if they were to be reintroduced into this reach.

Assessment and evaluation of primary fishery issues in the study area (e.g., rate and magnitude of ramping, fish passage, water quality, and instream flows) will benefit from having good, current information on the existing fish communities (and their associated habitats) in the affected stream reaches. This investigation will help support these issue evaluations.

3.4 METHODS AND GEOGRAPHIC SCOPE

This section of the Fish Resources FTR includes several study elements that can be categorized as pertaining to either river reaches or reservoirs. Therefore, subsections to follow (3.4.1 and 3.4.2) are presented first as River Studies, then as Reservoir Studies. Specific methods for fish collection/data analysis are presented separately for the two study categories in their respective subsections.

The geographic scope of the fisheries investigations presented in this section includes the Link River, Fall Creek, Klamath River from Keno dam to Iron Gate reservoir, and the four primary project reservoirs (Keno, J.C. Boyle, Copco, and Iron Gate). Specific sampling locations within this geographic scope are outlined below in the description of methods.

3.4.1 River Studies

3.4.1.1 Sampling Locations and Effort

Fish collection was done primarily using electrofishing and hook-and-line sampling; baited minnow traps also were used where site conditions allowed efforts to further characterize existing fisheries conditions. Backpack electrofishing and hook-and-line sampling were used to sample riffle/run/pool habitat in shallow reaches. Boat electrofishing was used to sample accessible areas with deeper riffle/run/pool habitat. To allow relative comparison of fisheries catch data among Project reaches, sampling was standardized according to method, sampling time or length of habitat sampled. Field crews followed the electrofishing guidelines established by the National Marine Fisheries Service (NMFS, 2000).

Six general stream reaches defined by Project features were sampled: Link River, Keno reach, J.C. Boyle bypass reach, J.C. Boyle peaking reach, Copco No. 2 bypass reach, and Fall Creek bypass reach. Within the six major reaches, specific sampling segments were identified based on habitat mapping, agency consultation, and observations during the October 2001 reconnaissance sampling effort. These segments primarily represented different channel types defined by geomorphic features and gradient. See Figure 3.4-1 for the approximate locations of the sampling activities. Segments in each reach are listed below:

Figure 3.4-1. Fish sampling survey effort.

Page 1 of 4

11 x 17 color

Front

GIS figure from Sarah Early/RDD. Final, ready to go to color printer

Figure 3.4-1

Page 1 of 4

11 x 17 color

Back

Figure 3.4-1

Page 2 of 4

11 x 17 color

Front

Figure 3.4-1

Page 2 of 4

11 x 17 color

Back

Figure 3.4-1

Page 3 of 4

11 x 17 color

Front

Figure 3.4-1

Page 3 of 4

11 x 17 color

Back

Figure 3.4-1

Page 4 of 4

11 x 17 color

Front

Figure 3.4-1

Page 4 of 4

11 x 17 color

Back

Link River

- Upper—Link River dam to East Side powerhouse
- Lower—East Side powerhouse to Keno reservoir

Keno Reach

- Upper—RM 233.0 to 231.5 (near dam)
- Lower—RM 231.5 to 229.0

J.C. Boyle Bypass Reach

- Upper—Uppermost 1.0 mile (above springs)
- Lower—Lower 3.0 miles to powerhouse

J.C. Boyle Peaking Reach

- RM 220.4 to RM 217.0 (Powerhouse to Old Powerhouse Road bridge)
- RM 217.0 to RM 214.3 (Old Powerhouse Road bridge to top of Caldera rapid)
- RM 209.4 to RM 203.5 (Old Hoover Ranch bridge to Copco No. 1 reservoir)

Copco No. 2 Bypass Reach

- Entire 1.4-mile reach

Fall Creek Bypass Reach

- Dam to gradient drop (approximately 3,000 feet)

Field sampling efforts and techniques, by river reach location, are summarized in Table 3.4-1. Also listed are habitat types included in the sampling. These various habitat types were sampled to ensure that catch data incorporated representative habitat types in each reach. It was not intended that data be analyzed separately by habitat type. Table 3.4-1 also addresses sampling in Keno reservoir, which is discussed later in this section.

Table 3.4-1. Summary of field sampling efforts.

Location	Sampling Effort (days/season)	Techniques	Habitats	State
Link River	2	Backpack and boat electrofishing, angling, and other[1]	Riffle, run, pool	Oregon
Keno Reservoir	2	Boat electrofishing	Developed and undeveloped shoreline[2]	Oregon
Keno Reach	4	Backpack electrofishing, angling, and other	Riffle, run, pool	Oregon
J.C. Boyle Bypass Reach	4	Backpack electrofishing, angling, and other	Riffle, run, pool	Oregon
J.C. Boyle Peaking Reach	4	Backpack electrofishing, angling, boat electrofishing, and other	Riffle, run, pool	Oregon/ California
Copco No. 2 Bypass Reach	1	Backpack electrofishing and angling	Riffle, run, pool	California
Fall Creek Bypass Reach	1	Backpack electrofishing	Riffle, run, pool	California

1 Other includes the use of minnow traps where applicable.

2 "Developed shoreline" includes near-shore areas adjacent to reservoir shoreline that contain buildings, landscaping, roads, etc. "Undeveloped shoreline" includes near-shore areas adjacent to undisturbed reservoir shoreline.

3.4.1.2 River Study Fish Collection Methods

Limited reconnaissance sampling occurred in all six riverine reaches in October 2001. While many useful data were obtained, the primary purpose of the trip was to test the feasibility and suitability of various collection methods, locate sampling access points, identify safety concerns, and refine sampling site locations and techniques for later trips. Results of the October 2001 sampling effort indicated that the use of certain gear types and sampling techniques was not feasible or suitable because of safety concerns, limited or no site access, and various other factors such as water clarity.

Collection methods assessed for feasibility during October 2001 included:

Angling

Fly fishing was a consistently successful sampling technique in the Project area. Barbed flies including Copper John, woolly bugger, mayfly pattern, and stonefly pattern were well received.

Boat Electrofishing (riverine)

The use of a boat-mounted electrofisher was deemed infeasible for most riverine reaches because of access or safety concerns under prevailing flow conditions. However, use of an electrofisher mounted in a drift boat was attempted and found feasible during the fall 2002 sampling effort in the Frain Ranch area and in the California segment of the J.C. Boyle peaking reach. Sampling was done at low-to-moderate flows for safety reasons and to maximize sampling efficiency. The use of the drift boat electrofisher was intended to sample the deeper riverine habitats that were not adequately sampled with other gear types.

Raft Electrofishing (riverine)

A generator-operated electrofishing unit was housed on a raft and tested for sampling areas of the river channel where boat electrofishing was not safe. This method created significant safety concerns, was judged not safe, and was therefore rejected as a feasible sampling technique.

Backpack Electrofishing

A backpack model Smith Root electrofisher was used to sample shallow margins of the Project area. This method provided good results; however, its use was limited to areas with wadable depths.

Snorkeling

Snorkeling was attempted in portions of the Keno and J.C. Boyle peaking reaches during the October 2001 sampling effort. Snorkeling was rejected as a viable method because of relatively high water velocity, safety concerns, and low visibility (water clarity) that occurs in the Project area most of the time. However, snorkeling was attempted during the summer 2002 effort in the J.C. Boyle peaking reach when the powerhouse was not operating. Useful observations were obtained, and the effort was repeated during the fall 2002 effort.

Seining

Substrate size and distribution (e.g., large boulders) as well as water depth, velocity, and flow in the Project area made seining difficult. Stretches of beach suitable for seining were not located, and no fish were captured in less favorable areas while using this method in October 2001. An attempt was made to drift a seine through pools at low-flow conditions in the J.C. Boyle peaking reach during the summer 2002 effort. No fish were captured, presumably because of the inability to keep the net tight to the bottom. Therefore, seining was rejected as a feasible sampling technique.

Minnow Traps

Minnow traps were used during the 2002 spring sampling period with minimal success. Only two sculpin have been captured in the Project area using this method.

Based on the October 2001 reconnaissance investigations, it was determined that electrofishing (targeting all species) and angling (targeting trout), and/or the occasional use of minnow traps provided representative sampling of habitat types in Project area reaches and provided a basis for standardizing and comparing catch data among species, seasons, and sampling locations.

Seasonal sampling events were conducted in spring, summer, and fall 2002. Summer sampling was not proposed in initial drafts of the study plan because of concerns that fish collection and stress from handling, combined with high water temperatures, would unavoidably result in some fish mortalities. However, agency and tribal biologists indicated that summer sampling would be critical in meeting the study objectives. Therefore, summer sampling was conducted over a 4-week period in late July/early August of 2002. To reduce the potential for fish mortalities during summer sampling, efforts were made to minimize fish handling and to focus sampling efforts early in the day in areas where water temperatures were expected to reach stressful levels in the afternoon. Fall sampling occurred over a 4-week period in October. Winter sampling was not considered practical because of weather and access problems (snow and mud). A summary of the fish sampling methods used by reach and season during 2001 and 2002 is shown in Table 3.4-2. This table also includes the data for reservoir studies.

On the basis of 2001 and 2002 electrofishing results and heightened concern regarding trout fry in the J.C. Boyle bypass and peaking reaches, PacifiCorp undertook additional electrofishing surveys in 2003 to better quantify the timing, distribution, and abundance of newly emerged trout fry entering rearing habitat. Specific sampling locations, collection methods, and data analysis are presented separately as a stand-alone report in Appendix 3A.

Table 3.4-2. Fish sampling methods by reach and season, 2001 and 2002.

	Link River				**Keno Reservoir**				**Keno Reach**				**J.C. Boyle Bypass**			
Sampling Methods	**Fall '01**	**Spr. '02**	**Sum. '02**	**Fall '02**	**Fall '01**	**Spr. '02**	**Sum. '02**	**Fall '02**	**Fall '01**	**Spr. '02**	**Sum. '02**	**Fall '02**	**Fall '01**	**Spr. '02**	**Sum. '02**	**Fall '02**
Backpack electrofishing	X	X	X	X					X	X	X	X	X	X	X	X
Boat electrofishing		X	X		X	X	X	X								
Angling	X	X	X	X					X	X	X	X	X	X	X	X
Minnow traps			X	X							X	X		X	X	X
Snorkeling																
Seining																

	J.C. Boyle Peaking Reach				**Copco Bypass Reach**				**Fall Creek**				**Spencer Creek**			
Sampling Methods	**Fall '01**	**Spr. '02**	**Sum. '02**	**Fall '02**	**Fall '01**	**Spr. '02**	**Sum. '02**	**Fall '02**	**Fall '01**	**Spr. '02**	**Sum. '02**	**Fall '02**[1]	**Fall '01**	**Spr. '02**	**Sum. '02**	**Fall '02**
Backpack electrofishing	X	X	X	X	X	X	X	X	X	X	X	X			X	X
Boat electrofishing				X												
Angling	X	X	X	X		X		X			X[1]					
Minnow traps			X	X												
Snorkeling			X	X												
Seining			X													

[1] Canal sampling included. Canal sampling was performed at Fall Creek in Fall 2002.

3.4.1.3 River Study Data Collection and Analysis

Fish information collected at each riverine site included species, length, and general condition (such as spawning or parasites). This information, together with site-specific descriptive information, was recorded on a field data sheet. Stomach contents were collected and preserved from selected larger trout (greater than 200 millimeters [mm] in length) as needed for the comparative trout study (discussed in Section 5.0). Environmental information documented during sampling include observed streamflow (from closest gage), water temperature and clarity, habitat type (consistent with ODFW definitions), and weather conditions. Figures 3.4-2 through 3.4-8 show the environmental information for the reaches during sampling. Measures of sampling effort (linear stream distance, electrofishing time, and angling time) were recorded for each site sampled. Basic habitat condition information including habitat unit type, physical stream measurements, valley form, adjacent bank and riparian vegetation, and water quality parameters (temperature, turbidity, DO, pH, and conductivity) also were collected in the field and recorded. Once sampling was complete, these data were entered into a spreadsheet for further analysis.

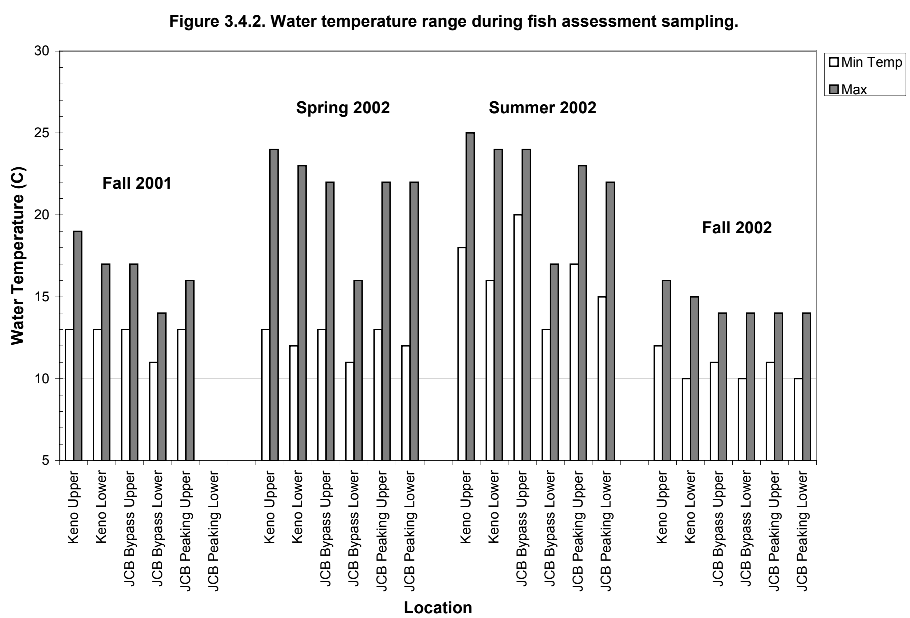

Figure 3.4-2. Water temperature range during fish assessment sampling.

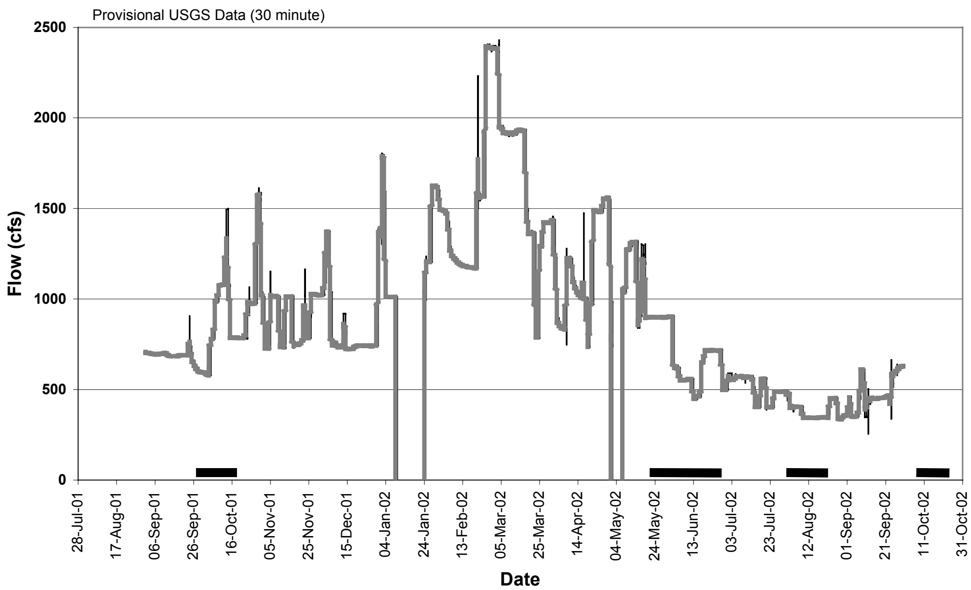

Figure 3.4-3. Flow at Keno gauge. (Black horizontal bar above dates identifies sampling period.)

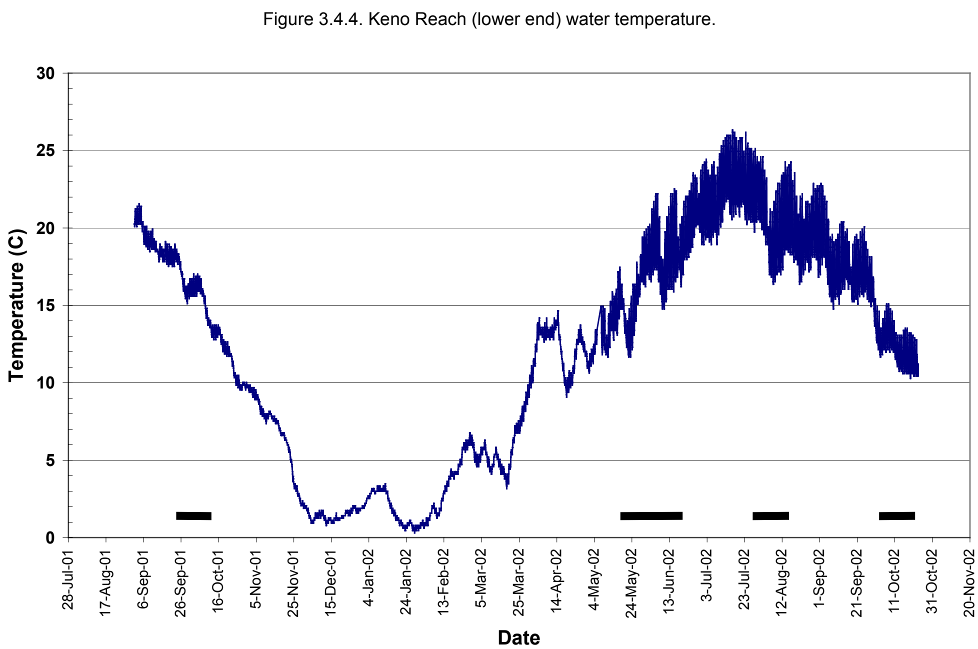

Figure 3.4-4. Keno reach (lower end) water temperatures.

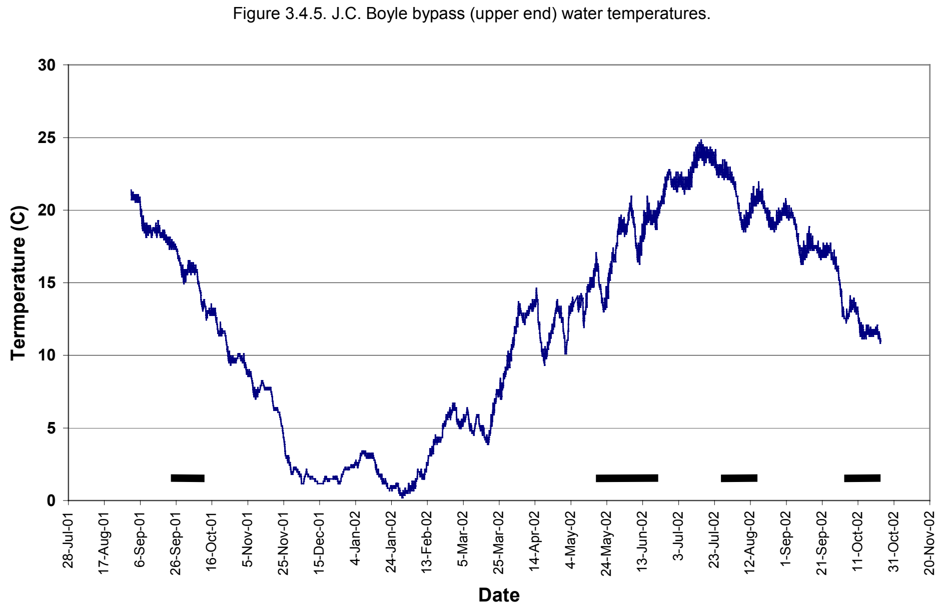

Figure 3.4-5. J.C. Boyle bypass (upper end) water temperatures. (Black horizontal bar above dates identifies sampling period.)

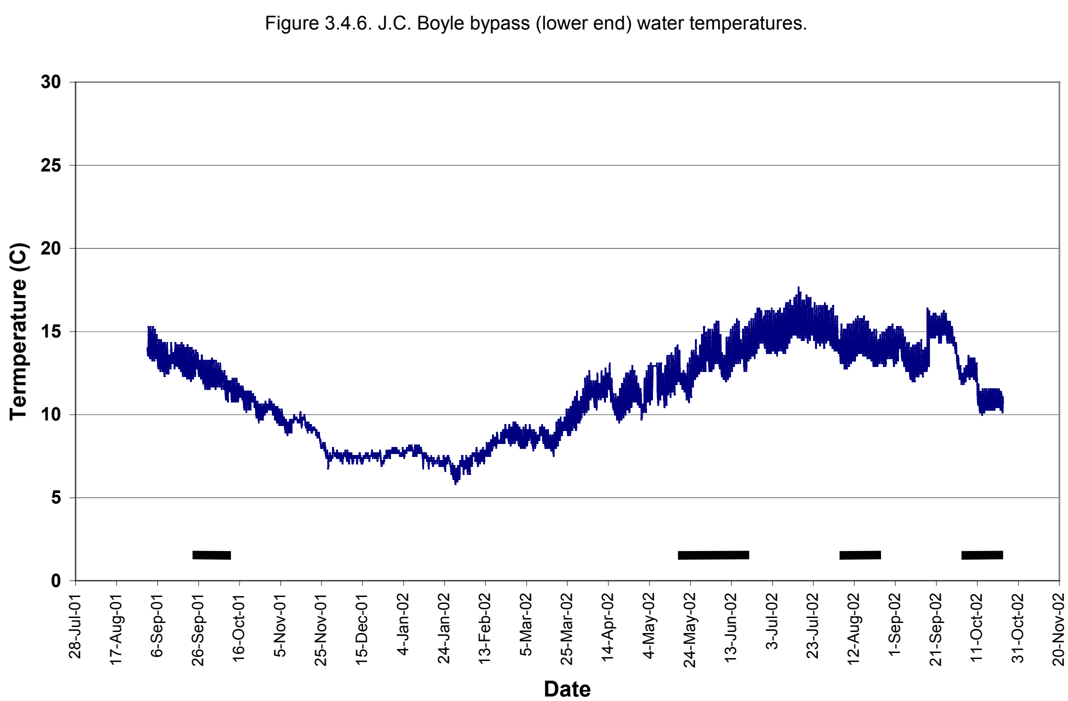

Figure 3.4-6. J.C. Boyle bypass (lower end) water temperatures. (Black horizontal bar above dates identifies sampling period.)

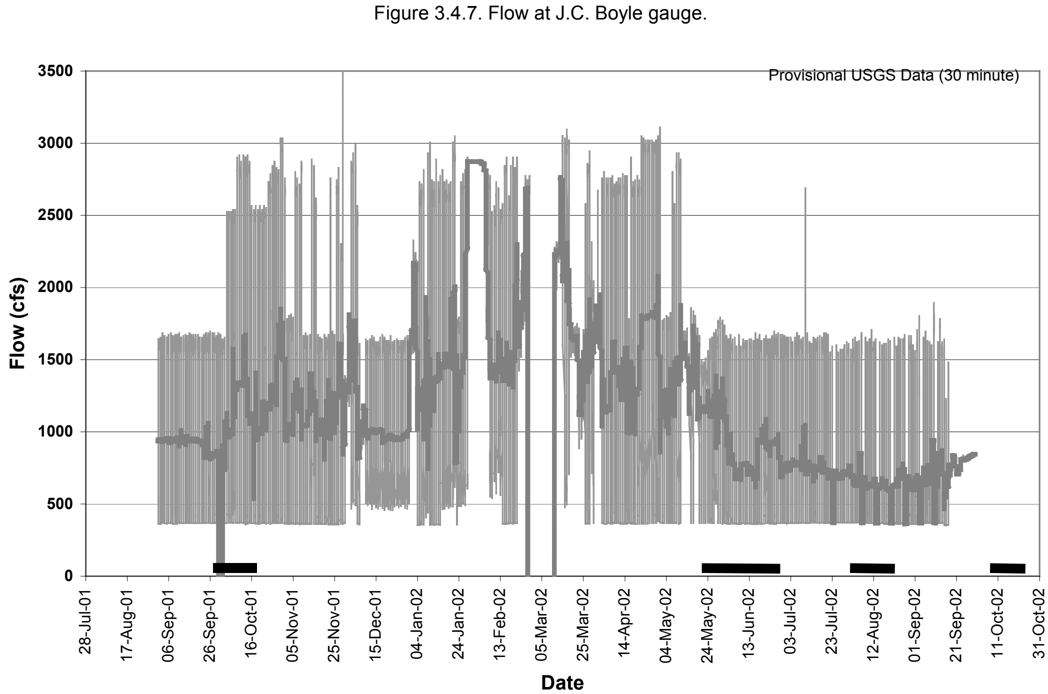

Figure 3.4-7. Flow at J.C. Boyle gauge. (Black horizontal bar above dates identifies sampling period.)

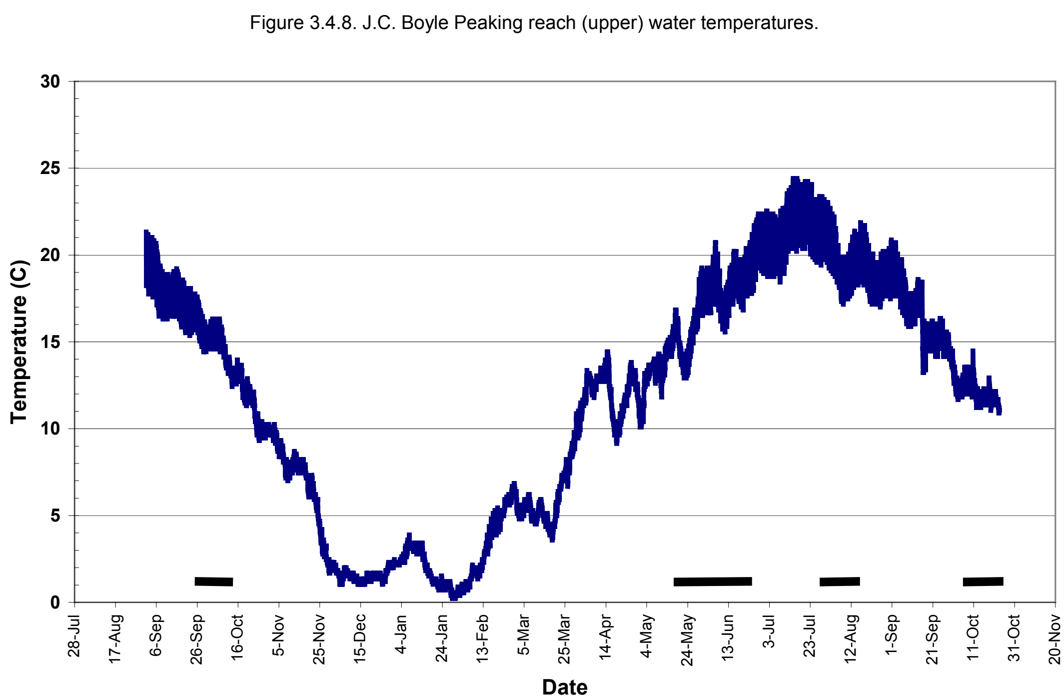

Figure 3.4-8. J.C. Boyle peaking reach (upper) water temperatures. (Black horizontal bar above dates identifies sampling period.)

For this study component, the data were summarized to produce a taxonomic list and the corresponding numbers of each fish species captured by reach. The relative abundance of each species was calculated as the percentage its numbers comprise of the total fish catch. These estimates allowed useful relative comparisons among reaches and locations where similar sampling approaches were used.

It has been noted, based on fish observed in angler surveys (ODFW file data), that trout in the J.C. Boyle peaking reach tend to be smaller than those in the 5-mile reach between Keno dam and J.C. Boyle reservoir. Limited sampling by PacifiCorp in October 2001 also noted a difference in the size of trout captured by angling. It has been speculated that flow fluctuations from peaking operations below the J.C. Boyle powerhouse may be primarily responsible for the size difference. However, other differences among these reaches, such as temperature regime, food sources, and population density (that is, competition), could influence the growth and size of fish as well. In an effort to assess the relative importance of these multiple factors, PacifiCorp collected information needed to compare size and growth of trout in these reaches. Data were obtained from trout captured mostly from angling and from some electrofishing.

Specific information obtained from collected trout included:

- Total length (mm)
- Weight (grams [g])
- Scale samples (for age determination)
- Stomach contents (from trout more than 200 mm in length)

A preliminary diet analysis was conducted to determine if there are obvious differences in feeding habits between trout in the Keno reach and those in the J.C. Boyle peaking and bypass reaches. Obtaining stomach contents required sacrificing 10 trout in each of the three reaches for each of the three seasons. Stomach contents were identified only to differentiate fish from insects in the diet. An attempt was made to identify fish species found in the diet of those trout sampled. Stomach contents were compared among the three sampling reaches to determine if there are differences in the prominence of fish versus insects in the diet that may contribute to differences in trout size among reaches. The diet analysis helped determine (as suggested by local anglers) if trout in the Keno reach are large because they can grow faster once they reach a threshold size by shifting their diet from insects and other invertebrates to small forage fish. Additional electrofishing of the shoreline areas was conducted to better describe the differences in the fish community (and potentially differences in the abundance of small forage fish) among sites.

Condition factor (K) is the length-weight relationship used to express relative plumpness or robustness of fish, and is assumed related to environmental conditions. Condition factors were calculated for each trout using the following equation (per Carlander, 1969):

$$K = (W \times 105) / L3$$

where:

K = condition factor
W = weight (g), and
L = length (mm)

The average, standard error, and range of conditions factor values were calculated by season for each reach.

Scale samples were collected from up to 100 trout of various sizes from each of the three reaches per sampling trip. This resulted in a total of about 400 individual trout scale samples for all three reaches and sampling periods. Scales from trout collected in three seasons of 2002 in the Keno, J.C. Boyle bypass, and J.C. Boyle peaking reaches initially were interpreted for age in late 2002. These data were to be used to compare the age structure as well as length-at-age for trout among the three reaches. However, scale back-calculations for estimating length-at-last-annulus were not performed at that time. Therefore, valid comparisons of length-at-age for trout caught in the three river reaches could be done only for in-season data where fish of a given age had an equal time to grow. For most potential comparisons (36 total among the three reaches, four age classes, and three seasons) sample sizes were not sufficient for meaningful statistical tests.

As a means to increase sample sizes, 128 saved scales were reread and length-to-last-annulus estimated for each scale using back-calculation. This was done to allow data for the three seasons to be combined. Methods used in the rereading and back-calculation are presented below.

After rereading 128 scales (done independently by two biologists without reference to the original results), it was determined that there were numerous discrepancies in age estimation between the initial scale reading effort and the subsequent rereading. It was found that the new estimated ages for many of the fish were 1 year less than the original estimated age. After discussions with the original scale reader, it was concluded that the discrepancies were primarily the result of differences in interpretation of the location of the first annulus and the presence or absence of an annulus at the outer edge of the scale. Circuli during the first year of growth (before formation of the first annulus) were sometimes irregular or partially resorbed. It was concluded that these were not annuli after taking into consideration fish size, capture date, and typical spawning and growth seasons for trout at these elevations. Another source of error was the irregular appearance of circuli at the edge of the scale that was sometimes identified as an annulus. These sources of error were apparent in scales from fish from all three river reaches. In addition, confidence in age estimation decreases with fish age because annuli become less distinct with age. Thus, it was difficult to obtain many scales of the older fish (3- and 4-year-old trout) that could be accurately back-calculated.

The effect of the reassignment of older fish to the 1- and 2-year-old age classes was to increase the power of statistical analysis for these age groups. For these ages, adequate data are most important for comparing growth among reaches because they represent the majority of the trout observed in the study area. However, the reassignment also decreased the number of available data for the 3- and 4-year-old fish. In light of this, PacifiCorp read additional scales from trout larger than 230 mm in order to gather more information on the length-at-age of older fish.

The length-at-age data were compared among reaches and age classes using an analysis of variance (ANOVA) approach. The ANOVA treated reach and age as two factors, with the interactions recognizing the differences in length between years and locations. Differences in length within locations were used to estimate growth, which was compared among the reaches.

The scale samples were selected from the three sampling events in 2002. Scales were selected from clean, unregenerated scales, mounted between two taped microscope slides, and digitized at a known magnification with a digital camera affixed to a dissection or compound microscope.

Scaling of the digitized image was determined by taking a digital image of an objective micrometer (10^{-3} mm)at the same magnifications used to digitize the fish scale. Digitized scale images were electronically stored in either JPEG or TIFF file formats.

Using scale pattern analysis, two biologists working independently estimated the age of each fish. Fish scale radii (i.e., scale focus to scale edge) and annulus radii (i.e., scale focus to annulus) were measured using AutoCAD. After completing the age ratings, the biologists compared their results and reviewed the images to resolve any discrepancies. The fork length (FL) and time of year caught were considered when age determination was difficult. Electronic drawing files were crated and stored for archiving. Data in drawing files were converted to text files for importing into Excel spreadsheets in order to facilitate calculation of scale measurements. All fish scale measurements were reported in micrometers.

Based on back-calculation methods (Bagenal, 1968; Hile, 1970; and Carlander, 1981), the scale measurements obtained and corresponding fish lengths were used to develop predicting equations for estimating fish size at earlier ages. These equations, based on least-squares linear regression, were used to estimate the size at age of individuals or groups of fish representing the populations and year classes for which scale samples have been obtained. An assessment of the precision of estimates was also made based on the degree of correlation between scale size and fish length.

3.4.1.4 Sampling Locations and Effort

Lake Ewauna

The Lake Ewauna (Keno reservoir) fishery was sampled by PacifiCorp consultants during fall 2001 and spring, summer, and fall 2002, using a boat-mounted electrofisher. Fall 2001 electrofishing was conducted on October 7, 8, 10, and 13; spring 2002 electrofishing was conducted on May 30 and 31; summer 2002 electrofishing on August 9 and 10; and fall 2002 electrofishing on October 9 and 10. Fish captured were identified to species whenever possible; their lengths (in mm) measured and recorded; and they then were returned live to the reservoir. Because many small juvenile fathead minnow, blue chub, and tui chub were collected during summer 2002, sizes of these specimens were recorded according to the 10-mm-length interval category in which they occurred (for example, 50 to 60 mm). Weights of representative-sized individual fish collected during spring 2002 sampling were measured and recorded in the field.

J.C. Boyle, Copco, and Iron Gate Reservoirs

The fishery in J.C. Boyle, Copco No. 1, and Iron Gate reservoirs was sampled in 1998 and 1999 by Oregon State University (OSU) as part of PacifiCorp's efforts to document the distribution and biology of shortnose and Lost River suckers in lower Klamath reservoirs (Desjardins and Markle, 2000). Six different gear types consisting of trammel, trap, dip and larval drift nets , beach seine, and larval trawl were used to sample larval, juvenile, and adult fish in the reservoirs. Sampling locations within the reservoirs and the use of sampling gear were adjusted seasonally to target different life history stages and sizes of suckers as they became vulnerable to different gear types. The three reservoirs were each sampled a total of more than 500 hours in 1998 and 700 hours in 1999.

These sampling efforts were initially directed at both species of endangered suckers and later at shortnose sucker because only three adult Lost River suckers had been captured. However, because the variety of gear types used sampled a full range of species and fish sizes, these studies also provide valuable information on the composition and abundance of other fish species present in the reservoirs.

3.4.1.5 Fish Collection Methods

Table 3.4-3 lists the six types of sampling gear employed in J.C. Boyle, Copco No. 1, and Iron Gate reservoirs, water depths and time of day sampled, and the targeted fish life stage by gear. Table 3.4-4 lists the sampling dates and effort by gear type in J.C. Boyle reservoir during 1998 and 1999. Table 3.4-5 lists the sampling dates and effort by gear type in Copco No. 1 reservoir during 1998 and 1999. Table 3.4-6 lists the sampling dates and effort by gear type in Iron Gate reservoir during 1998 and 1999. Methods used by OSU to sample adult, juvenile, and larval life stages in J.C. Boyle, Copco No. 1, and Iron Gate reservoirs are described briefly in the following text (Desjardins and Markle, 2000).

Table 3.4-3. Reservoir sampling gear and targeted life stages during 1998 and 1999.

Gear Type	Dimensions	Sampling Depth	Sampling Time	Targeted Life Stage
Trammel net	300 feet long	To 20 feet	Night	Adult
Trap net	3-foot x 15-foot opening; 25-foot lead	3 to 20 feet	Day, mostly night	Adult and Juvenile
Beach seine	20 feet	To 6 feet	Day	Juvenile
Larval trawl	2-foot x 4-foot opening; 8-foot length	1.5 to 5 feet	Day, mostly night	Larval and Juvenile
Dip net		Shallow	Day	Larval and Juvenile
Larval drift net	1.5-foot diameter	Surface	Night	Larval and Juvenile

Adult Sampling

Adult sampling was conducted from March through October in 1998 and from April through July in 1999 (Tables 3.4-3 and 3.4-4). Three 300-foot trammel nets were set at depths less than approximately 20 feet. Trammel nets were deployed during both day and night in 1998. Nets were set only during night in 1999 as night sets proved to be more successful in capturing fish. Trap nets also were used to sample adults, as well as juveniles, and are described further in the juvenile sampling section, below. Fish species, length, and condition were recorded for all individuals captured. In addition, spawning condition and weight data were recorded for endangered suckers (Desjardins and Markle, 2000).

Juvenile Sampling

Beach seines and trap nets were used to sample juvenile fish during various months in 1998 and 1999 (Tables 3.4-3 and 3.4-4). Backpack electrofishing, cast nets, and otter trawls also were used in 1998, but were only marginally successful. Those sampling results are limited and are not included in this report.

Beach seining sites included all available accessible habitats. A 6.1-m beach seine (2- by 2- by 2-m bag and a 4.8-mm bar mesh) was used to sample a wide range of depths and substrates in vegetated and nonvegetated areas. Seine hauls were conducted approximately 15 meters from shore in water not more than 2 m deep. Fish species and lengths were recorded for all individuals captured.

Two trap nets (5- by 1-m trap with 4.8-mm mesh and a 25-m lead) were deployed at various depths (1 to 7 m) during day and night in 1998. In 1999, trap netting targeted juvenile suckers and was conducted at night throughout the sampling period. Fish species, size, and condition were recorded for all individuals captured (Desjardins and Markle, 2000).

Larval Sampling

Larval drift nets, larval trawls, and dip nets were used to sample larval fish (Tables 3.4-5 and 3.4-6). Each method was deployed at various times throughout the spring and summer in 1998 and 1999. Types and numbers of fish captured were recorded. Taxonomic difficulties prevented the identification of many larval fish, including suckers, to species.

Table 3.4-4. J.C. Boyle reservoir sampling dates and effort by gear type during 1998 and 1999 (Desjardines and Markle, 2000).

Gear Type	Sampling Dates										Effort	
1998	**Mar 30**	**Apr 22**	**May 12**	**Jun 3**	**Jun 24**	**Jul 13**	**Aug 5**	**Aug 25**	**Sep 14**	**Oct 8**	**Sets/Pulls**	**Duration (hours)**
Trammel net	X	X	X	X		X				X	16	173
Trap net										X	10	118
Larval trawl			X	X	X	X	X				19	—
Dip net				X	X						7	—
Larval drift net		X	X	X	X						7	25
Beach seine						X	X	X			17	—
1999	**Apr 12**	**May 3**	**May 18**	**May 26**	**Jun 3**	**Jun 8**	**Jun 16**	**Jun 22**	**Jul 8**	**Jul 28**	**Sets/Pulls**	**Duration (hours)**
Trammel net	X	X		X							8	119
Trap net	X	X		X		X	X		X	X	13	197
Larval trawl			X			X	X	X	X		17	—
Dip net			X				X	X	X		10	—
Larval drift net	X	X	X	X		X	X	X			16	79
Beach seine						X	X	X		X	18	—

Table 3.4-5. Copco No. 1 reservoir sampling dates and effort by gear type during 1998 and 1999 (Desjardines and Markle, 2000).

Gear Type	**Sampling Dates**										**Effort**	
1998	**Mar 30**	**Apr 22**	**May 12**	**Jun 3**	**Jun 24**	**Jul 13**	**Aug 5**	**Aug 25**	**Sep 14**	**Oct 8**	**Sets/Pulls**	**Duration (hours)**
Trammel net	X	X	X		X	X				X	17	204
Trap net										X	2	35
Larval trawl			X	X	X	X	X				18	—
Dip net				X	X						5	—
Larval drift net		X	X	X	X						8	30
Beach seine						X	X	X			21	—
1999	**Apr 12**	**May 3**	**May 18**	**May 26**	**Jun 3**	**Jun 8**	**Jun 16**	**Jun 22**	**Jul 8**	**Jul 28**	**Sets/Pulls**	**Duration (hours)**
Trammel net	X	X		X							8	123
Trap net	X	X		X		X	X		X	X	14	219
Larval trawl			X			X	X	X	X		32	—
Dip net			X				X	X	X		14	—
Larval drift net	X	X	X	X		X	X	X			16	73
Beach seine						X	X	X	X	X	21	—

Table 3.4-6. Iron Gate reservoir sampling dates and effort by gear type during 1998 and 1999 (Desjardines and Markle, 2000).

Gear Type	Sampling Dates										Effort	
1998	**Mar 30**	**Apr 22**	**May 12**	**Jun 3**	**Jun 24**	**Jul 13**	**Aug 5**	**Aug 25**	**Sep 14**	**Oct 8**	**Sets/Pulls**	**Duration (hours)**
Trammel net	X	X	X		X	X				X	19	118
Trap net										X	3	56
Larval trawl			X	X	X	X	X				17	—
Dip net				X	X						6	—
Larval drift net		X	X	X	X						12	44
Beach seine						X	X	X			13	—
1999	**Apr 12**	**May 3**	**May 18**	**May 26**	**Jun 3**	**Jun 8**	**Jun 16**	**Jun 22**	**Jul 8**	**Jul 28**	**Sets/Pulls**	**Duration (hours)**
Trammel net	X	X		X						X	10	118
Trap net	X	X		X		X	X		X		12	206
Larval trawl			X		X	X	X	X	X		27	—
Dip net			X		X	X	X	X	X		25	—
Larval drift net	X	X	X	X	X	X	X	X			20	87
Beach seine						X	X			X	13	—

Larval drift nets were set at various times in 1998. However, because they were not that successful during daylight, only night sets were made in 1999. Half-meter-diameter (1,000-micron mesh) drift nets were set in areas of visible flow, usually at the reservoir inflow.

The larval trawl consisted of a 2.5-m net (1,000-micron mesh) with a 0.8- by l.5-m opening. The trawl net was mounted on an aluminum frame with runners. Sampling sites were selected based on accessibility, coverage with the gear type, depth, substrate, slope, and vegetation density. Both vegetated and nonvegetated sites were sampled. The larval trawl was set 3 to 15 m from shore in water approximately 0.5 to 1.5 m deep, then pulled to shore with ropes. The trawl was allowed to sit for approximately 12 minutes before retrieving so the site would recover from the disturbance of setting the trawl.

Dip net sampling sites were selected based on suitable habitat for larvae (around macrophytes in shallow embayments), and were used to supplement trawl data by sampling areas not easily sampled with the larval trawl. Dip net sampling was especially useful in reservoirs such as Iron Gate where steep shorelines made larval trawl sampling difficult. Dip net sampling consisted of a 5-minute search-and-capture technique and was conducted only during daylight hours (Desjardins and Markle, 2000).

Boat Electrofishing

A Smith Root electrofishing boat was very effective when used to sample fish in Keno reservoir and a lower portion of the Link River in 2001 and 2002. This method provided capture of a diverse group of species and (relative to other techniques) a large number of individuals.

3.4.1.6 Data Collection and Analysis

In addition to these recent sampling efforts by OSU, fish collection data from ODFW and the CDFG for all three reservoirs were reviewed. These data, together with results of the sampling in Keno reservoir, have been presented in the comparative description of the fish communities in each Project reservoir in Section 3.7. Taxonomic lists and the number of each fish species captured by reservoir and gear type are included in that section.

Results and discussion of river and reservoir studies are provided in Section 3.7.

3.5 RELATIONSHIP TO REGULATORY REQUIREMENTS AND PLANS

These investigations are intended to provide baseline information that, together with environmental data and results of other past and ongoing studies, can be used to assess effects of Project operations on fish resources and to help formulate recommendations for protection, mitigation, and enhancement measures consistent with agency and tribal management goals. The following contain references to objectives for fisheries in the study area:

- CDFG Upper Klamath Wild Trout Management Plan
- ODFW Klamath River Basin Fish Management Plan
- USFWS and NMFS Endangered Species Act requirements
- Klamath River Wild and Scenic River Plan
- Tribal natural resource goals and objectives and cultural values

- Klamath River Basin Task Force (KRBFTF) Long Range Plan

3.6 TECHNICAL WORKGROUP COLLABORATION

PacifiCorp worked with stakeholders to establish a collaborative process for planning and conducting studies needed to support Project relicensing documentation. Beginning in early 2001 the stakeholders and PacifiCorp developed a Process Protocol to guide the collaborative effort. The structure is comprised of a Plenary group (all interested stakeholders) and a number of technical working groups. As part of this structure, an Aquatics Work Group (AWG) was established to address most of the fisheries studies, except those related to fish passage, which had its own working group. The AWG has met approximately monthly. Additional meetings (often via phone conference) of AWG participants have been held to address specific study topics. In late 2003 several of the monthly AWG meetings were combined with the Fish Passage Work Group meetings to address some of the study topics that cross over both work groups.

3.7 RESULTS AND DISCUSSION

3.7.1 River Studies

The following sections present the results and discussion of the 2001 and 2002 fish sampling efforts in the riverine reaches of the Project area. The information presented includes such parameters as species captured, catch-per-unit effort (CPUE), and seasonal catch data where applicable. Tables containing the number of fish captured are included in Appendix 3B. The results and discussion are presented by river reach starting with the most upstream location (Link River) then moving downstream. Specific information regarding rainbow trout, such as length, age and growth, condition factors, and diet information are presented and discussed in the Adult Rainbow Trout Movement Study (see Section 5.0). Results of the trout fry distribution and abundance study also are summarized in Section 5.0. A specific report for this study element is included in Appendix 3A.

3.7.1.1 Link River

The Link River was sampled in the fall of 2001, and in the spring, summer, and fall of 2002. Twelve fish species were caught in the Link River over the duration of the field studies (Table 3.7-1). Of these, eight were native and four were non-native species. Included in these were the special status species of rainbow trout and shortnose sucker.

Table 3.7-1. Link River fish species sampled, all methods, all seasons.

Common Name	Link River
Rainbow trout[1]	X
Blue chub[1]	X
Tui chub[1]	X
Chubb spp.[1]	--
Speckled dace[1]	X
Sculpin spp.[1]	X
Lamprey[1]	--
Shortnose sucker[1]	X
Lost River sucker[1]	X
Klamath suckers[1,2]	X
Unknown sucker spp.[1]	--
Largemouth bass	X
Sacramento perch	--
Bluegill	X
Pumpkinseed	--
Crappie spp.	--
Fathead minnow	X
Yellow perch	X
Bullhead spp.	--
Unknown species	X

[1] Native species.

[2] Largescale and/or smallscale suckers.

-- None sampled.

Backpack Electrofishing

During the fall 2001 sampling, eight species were captured, of which five were native (Table 3.7-2). The most frequently sampled species were fathead minnow, speckled dace, and blue chubs. The least frequently captured were bluegill and yellow perch. The only species of special status captured was the shortnose sucker.

Table 3.7-2. Link River CPUE (fish per hour) by near-shore backpack electrofishing during fall 2001.

Common Name	CPUE
Rainbow trout[1]	--
Blue chub[1]	479.5
Tui chub[1]	112.5
Chubb spp. [1]	--
Speckled dace[1]	278.1
Sculpin (marbled)[1]	35.8
Lamprey[1]	--
Shortnose sucker[1]	18.5
Lost River sucker[1]	--
Klamath suckers[1,2]	--
Largemouth bass	--
Sacramento perch	--
Bluegill	1.2
Pumpkinseed	--
Black crappie	--
White crappie	--
Fathead minnow	608.0
Yellow perch	1.2
Bullhead	--
Unknown species	--

1 Native species.

2 Klamath largescale and/or smallscale suckers.

-- None sampled.

Seasonal Results. During the spring 2002 sampling, seven species were captured, six of which where native and one being a non-native species (Table 3.7-3). The most frequently sampled species were sculpin, speckled dace, and blue chubs. The least frequently captured were the native rainbow trout, shortnose suckers, and blue chub.

In the summer of 2002, six species were captured. Four species were native, two were non-native, and a few unidentified species that were mostly minnows or chubs (Table 3.7-3). The most frequently caught species were fathead minnow, sculpin, and Tui and blue chubs. The least frequently captured species was yellow perch and speckled dace. There were no special status species captured during the summer sampling.

Table 3.7-3. Link River CPUE (fish per hour) by near-shore backpack electrofishing for each season, segments combined, during 2002.

Fish Species Common Name	Spring	Summer	Fall
Rainbow trout	4.3	--	--
Blue chub	1.4	204.2	305.3
Tui chub	26.1	325.2	208.0
Chubb spp.	--	--	--
Speckled dace	34.8	7.6	23.5
Sculpin (marbled)	47.8	302.5	140.9
Lamprey	--	--	--
Shortnose sucker	1.4	--	--
Lost River sucker	--	--	--
Klamath sucker spp.[1]	--	--	--
Unknown sucker spp.	--	--	--
Largemouth bass	--	--	3.4
Sacramento perch	--	--	--
Bluegill	--	--	--
Pumpkinseed	--	--	--
Black crappie	--	--	--
White crappie	--	--	--
Fathead minnow	10.1	219.3	520.0
Yellow perch	--	3.8	--
Bullhead spp.	--	--	--
Unknown species [2]	--	37.8	164.4

[1] Largescale and/or smallscale suckers.

[2] Most likely fathead minnows and/or

-- None sampled.

The results of the fall 2002 sampling were very similar to that for the summer. Six species were captured, four of which were native and two of which were non-native species (Table 3.7-3). As in the summer of 2002, the most frequently caught species were fathead minnow, sculpin, and Tui and blue chubs. The least frequently caught species was largemouth bass. As in the summer, no special status species were captured in the Link River during the fall.

The only obvious trend regarding the comparison of the seasonal sampling was that the fall sampling had much higher overall CPUEs than the spring and summer. The spring CPUEs were by far the lowest, both overall and for specific species. The general trend of “relative abundance” based on CPUEs was mostly the same in all seasons. The catch was dominated by sculpins, chubs and minnows, and gamefish such as trout, sunfish, and even suckers were infrequently captured.

<u>Upper Segment Versus Lower Segment.</u> For all seasonal data combined, the sampling in the upper segment captured eight species of fish, six of which were native, and two that were non-native (Table 3.7-4). In the lower segment, six species of fish were captured, four of which were native and two of which were non-native. Unidentified species (most likely chubs and/or minnows) were caught in both segments.

As with the seasonal comparison, sculpins, chubs, dace, and minnows dominated the catch in both segments. However, unlike in the seasonal comparison, the highest catch rates in the lower segment occurred during the summer sampling, as opposed to the fall. The spring was still the season with lowest catch rates for both segments of the river.

Table 3.7-4. Link River CPUE (fish per hour) by near-shore backpack electrofishing during 2002.

Fish Species - Common Name	All Seasons/ Segments Combined	Upper Segment				Lower Segment			
		All Seasons	**Spring**	**Summer**	**Fall**	**All Seasons**	**Spring**	**Summer**	**Fall**
Rainbow trout	2.4	4.0	6.7	--	--	--	--	--	--
Blue chub	116.6	102.4	2.2	--	444.2	137.9	--	408.4	118.2
Tui chub	132.5	115.7	31.2	105.9	344.8	157.9	16.6	544.5	23.6
Chubb spp.	--	--	--	--	--	--	--	--	--
Speckled dace	26.3	27.9	31.2	--	40.9	--	41.5	15.1	
Sculpin spp.	123.8	61.2	71.3	--	81.8	217.9	4.1	605.0	220.6
Lamprey	--	--	--	--	--	--	--	--	--
Shortnose sucker	0.8	1.3	2.2	--	--	--	--	--	--
Lost River sucker	--	--	--	--	--	--	--	--	--
Klamath sucker spp.[1]	--	--	--	--	--	--	--	--	--
Unknown sucker spp.	--	--		--	--	--	--	--	--
Largemouth bass	0.8	1.3	--	--	5.8	--	--	--	--
Sacramento perch	--	--	--	--	--	--	--	--	--
Bluegill	--	--	--	--	--	--	--	--	--
Pumpkinseed	--	--	--	--	--	--	--	--	--
Black crappie	--	--	--	--	--	--	--	--	--
White crappie	--	--	--	--	--	--	--	--	--
Fathead minnow	175.6	130.3	11.1	--	543.5	243.9	8.3	438.7	488.4
Yellow perch	0.8	--	--	--	--	2.0	--	7.6	--
Bullhead spp.	--	--	--	--	--		--	--	--
Unknown species [2]	47.1	5.3	--	--	23.4	109.9	--	75.6	354.5

[1] Largescale and/or smallscale suckers.
[2] Most likely fathead minnows and/or chubs.
-- None sampled.

Boat Electrofishing

Boat electrofishing was conducted in the lower segment of the Link River in the spring and summer of 2002. Seven species were captured collectively during the boat electrofishing efforts (Table 3.7-5). The most commonly captured fish were blue chubs and Tui chubs during both seasons. While resident populations of these two species certainly exist in the reach, it is highly likely that many of these observed in the river are from Upper Klamath Lake. This is consistent with data from previous fish entrainment studies performed by PacifiCorp and the USBR (New Earth and PacifiCorp, 2001). Upper Klamath Lake has extensive populations of both these species and both prefer lacustrine (lake) habitat.

During the spring sampling, rainbow trout and shortnose sucker were also captured by boat electrofishing, although in low numbers (Table 3.7-5). Whether these fish moved up from Keno reservoir or down from Upper Klamath Lake is unknown. It is doubtful that the Link River has a year-round population of trout because of the excessively warm (greater than 25°C) water temperatures in the summer.

Table 3.7-5. Link River CPUE (fish per hour) by boat electrofishing for each season during 2002.

Fish Species - Common Name	Spring	Summer
Rainbow trout	9.1	--
Blue chub	182.3	1361.7
Tui chub	437.5	466.3
Chubb spp.	--	--
Speckled dace	--	--
Sculpin (marbled)	--	--
Lamprey	--	--
Shortnose sucker	109.4	--
Lost River sucker	9.1	--
Klamath sucker spp.[1]	18.2	18.7
Unknown sucker spp.	--	--
Largemouth bass	--	--
Sacramento perch	--	--
Bluegill	--	--
Pumpkinseed	--	--
Black crappie	--	--
White crappie	--	--
Fathead minnow	--	56.0
Yellow Perch	--	--
Bullhead spp.	--	--
Unknown species [2]	--	--

[1] Largescale and/or smallscale suckers.

[2] Most likely fathead minnows and/or chubs.

-- None sampled.

Angling

Angling was conducted in the Link River in the fall of 2001 and in the spring, summer, and fall of 2002. Only one fish (a 135-mm blue chub) was captured for all the angling efforts combined.

Minnow Traps

Minnow traps were placed in the Link River in the summer and fall of 2002 and provided only a minimal amount of fish data. In the summer, 15 individuals of four species were caught (Table 3.7-6). The most frequently caught species was yellow perch. In the fall of 2002, 39 fish of six species were caught; the most frequently caught species was the fathead minnow.

Table 3.7-6. Link River number of fish caught by minnow traps during 2002.

Common Name	Summer 2002	Fall 2002
Blue chub	4	7
Fathead minnow	0	14
Sculpin spp.	1	5
Speckled dace	0	5
Tui chub	1	6
Yellow perch	9	2

3.7.1.2 Keno Reach

The Keno reach was sampled using backpack electrofishing and angling in the fall of 2001, and during the spring, summer, and fall of 2002. The fall sampling occurred in the lower portion of the Keno reach, while the 2002 sampling (using both electrofishing and angling) was conducted in the upper and lower sections (as stated in Section 3.4, Methods and Geographic Scope). Minnow traps were set during the summer and fall 2002 sampling.

Twelve species were captured from the Keno reach (Table 3.7-7). Eight of these were native species and four were non-native species. Included in these were the special status species of rainbow trout, Lost River sucker, and lamprey.

Table 3.7-7. Keno reach fish species sampled, all methods, all seasons.

Common Name	Keno Reach
Rainbow trout[1]	X
Blue chub[1]	X
Tui chub[1]	X
Chubb spp.[1]	--
Speckled dace[1]	X
Sculpin spp.[1]	X
Lamprey[1]	X
Shortnose sucker[1]	--
Lost River sucker[1]	X
Klamath suckers[1,2]	X
Unknown sucker spp.[1]	--
Largemouth bass	--
Sacramento perch	--
Bluegill	X
Pumpkinseed	X
Crappie spp.	--
Fathead minnow	X
Yellow perch	--
Bullhead spp.	--
Unknown species	X

[1] Native species.

[2] Largescale and/or smallscale suckers.

-- None sampled.

Backpack Electrofishing

Ten species were captured during backpack electrofishing, seven of these being native. Special status species that were captured included rainbow trout, lamprey, and Lost River sucker. These species represented only a small portion of the catch for the Keno reach and only rainbow trout were captured during every sampling event (Tables 3.7-8 and 3.7-9). Lost River suckers and lamprey were only captured during the spring sampling. The results of seasonal sampling and upper- versus lower-segment sampling in the Keno reach are discussed below.

Table 3.7-8. Keno reach CPUE (fish per hour) by near-shore backpack electrofishing during fall 2001.

Common Name	CPUE
Rainbow trout[1]	3.0
Blue chub[1]	184.0
Tui chub[1]	120.0
Chubb spp.[1]	--
Speckled dace[1]	--
Sculpin (marbled)[1]	264.0
Lamprey[1]	--
Shortnose sucker[1]	--
Lost River sucker[1]	--
Klamath suckers[2]	16.0
Largemouth bass	--
Sacramento perch	--
Bluegill	--
Pumpkinseed	--
Black crappie	--
White crappie	--
Fathead minnow	216.0
Yellow perch	--
Bullhead	--
Unknown species	--

[1] Native species.

[2] Klamath largescale and/or smallscale suckers.

-- None sampled.

Table 3.7-9. Keno reach CPUE (fish per hour) by near-shore backpack electrofishing for each season, segments combined, during 2002.

Fish Species Common Name	Spring	Summer	Fall
Rainbow trout	72.0	25.0	42.3
Blue chub	83.4	--	132.9
Tui chub	7.6	41.7	110.7
Chubb spp.	--	--	--
Speckled dace	306.9	211.4	108.3
Sculpin (marbled)	552.0	166.9	60.7
Lamprey	1.3	--	--
Shortnose sucker	--	--	--
Lost River sucker	1.3	--	--
Klamath sucker spp.[1]	--	--	--
Unknown sucker spp.	--	--	--
Largemouth bass	--	--	--
Sacramento perch	--	--	--
Bluegill	1.3	--	--
Pumpkinseed	--	--	0.8
Black crappie	--	--	--
White crappie	--	--	--
Fathead minnow	21.5	65.4	182.9
Yellow perch	--	--	--
Bullhead spp.	--	--	--
Unknown species[2]	--	162.7	0.8

1 Largescale and/or smallscale suckers.

2 Most likely fathead minnows and/or chubs.

-- None sampled.

Seasonal Results. During the fall 2001 sampling, six species were captured, five of which where native (Table 3.7-9). The most frequently caught species were sculpin and fathead minnows. The least frequent caught were rainbow trout and Klamath largescale/smallscale suckers.

In the spring of 2002, nine species were captured, seven of which were native (Table 3.7-9). The most frequently caught species were sculpin and speckled dace, and the least frequent were tui chubs and lamprey.

In the summer of 2002, six species were captured, four being native (Table 3.7-9). The most frequently caught species were speckled dace and sculpin. There was also a relatively high number of unidentified species captured; these were most likely young chub and/or minnow species. The least frequently captured species was rainbow trout.

During the fall 2002 sampling, eight species were captured, five of which were native (Table 3.7-9). The most frequently captured species were fathead minnow, blue chub, and Tui chub. The least frequently caught were pumpkinseed and rainbow trout. A small number of unidentified fish were also captured and again, these most likely were small chubs or minnows.

The pattern of seasonal catch for the 2002 backpack electrofishing appears to be fairly consistent. For the most part dace, chubs, and sculpins dominated the catch for all three seasons. However, there did appear to be a trend of a decreasing abundance of sculpins and dace from spring through fall and an increasing abundance of fathead minnows.

Upper Segment Versus Lower Segment. In comparing the backpack electrofishing results between the upper and lower reaches, only the 2002 data were considered and the seasonal data were combined for each of the reaches. In the upper segment, nine species were captured, six being native (Table 3.7-10). In the lower segment, nine species also were captured, with five being native.

Table 3.7-10. Keno reach: upper segment compared to lower segment, 2002.

Fish Species Common Name	All Seasons Segments Combined	Upper Segment All Seasons Combined	Lower Segment All Seasons Combined
Rainbow trout	46.2	3.0	69.7
Blue chub	85.0	222.3	10.4
Tui chub	64.0	142.5	21.4
Chubb spp.	--	--	--
Speckled dace	190.6	165.7	204.1
Sculpin (marbled)	226.2	469.8	93.8
Lamprey	0.4	--	0.5
Shortnose sucker	--	--	--
Lost River sucker	0.4	1.0	--
Klamath sucker spp.[1]	--	--	--
Unknown sucker spp.	--	--	--
Largemouth bass	--	--	--
Sacramento perch	--	--	--
Bluegill	0.4	1.0	--
Pumpkinseed	0.4	--	0.5
Black crappie	--	--	--
White crappie	--	--	--
Fathead minnow	107.4	231.4	40.1
Yellow perch	--	--	--
Bullhead spp.	--	--	--
Unknown species [2]	42.0	99.0	11.0

[1] Largescale and/or smallscale suckers.

[2] Most likely fathead minnows and/or chubs.

-- None sampled.

As with the seasonal analysis, dace, chubs, and sculpins dominated the catch for both the upper and lower segments. The only noticeable difference was that the upper segment had much higher CPUEs for the more frequently caught species. However, the lower segment had a much higher CPUE for rainbow trout, with virtually all of the rainbow trout captured in the Keno reach having been caught in the lower segment. This may have resulted from fish moving in and out of the upper portion of J.C. Boyle reservoir.

Angling

Rainbow trout was the only species captured by angling in the Keno reach. Thirteen redband trout were captured in the fall of 2001, and 16, 10, and 57 trout were captured in the spring, summer, and fall of 2002, respectively. Collectively, the trout captured ranged in size from about 120 mm to 475 mm with an average size of about 270 mm in FL. Discussions regarding the specifics of the data collected for trout in the Keno reach are presented in Section 5.0, Trout Movement.

Minnow Traps

The minnow trap sampling in the Keno reach (summer and fall of 2002) provided only a minimal amount of fish data. Collectively, the sampling captured only 35 fish of six species (Table 3.7-11). Sculpin was the most frequently caught species in each season sampled.

Table 3.7-11. Number of fish caught by minnow traps in the Keno reach during 2002.

Common Name	Summer 2002	Fall 2002
Blue chub	0	2
Fathead minnow	4	5
Sculpin spp.	3	13
Speckled dace	0	6
Tui chub	1	0
Unknown spp.	1	0

3.7.1.3 J.C. Boyle Bypass Reach

The J.C. Boyle bypass reach was sampled using backpack electrofishing and angling in the fall of 2001, and in the spring, summer, and fall of 2002. Minnow traps were set in the spring, summer, and fall of 2002. Fourteen species were captured during the sampling events, with half being native and half being non-native species (Table 3.7-12). Those with special status included rainbow trout, shortnose suckers, and lamprey.

Table 3.7-12. J.C. Boyle bypass fish species sampled, all methods all seasons.

Common Name	J.C. Boyle Bypass
Rainbow trout[1]	X
Blue chub[1]	X
Tui chub[1]	X
Chubb spp. [1]	--
Speckled dace[1]	X
Sculpin spp.[1]	X
Lamprey[1]	X
Shortnose sucker[1]	X
Lost River sucker[1]	--
Klamath suckers[2]	--
Unknown sucker spp.[1]	--
Largemouth bass	X
Sacramento perch	X
Bluegill	X
Pumpkinseed	X
Crappie spp.	X
Fathead minnow	X
Yellow perch	--
Bullhead spp.	X
Unknown species	--

1 Native species.

2 Largescale and/or smallscale suckers.

-- None sampled.

Backpack Electrofishing

Fifteen species were captured during backpack electrofishing, seven of these being native. Special status species captured included rainbow trout, lamprey, and shortnose suckers. Lamprey and shortnose suckers represented only a small portion of the total catch for the J.C. Boyle bypass reach as shortnose suckers were captured only in small numbers in the fall of 2001 and lamprey in small numbers in the fall of 2002. Rainbow trout were captured during every sampling event and constituted a substantial portion of the catch in most of the seasons (Tables 3.7-13 and 3.7-14). The results of seasonal sampling and upper- versus lower-segment sampling of the bypass reach are discussed below.

Seasonal Results. During the fall 2001 sampling, five species were captured, all of which were native (Table 3.7-13). The most frequently caught species was rainbow trout, followed by speckled dace.

Table 3.7-13. J.C. Boyle bypass reach CPUE (fish per hour) by near-shore backpack electrofishing during fall 2001.

Common Name	CPUE
Rainbow trout[1]	112
Blue chub[1]	--
Tui chub[1]	16
Chubb spp. [1]	--
Speckled dace[1]	24
Sculpin (marbled)[1]	16
Lamprey[1]	--
Shortnose sucker[1]	8
Lost River sucker[1]	--
Klamath suckers[2]	--
Largemouth bass	--
Sacramento perch	--
Bluegill	--
Pumpkinseed	--
Black crappie	--
White crappie	--
Fathead minnow	--
Yellow perch	--
Bullhead	--
Unknown species	--

[1] Native species.

[2] Klamath largescale and/or smallscale suckers.

-- None sampled.

In the spring of 2002, six species were captured, four of which were native (Table 3.7-14). The most frequently caught species was sculpin and the least frequent was non-native bullhead.

In the summer of 2002, six species were captured, five of which were native (Table 3.7-14). The most frequently caught species were sculpin, speckled dace and rainbow trout. The least frequently captured species was non-native bullhead.

Table 3.7-14. J.C. Boyle bypass CPUE (fish per hour) by near-shore backpack electrofishing for each season, segments combined.

Fish Species Common Name	Spring	Summer	Fall
Rainbow trout	3.3	23.5	28.9
Blue chub	2.6	1.1	2.8
Tui chub	2.0	4.3	1.7
Chubb spp.	--	--	--
Speckled dace	--	37.4	17.8
Sculpin (marbled)	19.8	48.1	18.9
Lamprey	--	--	0.6
Shortnose sucker	--	--	--
Lost River sucker	--	--	--
Klamath sucker spp.[1]	--	--	--
Unknown sucker spp.	--	--	--
Largemouth bass	--	--	1.7
Sacramento perch	--	--	0.6
Bluegill	--	--	7.2
Pumpkinseed	4.0	--	5.0
Black crappie	--	--	0.6
White crappie	--	--	0.6
Fathead minnow	--	--	0.6
Yellow perch	--	--	--
Bullhead spp.	1.3	3.2	8.3
Unknown species[2]	--	--	--

[1] Largescale and/or smallscale suckers.

[2] Most likely fathead minnows and/or chubs.

-- None sampled.

The most species were captured during the fall 2002 sampling, with 14 species sampled, six of which were native (Table 3.7-14). The most frequently captured species, however, were the native species of rainbow trout, sculpin, and speckled dace. The least frequently caught species included, for the most part, a variety of non-native fish.

The pattern of seasonal catch for the J.C. Boyle bypass reach using backpack electrofishing appears to be fairly consistent. Native species dominated the catch with rainbow trout, sculpins and dace being the most abundant. The only season when rainbow trout were not a substantial part of the catch was in the summer sampling.

Upper Segment Versus Lower Segment. In comparing the backpack electrofishing results between the upper and lower reaches, only the 2002 data were considered and the seasonal data were combined for each of the reaches. In the upper segment, 13 species were captured, six of which were native (Table 3.7-15). In the lower segment, eight species were captured, five of which were native.

Table 3.7-15. J.C. Boyle bypass reach CPUE (fish per hour) by near-shore backpack electrofishing.

Fish Species Common Name	All Seasons/ Segments Combined	Upper Segment				Lower Segment			
		All Seasons	Spring	Summer	Fall	All Seasons	Spring	Summer	Fall
Rainbow trout	18.6	12.2	4.6	16.9	12.1	22.6	3.1	27.6	53.5
Blue chub	2.4	4.9	9.2	2.8	4.7	0.8	1.5	--	--
Tui chub	--	5.5	9.2	11.3	2.8	0.4	0.8	--	--
Chubb spp.	--	--	--	--	--	--	--	--	--
Speckled dace	15.8	38.3	--	90.1	28.9	1.5	--	5.2	1.4
Sculpin (marbled)	25.6	17.0	4.6	36.6	13.1	31.1	22.3	55.2	27.5
Lamprey	0.2	0.6	--	--	0.9	--	--	--	--
Shortnose sucker	--	--	--	--	--	--	--	--	--
Lost River sucker	--	--	--	--	--	--	--	--	--
Klamath sucker spp.[1]	--	--	--	--	--	--	--	--	--
Unknown sucker spp.	--	--	--	--	--	--	--	--	--
Largemouth bass	0.7	1.2	--	--	1.9	0.4	--	--	1.4
Sacramento perch	0.2	0.6	--	--	0.9	-	--	--	--
Bluegill	3.1	7.9	--	--	12.1	-	--	--	--
Pumpkinseed	3.5	7.9	27.6	--	6.5	0.8	--	--	2.7
Black crappie	0.2	0.6	--	--	0.9	-	--	--	--
White crappie	0.2	0.6	--	--	0.9	-	--	--	--
Fathead minnow	0.2	--	--	--	-	0.8	--	--	1.4
Yellow perch	--	--	--	--	--	--	--	--	--
Bullhead spp.	4.7	12.2	9.2	8.4	14.0	--	---	--	--
Unknown species[2]	--	--	--	--	--	--	--	--	--

[1] Largescale and/or smallscale suckers.
[2] Most likely fathead minnows and/or chubs.
-- None sampled.

As with the seasonal analysis , sculpins, dace, and rainbow trout were among the most frequently caught species overall for both the upper and lower segments. The only noticeable difference was that the upper segment had a lower CPUE for redband/rainbow trout and higher CPUE for speckled dace. In addition, the upper segment had many more non-native species present, although in low numbers. This most likely resulted from fish moving out of J.C. Boyle reservoir. All of these species (sunfish), except for bullheads, are considered lake or reservoir fish and it is very unlikely that there are resident populations of these species in the upper segment of the bypass reach. Water in the upper portion of the bypass reaches provided from the fish ladder and fish bypass discharge, along with a small amount of spill at the dam. These avenues would be the source of these non-native fish.

Angling

Angling was conducted in the J.C. Boyle bypass reach in the fall of 2001 and in the spring, summer, and fall of 2002. Two species were caught during the sampling events: rainbow trout and blue chub. Overall, 262 rainbow trout were caught in the bypass reach, some during every sampling event (Table 3.7-16). However, only two blue chub were captured, one each in the spring and summer sampling of 2002.

Table 3.7-16. J.C. Boyle bypass reach CPUE (fish per hour) by near-shore backpack electrofishing in upper segment compared to lower segment.

Fish Species Common Name	All Seasons/ Segments Combined	Upper Segment All Seasons Combined	Lower Segment All Seasons Combined
Rainbow trout	18.6	12.2	22.6
Blue chub	2.4	4.9	0.8
Tui chub	--	5.5	0.4
Chubb spp.	--	--	--
Speckled dace	15.8	38.3	1.5
Sculpin (marbled)	25.6	17.0	31.1
Lamprey	0.2	0.6	--
Shortnose sucker	--	--	---
Lost River sucker	--	--	---
Klamath sucker spp.[1]	--	--	--
Unknown sucker spp.	--	--	--
Largemouth bass	0.7	1.2	0.4
Sacramento perch	0.2	0.6	--
Bluegill	3.1	7.9	--
Pumpkinseed	3.5	7.9	0.8
Black crappie	0.2	0.6	--
White crappie	0.2	0.6	--
Fathead minnow	0.2	--	0.8
Yellow perch	--	--	--
Bullhead spp.	4.7	12.2	--
Unknown species [2]	--	--	--

[1] Largescale and/or smallscale suckers.

[2] Most likely fathead minnows and/or chubs.

-- None sampled.

In the fall of 2001, fourteen trout were captured in the bypass reach. The trout ranged in size from 143 mm to 222 mm, with an average length of 179 mm. In the spring of 2002, 32 trout were captured, ranging in size from 127 mm to 300 mm, with an average length of 191 mm. During the summer 2002 sampling, 34 trout were captured, ranging in size from 130 mm to 315 mm with an average length of 190 mm. The most trout were captured in the fall of 2002 (182 trout) and ranged in size from 144 mm to 301 mm, with an average size of 182 mm. A full analysis of the trout data collected in the bypass reach is presented in Section 3.7.1.7, Trout Comparison.

Minnow Traps

Minnow traps were set in the J.C. Boyle bypass reach in the spring, summer, and fall of 2002. Sculpin were the only species captured (other than a few unidentified species) and only a total seven sculpins were collectively captured throughout the minnow trap sampling, four in the spring, one in the summer, and two in the fall.

Fry distribution and Relative Abundance

Fry distribution and relative abundance studies were conducted in the J.C. Boyle bypass and peaking reaches in 2003. The discussion of fry for both these reaches is presented in the next section for the J.C. Boyle Peaking Reach.

3.7.1.4 J.C. Boyle Peaking Reach

The J.C. Boyle peaking reach was sampled using backpack electrofishing and angling in the fall of 2001 and in the spring, summer, and fall of 2002. Boat electrofishing was conducted in the fall of 2002. Minnow traps and snorkeling were employed to gain additional information in the summer and fall of 2002. Nine species were captured collectively from the sampling events and all were native species (Table 3.7-17).

Table 3.7-17. J.C. Boyle peaking reach fish species sampled, all methods, all seasons.

Common Name	J.C. Boyle Peaking
Rainbow trout[1]	X
Blue chub[1]	X
Tui chub[1]	X
Chubb spp.[1]	X
Speckled dace[1]	X
Sculpin spp.[1]	X
Lamprey[1]	X
Shortnose sucker[1]	X
Lost River sucker[1]	--
Klamath suckers[2]	X
Unknown sucker spp.[1]	X
Largemouth bass	--
Sacramento perch	--
Bluegill	--
Pumpkinseed	--
Crappie spp.	--
Fathead minnow	--
Yellow perch	--
Bullhead spp.	--
Unknown species	X

1 Native species.

2 Largescale and/or smallscale suckers.

-- None sampled.

Backpack Electrofishing

Only five species were captured during the combined backpack electrofishing efforts in the J.C. Boyle peaking reach; all were native species. Special status species that were captured included rainbow trout and shortnose suckers. Shortnose suckers were captured only in the fall of 2001.

(Tables 3.7-18 and 3.7-19). The results of seasonal sampling and upper- versus lower-segment sampling of the peaking reach are discussed below.

Seasonal Results. During the fall 2001 sampling, four species were captured (Table 3.7-18). The most frequently caught species was rainbow trout, followed by sculpins, Tui chubs, and shortnose suckers.

Table 3.7-18. J.C. Boyle peaking reach CPUE (fish per hour) by near-shore backpack electrofishing during fall 2001.

Common Name	CPUE
Rainbow trout[1]	112
Blue chub[1]	--
Tui chub[1]	16
Chubb spp.[1]	--
Speckled dace[1]	--
Sculpin spp. [1]	16
Lamprey[1]	--
Shortnose sucker[1]	8
Lost River sucker[1]	--
Klamath suckers[2]	--
Largemouth bass	--
Sacramento perch	--
Bluegill	--
Pumpkinseed	--
Black crappie	--
White crappie	--
Fathead minnow	--
Yellow perch	--
Bullhead	--
Unknown species	--

1 Native species.

2 Klamath largescale and/or smallscale suckers.

-- None sampled.

In the spring of 2002, four species were captured, with speckled dace and sculpin being the most frequently caught (Table 3.7-19). Spring was the only season in which rainbow trout were not caught in the peaking reach.

Table 3.7-19. J.C. Boyle peaking reach CPUE (fish per hour) by near-shore backpack electrofishing for each season, segments combined, during 2002.

Fish Species Common Name	Spring[3]	Summer	Fall
Rainbow trout	--	63.2	2.9
Blue chub	10.3	--	--
Tui chub	24.1	--	--
Chubb spp.	--	--	--
Speckled dace	68.8	497.7	261.4
Sculpin (marbled)	31.0	144.8	116.2
Lamprey	--	--	--
Shortnose sucker	--	--	--
Lost River sucker	--	--	--
Klamath sucker spp.[1]	--	--	--
Unknown sucker spp.	--	--	59.5
Largemouth bass	--	--	--
Sacramento perch	--	--	--
Bluegill	--	--	--
Pumpkinseed	--	--	--
Black crappie	--	--	--
White crappie	--	--	--
Fathead minnow	--	--	--
Yellow perch	--	--	--
Bullhead spp.	--	--	--
Unknown species[2]	--	--	--

1 Largescale and/or smallscale suckers.

2 Most likely fathead minnows and/or chubs.

3 California segment of peaking reach not sampled.

-- None sampled.

In the summer of 2002, only three species were captured, all of which were native (Table 3.7-19). The most frequently caught species by far was sculpin, followed by speckled dace and rainbow trout.

During the fall 2002 sampling four species were caught, with speckled dace and sculpin being the most frequently captured. (Table 3.7-19).

The pattern of seasonal catch for the peaking reach backpack electrofishing appears to be fairly consistent. Only native species were present and, other than in the fall of 2001, speckled dace and sculpins dominated the catches.

Oregon Segment Versus California Segment. In comparing the backpack electrofishing results between the Oregon (upper) and California (lower) reaches, only the 2002 data were considered and the seasonal data were combined for each of the reaches. In the Oregon segment, five species were captured, and in the California segment, only three species were captured (Table 3.7-20).

Table 3.7-20. J.C. Boyle peaking reach CPUE (fish per hour) by near-shore backpack electrofishing.

Fish Species Common Name	All Seasons/ Segments Combined	Oregon Segment				California Segment			
		All Seasons	Spring	Summer	Fall	All Seasons	Spring	Summer	Fall
Rainbow trout	19.1	1.0	--	--	1.9	71.9	Not sampled	126.9	6.3
Blue chub	4.4	5.9	10.3	--	--	--		--	--
Tui chub	5.2	6.9	24.1	--	--	--		--	--
Chubb spp.	--	--	--	--	--	--		--	--
Speckled dace	286.3	193.8	68.8	314.9	218.8	555.4		681.9	404.2
Sculpin (marbled)	106.0	126.6	31.0	204.7	150.9	46.0		84.6	--
Lamprey	--	--	--	--	--	--		--	--
Shortnose sucker	--	--	--	--	--	--		--	--
Lost River sucker	--	--	--	--	--	--		--	--
Klamath sucker spp.[1]	--	--	--	--	--	--		--	--
Unknown sucker spp.	30.2	40.5	--	--	77.3	--		--	--
Largemouth bass	--	--	--	--	--	--		--	--
Sacramento perch	--	--	--	--	--	--		--	--
Bluegill	--	--	--	--	--	--		--	--
Pumpkinseed	--	--	--	--	--	--		--	--
Black crappie	--	--	--	--	--	--		--	--
White crappie	--	--	--	--	--	--		--	--
Fathead minnow	--	--	--	--	--	--		--	--
Yellow perch	--	--	--	--	--	--		--	--
Bullhead spp.	--	--	--	--	--	--		--	--
Unknown species[2]	--	--	--	--	--	--		--	--

[1] Largescale and/or smallscale suckers.

[2] Most likely fathead minnows and/or chubs.

-- None sampled.

As with the seasonal data, sculpins and speckled dace were generally the most frequently caught species in both segments. The only noticeable difference was that the CPUE of redband/rainbow trout was considerably higher in the California segment and they were captured in all seasons sampled (the California segment was not sampled in the spring of 2002). In addition, redband trout were only captured in the Oregon segment in the fall of 2002. Another interesting note is that none of the non-native species captured in the upstream bypass reach were sampled in either segment of the J.C. Boyle peaking reach during the back-pack electrofishing.

<u>Boat Electrofishing</u>

Boat electrofishing was conducted in the J.C. Boyle peaking reach in the fall of 2002. Five species were captured: rainbow trout, speckled dace, sculpin spp., and Klamath largescale/ smallscale suckers (Table 3.7-21). A few unknown species also were captured that were presumably chub and/or minnow species. Suckers and rainbow trout were the most frequently captured fish, accounting for more than 75 percent of the total catch.

Table 3.7-21. J.C. Boyle peaking reach comparison of total catch and CPUE during drift-boat electrofishing in Oregon and California segments during fall 2002.

Common Name	Oregon Reach		California Reach		Combined Reaches	
	Catch	Catch Per Unit Effort	Catch	Catch Per Unit Effort	Total Catch	Total Catch Per Unit Effort
Rainbow trout	8	25.3	20	27.9	28	26
Blue chub	--	--	--	--	--	--
Tui chub	--	--	--	--	--	--
Chubb spp.	--	--	--	--	--	--
Klamath speckled dace	7	22.1	2	2.8	9	9
Sculpin (marbled)	1	3.16	--	--	1	3
Lamprey	1	3.16	--	--	1	3
Shortnose sucker	--	--	--	--	--	--
Lost River sucker	--	--	--	--	--	--
Klamath sucker spp.[1]	3	9.5	43	60	46	45
Largemouth bass	--	--	--	--	--	--
Sacramento perch	--	--	--	--	--	--
Bluegill	--	--	--	--	--	--
Pumpkinseed	--	--	--	--	--	--
Black crappie	--	--	--	--	--	--
White crappie	--	--	--	--	--	--
Fathead minnow	--	--	--	--	--	--
Yellow perch	--	--	--	--	--	--
Bullhead spp.	--	--	--	--	--	--
Unknown species[2]	4	12.6	1	1.4	5	5

[1] Largescale and/or smallscale suckers.

[2] Most likely fathead minnows and/or chubs.

-- None sampled.

For analysis purposes, the data were divided into an Oregon reach and a California reach. The catch rates for suckers were substantially higher in the California portion of the peaking reach, but more species were caught in the Oregon reach (Table 3.7-21). This was similar to the results from the backpack electrofishing efforts.

<u>Angling</u>

Angling was conducted in the peaking reach in the fall of 2001 and the spring, summer, and fall of 2002. The only species captured was rainbow trout. Overall, 187 trout were captured from the peaking reach.

In the fall of 2001, 29 trout were captured. The size of trout ranged from 156 mm to 412 mm, with an average length of 270 mm. In the spring of 2002, 48 trout were captured ranging in size from 145 mm to 393 mm, with an average length of 242 mm. In the summer of 2002, 32 trout were captured ranging in size from 180 mm and 407 mm, with an average length of 270 mm. In the fall of 2002, 78 trout were captured ranging in size from 136 mm to 381 mm, with an average length of 249 mm. An analysis of the trout data recorded from the J.C. Boyle peaking reach is presented in Section 3.7.1.7, Trout Comparison.

Minnow Traps

Minnow traps were set in the summer and fall of 2002 in the J.C. Boyle peaking reach. No fish were caught in the summer sampling and only four speckled dace were caught in the fall.

Snorkeling

Snorkeling was conducted in the summer and fall of 2002. A total of 165 fish were observed during the summer sampling and only four fish were observed in the fall. During the summer, most of the fish were rainbow trout (45), followed by sculpin spp. (56) and sucker spp. (37). Two speckled dace were also observed along with 25 individuals of unknown species. During the fall one rainbow trout was observed along with one sculpin and two other unidentified fish.

Trout Fry Distribution and Relative Abundance

Past studies have documented trout spawning and fry rearing in the tributaries of the Project Area, particularly Shovel Creek (Beyer, 1984) and Spencer Creek (various ODFW reports). Most trout fry tend to remain in these tributaries through the summer, and through the winter in Spencer Creek, before migrating to the Klamath River. During PacifiCorp's relicensing studies, spawning trout and fry were observed in the J.C. Boyle bypass reach. Trout spawning has not been documented in the peaking reach, although potential spawning areas may exist at tributary confluences. Sampling efforts in the peaking reach in 2001 and 2002 yielded few fry observations.

A reconnaissance of peaking reach tributaries, including Rock Creek, was performed in 2003. Although these tributaries were predominately dry during the site visit, significant bedload, including spawnable gravel, was abundant in some locations. This indicates the possibility that when runoff provides sufficient flow for bedload transport, these materials would be delivered to the Klamath River. The confluences of these intermittent tributaries with the Klamath River may provide suitable spawning habitat for trout that has not been identified in the peaking reach.

To further assess fry in the J.C. Boyle bypass and peaking reaches, a fry distribution and relative abundance study was conducted from May through August (depending on the location). The purpose of these studies was to:

- Assess the relative distribution and abundance of trout fry (less than 5 cm)
- Compare index densities of trout fry among different Stream Margin Edge Types (SMETs)
- Compare index densities of fry along specific margin areas immediately before, during, and after a peaking event

The following is a summary of the results of the trout fry study. The complete technical report for the fry distribution and abundance study is presented in Appendix 3A.

Electrofishing was conducted along stream margins of the Upper Klamath River project area at 26 locations: six in the J.C. Boyle bypass reach and 10 each in the peaking reaches.

All margin units in the bypass and Oregon peaking reaches were sampled six times at biweekly intervals from late May to mid-August. The California peaking units were sampled bi-weekly in July with a fourth sample in early September. Single-pass electrofishing was conducted using backpack electroshockers and a crew of two to four biologists. Lengths and weights were recorded for all captured trout fry, other species were enumerated. Trout fry in the bypass reach were fin-clipped to determine patterns of residency or movement among index locations. Some fry were also fin-clipped immediately prior to a peaking flow event, then the margin units were resampled after the flow increase to determine short-term residency. Multiple-pass electrofishing was also conducted within a subset of the single-pass margin units. Multiple-pass data were used to generate estimates of abundance using removal-depletion estimators, which were then compared to index estimates based on the first (i.e., single) pass data alone.

A total of 1,212 fry were captured by single-pass electrofishing at 26 index locations representing 61 individual margin units. Fry were common along margins in the bypass reach downstream of the spillway, where index densities were 1-3 fry/100 ft^2. In the Oregon section of the peaking reach, fry were captured in low numbers (0.1-0.3 fry/100 ft^2) in the upper five index locations closest to the bypass reach, but fry were rarely observed in the downstream sites near Frain Ranch. In the California section of the peaking reach, fry were common at most index locations below Shovel Creek (0.2-1 fry/100 ft^2), but were not observed at sites above this tributary.

The observed differences in fry densities among the 26 index locations appeared to be strongly influenced by proximity to known spawning location. Highest densities occurred downstream of known spawning areas in the bypass reach and in the California section of the peaking reach, whereas index locations upstream of or well downstream of recruitment sources had the lowest fry densities. Aside from the effect of distance to spawning area, considerable variation in fry densities remained even among closely spaced index locations. Differences in margin habitat characteristics could help explain such variability in fry densities.

Correlation analysis was used to select an initial set of predictor variables for input into a stepwise regression procedure. The response variable was log-transformed expanded fry densities (see below for an explanation of expanded densities), with the four selected predictor variables (in order of inclusion with regression coefficient): average velocity (0.6038), log distance to upstream spawning area (-0.8607), maximum depth (-0.2765), and dominant substrate type (0.0556). Overall, the regression model was highly significant ($P<0.001$) and explained 76 percent of the observed variation in fry densities among the included margin units.

Temporal variation in fry index densities was evaluated by comparing densities per location over time, and by calculating an average density among index locations by reach for each sampling period. The mean fry density by sampling period showed a minor decrease through the summer in all three reaches. Length-frequency data from captured fry showed a prominent recruitment of very small fry in late July in each reach. Trout spawning observations in the bypass reach revealed a protracted spawning period of more than 2 months in duration, with at least two peaks in activity. Although an extended spawning period is not known to occur in Shovel Creek, fry do emigrate into the mainstem Klamath River throughout the late summer months. The minor decrease in fry index densities despite growth of fry into the next size class ("juveniles" at 50mm+) may be attributable to the continued recruitment of small fry into the peaking reaches throughout the summer.

Fry densities were compared between paired margin units either with or without vegetative instream cover in the Oregon and California sections of the peaking reach (the bypass only contained vegetated margin units). Fry index densities calculated from single-pass electrofishing suggested that fry were more common along vegetated margins in Oregon, but were more common along nonvegetated units in California. Comparative expanded densities in the California portion of the peaking reach were nearly equal in vegetated and nonvegetated units, but when the peaking reaches were combined the overall expanded densities in vegetated units was 1½ times greater than densities in nonvegetated units (P=0.07, Wilcoxon's signed rank test).

Most of the trout fry captured in the bypass reach and some fry captured in the California section of the peaking reach were fin-clipped according to index location. Of approximately 400 fin-clipped fry, 23 were recaptured in the same location and one was recaptured in a downstream location. In the bypass, seven clipped fry were recaptured after flows increased from 325 cfs to 520 cfs, 2 days after marking. Eight other recaptures were made in the bypass following an interval of at least 2 weeks. In the California peaking reach, 73 fry were marked during low flow (320 cfs) and nine were recaptured in the same locations either later the same day or on the following day after flows were peaked to over 1,500 cfs.

3.7.1.5 Copco N. 2 Bypass Reach

Fish sampling in the Copco No. 2 bypass reach consisted of backpack electrofishing in the fall of 2001 and the spring, summer, and fall of 2002. Angling was also conducted in the reach during the spring and fall of 2002. Collectively, the sampling captured eight different fish species, five which were native. The only special status species captured was a redband/rainbow trout.

Backpack Electrofishing

In the fall of 2001, only three species were captured—Tui chub, speckled dace, and sculpin (Table 3.7-22). Of these three, speckled dace and sculpins were the most abundant. In the spring of 2002, again only three species were captured—sculpins, speckled dace, and yellow perch (Table 3.7-23). Speckled dace were the most abundant. In the summer, five species were caught, and included those already mentioned in the spring sampling with the addition of rainbow trout and blue chub. Speckled dace and sculpins again were the most abundant (Table 3.7-23). In the fall of 2002, five species were also captured and they were speckled dace, sculpin, rainbow trout, crappie, and largemouth bass, in order of relative abundance.

Table 3.7-22. Copco No. 2 bypass reach fish species sampled, all methods, all seasons.

Common Name	Copco No. 2 Bypass
Rainbow trout[1]	X
Blue chub[1]	X
Tui chub[1]	X
Chubb spp.[1]	--
Speckled dace[1]	X
Sculpin spp.[1]	X
Lamprey[1]	--
Shortnose sucker[1]	--
Lost River sucker[1]	--
Klamath suckers[1,2]	--
Unknown sucker spp.[1]	--
Largemouth bass	X
Sacramento perch	--
Bluegill	--
Pumpkinseed	--
Crappie spp.	X
Fathead minnow	--
Yellow perch	X
Bullhead spp.	--
Unknown species	--

[1] Native species.

[2] Largescale and/or smallscale suckers.

-- None sampled.

Table 3.7-23. Copco No. 2 bypass fish species and CPUE (fish per hour) of fish captured by backpack electrofishing.

Common Name	Fall 2001	Spring 2002	Summer 2002	Fall 2002
Rainbow trout	--	--	8.9	21.1
Blue chub	--	--	3.0	--
Tui chub	95.4	--	--	--
Chubb spp.	0.0	--	--	--
Speckled dace	254.3	447.4	608.9	473.0
Sculpin (marbled)	278.1	109.2	404.9	165.7
Lamprey	--	--	--	--
Shortnose sucker	--	--	--	--
Lost River sucker	--	--	--	--
Klamath sucker	--	--	--	--
Largemouth bass	--	--	--	6.0
Sacramento perch	--	--	--	--
Bluegill	--	--	--	--
Pumpkinseed	--	--	--	--
Black Crappie	--	--	--	15.1
White crappie	--	--	--	--
Fathead minnow	--	--	--	--
Yellow perch	--	20.8	5.9	--
Bullhead	--	--	--	--
Unknown species	--	--	--	--

-- None sampled.

Based on the backpack electrofishing and angling data, it appears that the fisheries resource in the Copco No. 2 bypass reach is limited. The predominant species in all seasons are speckled dace and sculpins. Game fish (trout and bass) appear to occur in the reach only sporadically, and based on the sampling, there is little evidence of resident populations of gamefish in the Copco No. 2 bypass reach. Gamefish most likely enter the bypass reach from the downstream reservoir (and possibly from the upstream reservoir). Based on the sampling, it appears that trout would move into the reach mostly in the fall, which is when water conditions would be more favorable.

Angling

Angling was largely unsuccessful in capturing fish in the Copco No. 2 bypass reach. Only three fish were captured in the spring 2002 sampling, one each of largemouth bass, yellow perch, and speckled dace. In the fall of 2002, three rainbow trout were captured.

3.7.1.6 Fall Creek

Backpack electrofishing and angling (fly fishing) were the only methods used in collecting fish in the bypass reach of Fall Creek. Electrofishing was conducted in the fall of 2001, and the spring, summer, and fall of 2002. Angling was conducted only during the summer of 2002. The only species captured using both methods was rainbow trout. A total of 74 trout were captured by electrofishing for all seasons combined and eight trout were captured by angling in the summer.

The calculated CPUE of the backpack electrofishing efforts showed that the highest catch rates occurred during the fall of 2001 and the lowest in the fall of 2002 (Table 3.7-24). Based on these results there does not appear to be any seasonal trend regarding the relative abundance of redband trout in the bypass reach of Fall Creek. However, the results do seem to indicate that rainbow trout appear to be the only fish species of any consequence in the reach, as other species were commonly caught by electrofishing in other studied river reaches in the Project area.

Table 3.7-24. Fall Creek backpack electrofishing data, 2002.

Season	**Date**	**Shock Time (hrs)**	**No. of Redband/rainbow trout Caught**	**CPUE**
Fall ‘01	17-Oct	0.13	12	90
Spring ‘02	24-Jun	0.25	16	64
Summer ‘02	16-Aug	0.46	24	52
Fall ‘02	24-Oct	0.53	22	42

In addition to the above efforts, limited sampling was conducted in Fall Creek above the diversion structure (fall of 2001) and in the diversion canal (fall of 2002) using backpack electrofishing. Again, the only species captured during these events was rainbow trout. Above the diversion, seven trout were caught with a calculated CPUE of about 42 fish per hour. In the canal, 66 trout were caught with a calculated CPUE of about 141 fish per hour. It should be noted that while the CPUE of the canal appears much greater than that of the bypass reach, as well as the reach above the diversion, it may be simply a function of the canal being easier to sample. In the canal there are few structures, except for a few boulders, where fish could actively or passively avoid capture. In addition, the canal is very narrow, with little riparian vegetation that allowed easy sampling access (i.e., line-of-sight and netting).

3.7.1.7 Trout Comparison

The Klamath River between Keno dam and Copco reservoir has three distinctive reaches defined by Project features. The 5-mile Keno reach is a run-of-river (ROR) reach, which is minimally affected by daily operations of the upstream Link River hydropower developments. Instream flows in this reach are dictated primarily by upstream USBR operations. The 4-mile J.C. Boyle bypass reach experiences stable flows most of the year consisting of 100 cfs released at the dam and an additional 250 cfs of cool spring water. The 16-mile J.C. Boyle peaking reach experiences daily flow fluctuations much of the year, which are associated with the load factoring operation of the J.C. Boyle powerhouse. Water temperature and other water quality parameters also fluctuate daily in this reach in association with the flow fluctuations.

Characteristics of the rainbow trout populations in these three reaches differ based on past information collected by ODFW. Of most interest is the observation by ODFW that trout caught by anglers in the Keno reach tend to be larger than those caught in the peaking reach. It has been speculated that flow fluctuations from peaking operations at the J.C. Boyle powerhouse may be primarily responsible for the size difference. However, other differences, such as temperature regime, food sources, population density, age structure, and angling harvest rates, also could affect trout growth and size structure. In an effort to assess potential impacts of the J.C. Boyle Development on the local trout populations, several sources of past data, as well as new information collected as part of the relicensing effort, are summarized below. Comparative information for the three river reaches includes fish size, angler catch rates, condition factor, age structure, length-at-age, annual growth rates, and limited diet analysis.

Size

ODFW conducted angler surveys in all three reaches (to the Oregon/California state line) of the Klamath River from 1979 through 1982. This period followed a change in trout management that included a cessation of planting hatchery-reared trout. Therefore, all fish were assumed to be naturally produced. Trout captured in the Keno reach were considerably larger than those captured in the bypass and peaking reaches (Figure 3.7-1). More than half of the Keno reach trout exceeded 300 mm. Trout in the bypass reach were the smallest, with only about 5 percent larger than 300 mm. Trout in the peaking reach were intermediate in length, with about 24 percent larger than 300 mm.

Results of sampling conducted by angling in 2002 indicate the same general differences in trout length among the three reaches as were seen in the 1979-1982 data (Figure 3.7-2). Average lengths were 271 mm, 205 mm, and 251 mm for the Keno, bypass, and peaking reaches, respectively. Trout in the Keno reach exhibited a much larger range in size primarily because there was a greater number of larger fish in the population. In the Keno reach, 28 percent of the trout were longer than 300 mm. This compares to the bypass and peaking reaches where 2 percent and 16 percent were longer than 300 mm, respectively.

Both the ODFW data and the 2002 sampling data for the Keno reach indicate a possible secondary peak in size at about 400 mm. This pattern suggests that some environmental condition associated with trout in the Keno reach may favor greater growth as the fish become larger. This pattern was not observed in trout found in the bypass and peaking reaches.

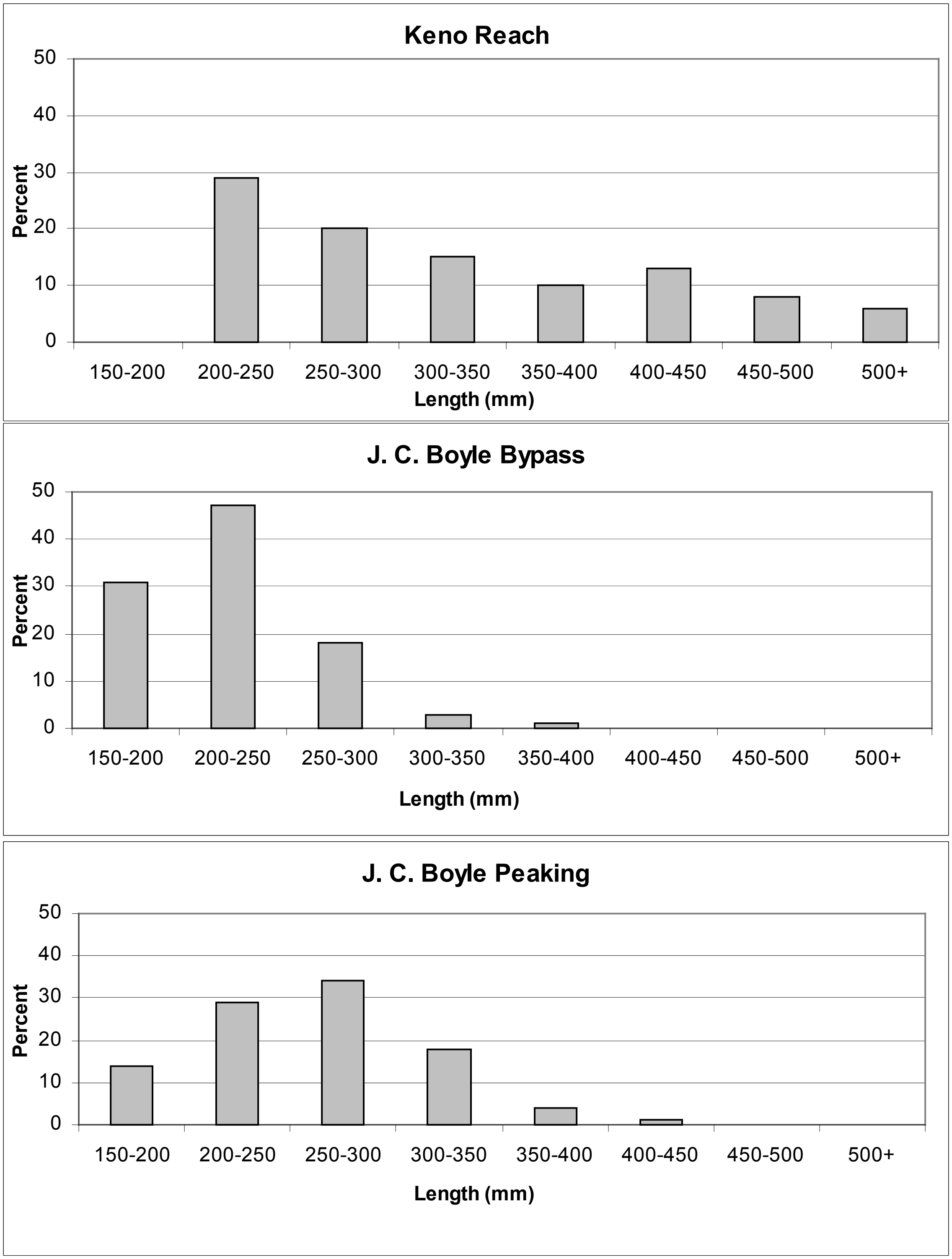

Figure 3.7-1. Trout length frequency from 1979–1982, ODFW angler surveys.

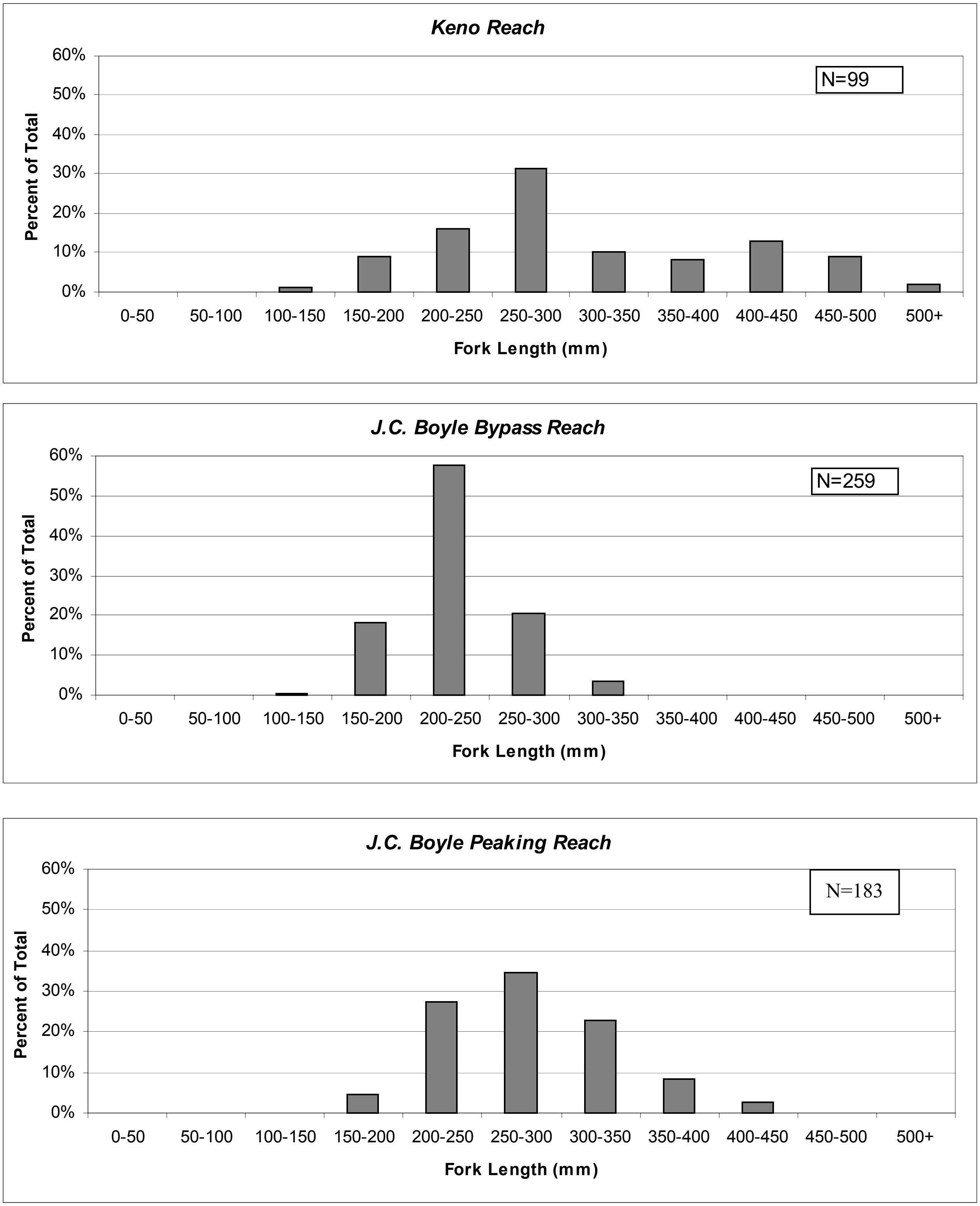

Figure 3.7-2. Length frequency of trout, all seasons, 2002, PacifiCorp fish investigations.

Catch Rates

Angler surveys conducted by ODFW between 1979 and 1984 show that catch rates (fish per hour) in the Keno reach consistently were lower than in the J.C. Boyle bypass and peaking reaches (Table 3.7-25). Average catch rates for these 6 years were 0.23, 0.62, and 0.78 fish per hour for the Keno, bypass, and peaking reaches, respectively. While differences in population abundance (available fish) may have contributed to these catch rate differences, water clarity and streamflow conditions also affect fishability and catchability in these three reaches. Water in the Keno reach is typically quite turbid and flows are often higher than those in the bypass and peaking reaches. Water in the bypass reach consists primarily of clear spring water, which is conducive to high catchability of trout. In the peaking reach, most angling occurs during the off-peak generation hours when flows are low and water clarity is high, both conditions of which are conducive to higher catchability of trout.

Table 3.7-25. Rainbow trout catch per hour.

Rainbow Trout Catch per Hour ODFW Angler Survey Data 1978-84			
Year	**Reach**		
	Keno Reach	**J. C. Boyle Bypass**	**J. C. Boyle Peaking Reach**
1979	0.33	0.41	0.74
1980	0.27	0.67	0.71
1981	0.09	0.47	1.31
1982	0.13	0.87	0.56
1983	0.08	0.62	0.56
1984	0.49	0.69	0.77
Average	**0.23**	**0.62**	**0.78**

Sampling conducted in 2002 by angling indicated the same general differences in trout catch rates among the three reaches as previously seen in the ODFW sport angler data. Catch rates were lowest in the Keno reach, highest in the J.C. Boyle peaking reach, and intermediate in the J.C. Boyle bypass reach (Table 3.7-26). Seasonal sampling indicated greatest catch rates in the fall for all three reaches. Catch rates in the upper and lower segments of the Keno reach were similar, as were catch rates in the Oregon (upper) and California (lower) segments of the J.C. Boyle peaking reach.

Condition Factor

Condition factor (K) is the length-weight relationship used to express relative robustness of fish, and is assumed to be related to environmental conditions. Condition factors for rainbow trout greater than 1.0 are generally indicative of healthy fish (Carlander, 1969). Seasonal differences in condition factors often occur because of slow growth periods (e.g., winter) and spawning activity (e.g., post-spawn weight loss). Therefore, condition factors for trout captured in the three reaches of the Klamath River were computed by season and the total average represents the simple (unweighted) average of the three seasonal values.

Table 3.7-26. Rainbow trout catch per hour by angling, 2002.

Rainbow Trout Catch Per Hour by Angling, 2002						
Keno Reach						
Catch per hour	**Total**	**Spring**	**Summer**	**Fall**	**Upper**	**Lower**
	0.6	0.6	0.2	1.1	0.5	0.8
J.C. Boyle Bypass Reach						
Catch per hour	**Total**	**Spring**	**Summer**	**Fall**		
	1.1	0.8	0.7	1.3		
J.C. Boyle Peaking Reach						
Catch per hour	**Total**	**Spring**	**Summer**	**Fall**	**Oregon**	**California**
	1.2	0.9	1.1	2.7	1.1	1.3

Condition factors for trout in all reaches and seasons exceeded 1.0, indicating healthy fish (Table 3.7-27). Average condition factors for the Keno, bypass, and peaking reaches were 1.18, 1.28, and 1.20, respectively. The higher average K in the bypass reach primarily resulted from a high value (1.43) in the spring. No clear pattern of differences in condition factor were apparent by season or by reach.

Table 3.7-27. Condition factors (K) of redband/rainbow trout caught in 2002.

Condition Factors (K) of Rainbow Trout Caught in 2002*			
Season	**Reach**		
	Keno	**Bypass**	**Peaking**
Spring	1.16	1.43	1.19
Summer	1.13	1.18	1.26
Fall	1.24	1.24	1.15
Average	**1.18**	**1.28**	**1.20**

*Only fish larger than 50 mm.

Age Structure

The length frequency data for trout indicate a clear difference in size among the three river reaches. Specifically, the Keno reach contains a greater proportion of larger fish than the bypass and peaking reaches. Differences in size can be attributable to differences in growth (see below), age composition, or a combination of both. To assess both of these factors, scales from 241 trout (approximately equal numbers per reach) were viewed under a microscope to determine age (and back calculated length-at-age). Because the scales were collected from trout captured primarily by angling, the younger (smaller) fish in the population were not represented in the sample. Also, age determination of older fish is difficult using scale reading, and the confidence in aging fish older than 5 years is poor. Therefore, trout age data are presented only for ages 1 through 5. While these data may not accurately represent the complete age structure of each population, they should reasonably represent the relative differences among the three river reaches for ages 1 through 5.

As shown in Figure 3.7-3, trout tend to be oldest in the Keno reach, followed by those in the J.C. Boyle peaking reach. The youngest age structure occurred in the J.C. Boyle bypass reach. The percentages of trout 3 years and older in the three reaches are Keno—52 percent; bypass—23 percent; and peaking—34 percent. These results clearly indicate that differences in trout age structure among the three reaches contribute to the observed differences in size composition.

The higher proportion of older fish in the Keno reach is consistent with the typical population response to a lower harvest rate (Anderson and Nehring, 1984). Logically, a reduced harvest rate allows more of the fish to survive to an older age. Angler catch rates in the Keno reach are about one-third of those in the J.C. Boyle peaking and bypass reaches, based on ODFW angler surveys (see above).

Trout Length-at-Age and Growth

A total of 241 trout scales, with approximately equal numbers representing each of the three river reaches, were examined for determination of age and back-calculation of fish length to each annulus. A least-squares linear regression model was generated based on the relationship between FL and scale radius. This model (formula) was used to estimate length at previous ages. Specific methods and initial results of the back-calculations are presented in Appendix 3C.

The average back-calculated length-at-age (to last annulus) for trout from the Keno, J.C. Boyle bypass, and peaking reaches is shown in Figure 3.7-4. Trout at age 1 and age 2 from the Keno reach were significantly smaller ($p < 0.01$) on average than those of the same age from the peaking reach. At age 3, however, Keno reach trout were of similar size to those in the peaking reach, and by age 4, Keno reach trout were significantly larger ($p < 0.01$) than peaking reach fish. A statistical evaluation of these length-at-age patterns was done using a generalized linear model that looked at length as a function of age, reach location, and the differences in the age function in different reaches (Entrix, Inc., 2004). The linear function of length-at-age was significantly different ($p < 0.001$) in the Keno reach compared to the peaking reach or the bypass reach (see Appendix 3D). Although the average length-at-age for the 4-year-old classes combined was similar for the Keno and peaking reaches, the observation of Keno fish being smaller at ages 1 and 2, then larger at age 4, was statistically significant.

Average annual growth rates of trout were determined by comparing the estimated length at last annulus to the previous-to-last annulus for each individual fish and then averaging the length differences. Results of the growth analysis (Figure 3.7-5) are consistent with the length-at-age analysis. Although the average annual growth rates for the 1 through 4 age classes were similar in the Keno reach (2.7 inches/year [67.4 mm/year]) as in the J.C. Boyle peaking reach (2.8 inches/year [71.8 mm/year]), the growth rates are significantly greater in the peaking reach compared to the Keno reach for trout through age 2, but similar for the age increment between 2 and 3. After age 3, growth rates become significantly greater for Keno reach fish compared to peaking reach fish.

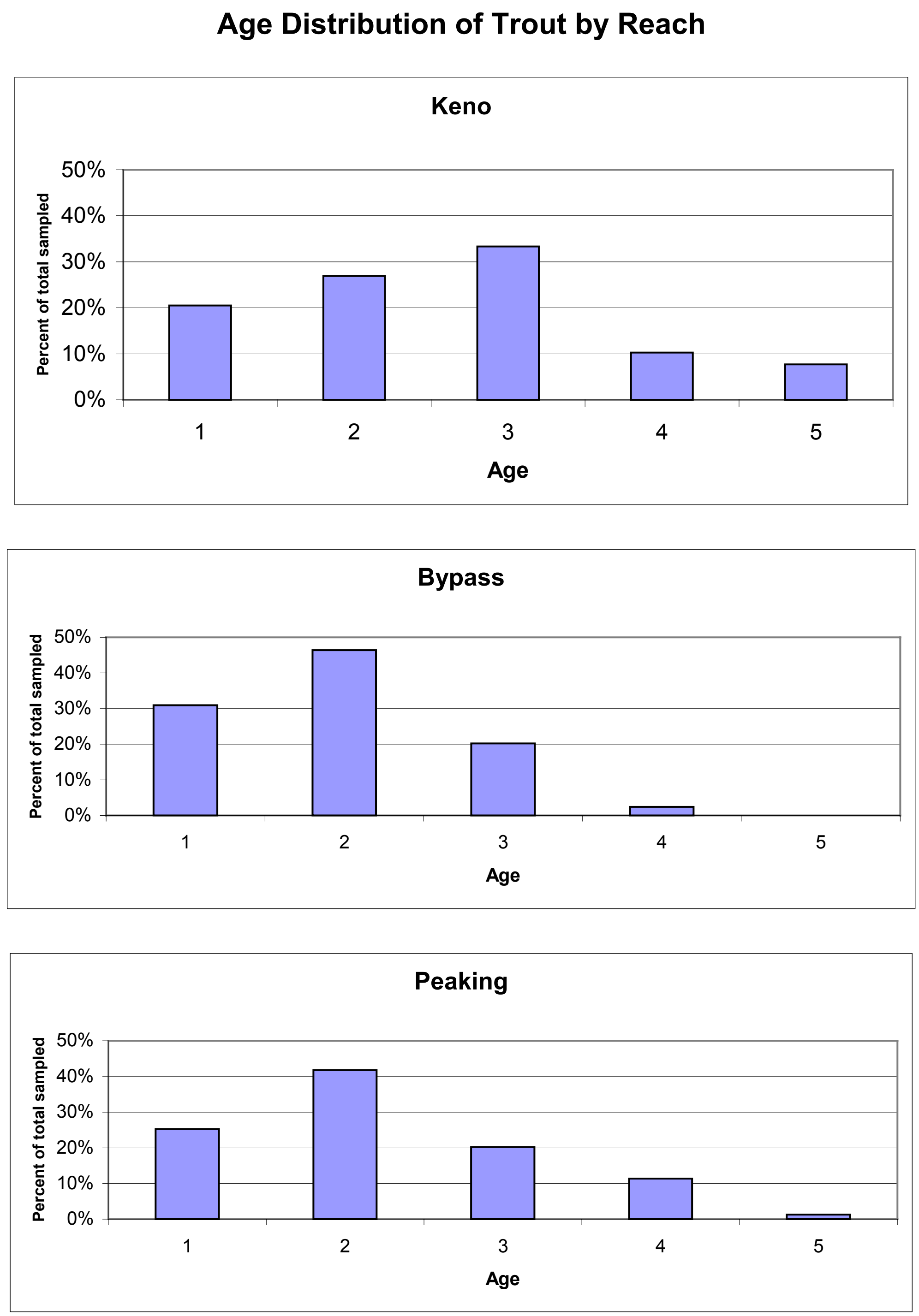

Figure 3.7-3. Age distribution of trout by reach.

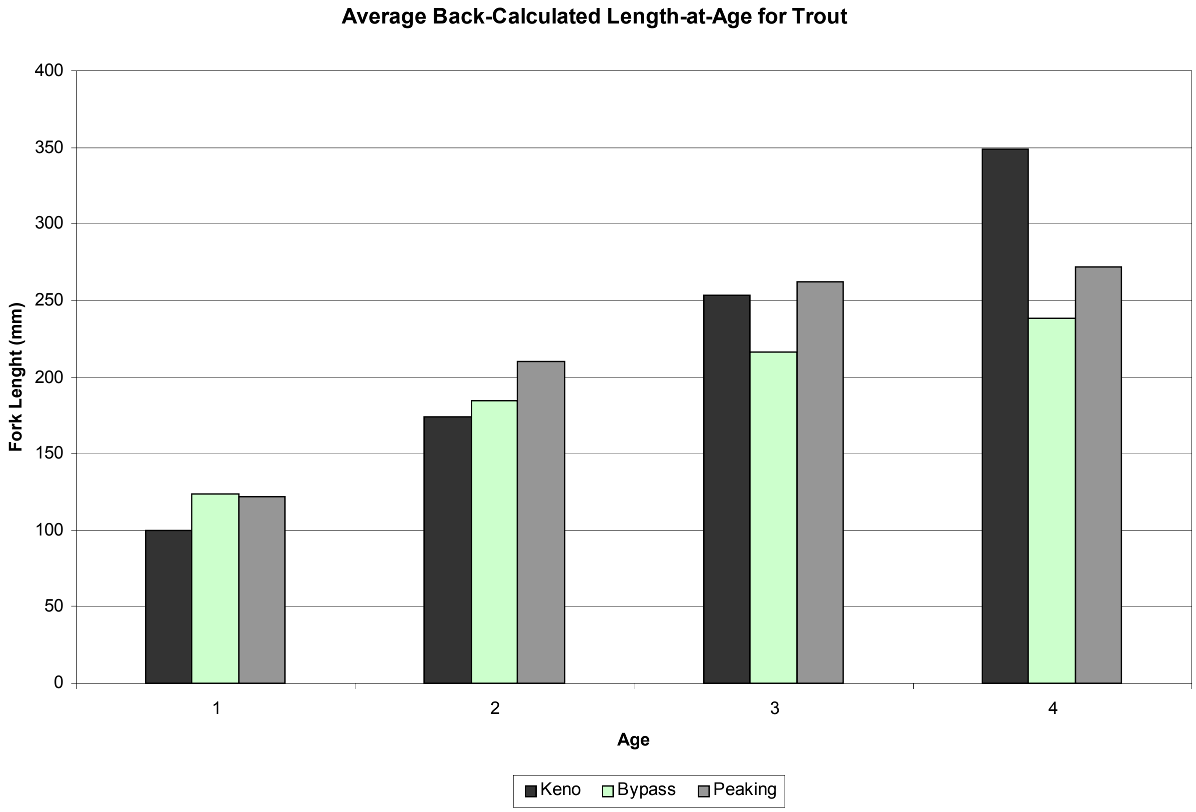

Figure 3.7-4. Average back-calculated length-at-age for trout.

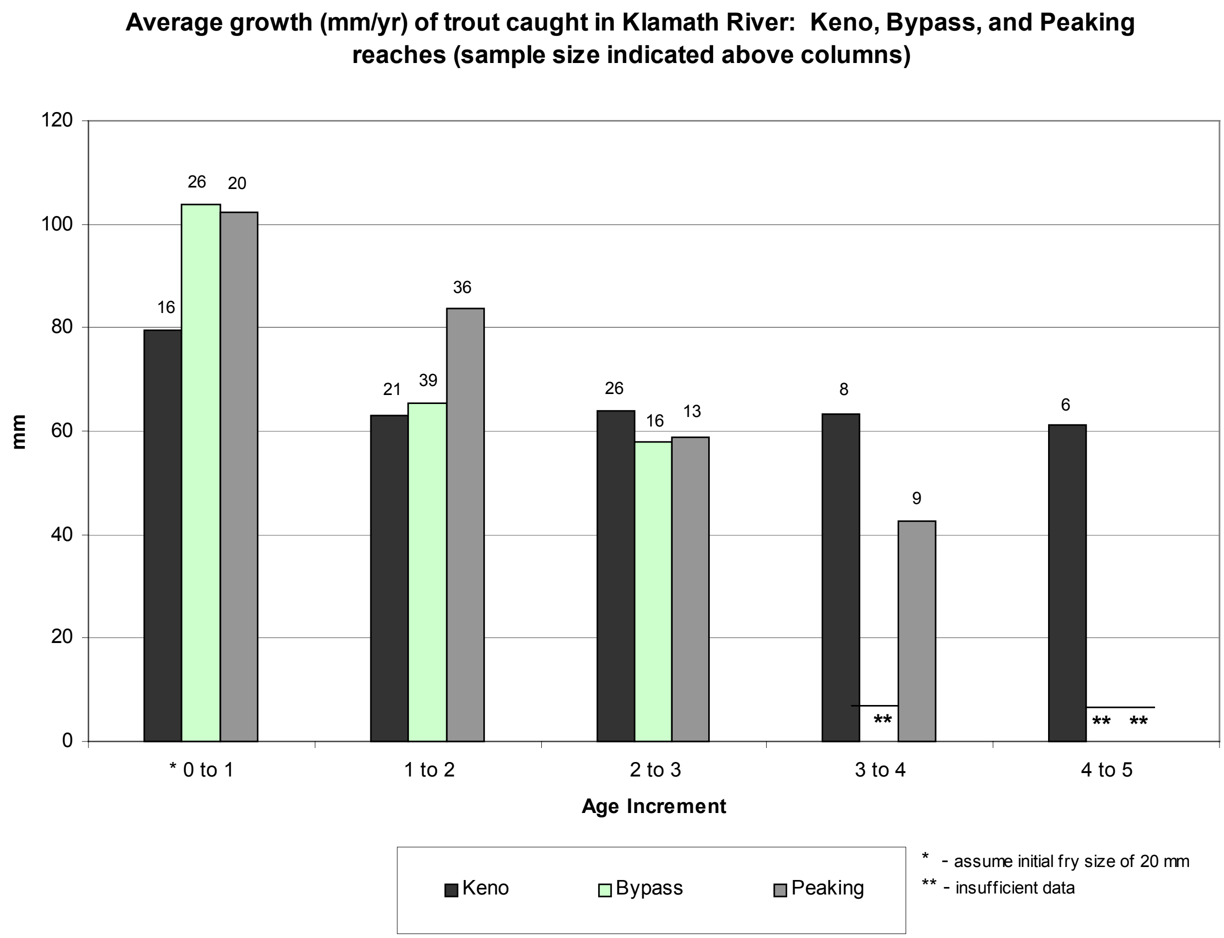

Figure 3.7-5. Average growth (mm/yr) of trout caught in Klamath River; Keno bypass, and peaking reaches (sample size indicated above columns).

Typically, growth rates of trout tend to decline with age (Carlander, 1969). This is the pattern observed for trout in the bypass and peaking reaches. Keno reach trout, however, show an unusual pattern of relatively constant growth (length gain per year) between age 1 and 5. The relatively higher growth rates for Keno reach trout after age 3 could be indicative of a shift in diet to larger prey organisms, such as fish, or a shift in location to a more energetically favorable habitat, such as a lake. A limited stomach content analysis conducted in 2002 indicated that trout from the Keno reach as well as those from the bypass and peaking reaches were eating predominately insects (Table 3.7-28). The analysis did not include a taxonomic or size determination of the ingested insects.

Table 3.7-28. Stomach contents of redband/rainbow trout collected by angling, 2002

Parameter	Keno Reach	J.C. Boyle Bypass Reach	J.C. Boyle Peaking Reach
N	23	23	31
Percent of fish stomachs containing:			
Fish	4[1]	0	3[2]
Invertebrates	96	100	100
Other	43	0	19
Percent of contents by weight:			
Fish	3	0	2
Invertebrates	79	100	86
Other	18	0	13

[1] The Keno reach trout containing fish as food was 413 mm, caught in spring.

[2] The J.C. Boyle peaking reach trout containing fish as food was 236 mm, caught in summer.

N = nongame.

A review of the growth rates for individual fish from age 2 to 3 indicates considerably more variability among fish in the Keno reach compared to the bypass and peaking reaches (Figure 3.7-6). The relatively rapid growth (>3.9 inches/year [>100 mm/year]) of some of the Keno reach fish may be indicative of their part-time residence in the reservoirs. Although downstream movement of trout has not been studied at Keno dam, large trout are commonly observed in the power canals at the upstream Link River dam, indicating downstream movement out of Upper Klamath Lake. Because Keno reservoir often experiences episodes of poor water quality (high temperature and low DO) it is reasonable to assume that some trout also would emigrate from Keno reservoir during these periods. Regarding J.C. Boyle reservoir, Keno reach trout are known to spawn almost exclusively in Spencer Creek, which is a tributary to J.C. Boyle reservoir (ODFW progress reports). Thus, mature trout must pass through the reservoir on their way to and from Spencer Creek. It is unknown if or how much time they spend rearing in the reservoir.

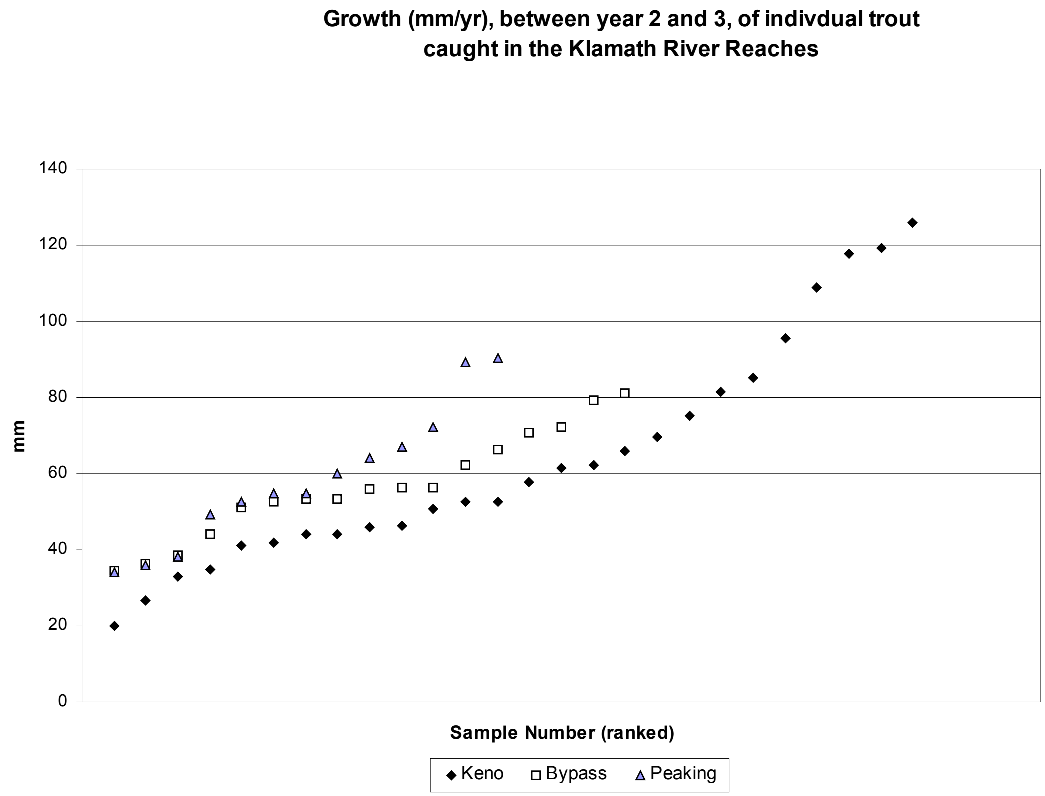

Figure 3.7-6. Growth (mm/yr) between year 2 and 3 of individual trout caught in the Klamath River reaches.

3.7.2 Reservoir Studies

This section describes results of recent fisheries investigations in the Klamath Hydroelectric Project study area reservoirs. The following descriptions of reservoir fish communities are based on sampling conducted in Lake Ewauna (Keno reservoir) in 2001 and 2002, and in J.C. Boyle, Copco No. 1, and Iron Gate reservoirs in 1998 and 1999. Lake Ewauna investigations were conducted as part of Project relicensing studies. Recent investigations in J.C. Boyle, Copco No. 1, and Iron Gate reservoirs, which focused on the endangered shortnose and Lost River suckers, provided information on the overall fish community in each of these reservoirs. Sampling methods, results, and discussions of these fisheries studies are presented in the following text. Background information on previous fisheries investigations and physical and chemical characteristics of each of the four reservoirs were presented in Section 3.4. In 2003, PacifiCorp also sampled the deep areas of Copco and Iron Gate reservoirs to better characterize the open water fish community and assess vertical distribution of fish relative to stratification and water quality conditions. Results of this particular hydroacoustic study are presented in a separate report included as Appendix 3E.

3.7.2.1 Lake Ewauna

Lake Ewauna Results

Table 3.7-29 summarizes electrofishing catch results for Lake Ewauna during 2001 and 2002. Information is presented on numbers of each species collected, their relative abundance, and CPUE values by season sampled and seasons combined. Scientific names of fish species listed in Table 3.7-29 are provided in Table 3.7-30.

Thirteen species of fish were collected in Lake Ewauna during 2001 and 2002 electrofishing surveys (Table 3.7-29). They consisted of seven cool water nongame species (native chubs, suckers, and dace), five cool or warm water game species (introduced perch, basses, and sunfish), and one warm water nongame species (introduced fathead minnow). Three other taxa listed in Table 3.7-29 that could not be identified to species (sculpins, suckers, sucker hybrids) are native cool water, nongame fish. Seasonal numbers of species and taxa collected were lowest in spring 2002 (seven), intermediate in fall 2001 (nine) and summer 2002 (nine), and highest in fall 2002 (14). No cold water species (rainbow trout) were collected during electrofishing surveys in Lake Ewauna during 2001 and 2002.

Fathead minnow (55.7 percent of the total catch), blue chub (23.3 percent), and Tui chub (16.4 percent) were the three most abundant species collected during electrofishing surveys (Table 3.7-29). These three species together accounted for approximately 95 percent of the total catch. They also accounted for approximately 95 percent of each season's catch, except during fall 2002 when they accounted for approximately 85 percent of the total catch. Seasonally numerically dominant species in electrofishing collections included blue chub and Tui chub in fall 2001, Tui chub in spring 2002, fathead minnow in summer 2002, and fathead minnow and blue chub in fall 2002 (Table 3.7-29).

Table 3.7-29. Lake Ewauna electrofishing catch data during fall 2001, and spring, summer, and fall 2002.

	Fall 2001			Spring 2002			Summer 2002			Fall 2002			Total		
Species	**Number Collected**	**Percent of Total (%)**	**CPUE***	**Number Collected**	**Percent of Total (%)**	**CPUE***	**Number Collected**	**Percent of Total (%)**	**CPUE***	**Number Collected**	**Percent of Total (%)**	**CPUE***	**Number Collected**	**Percent of Total (%)**	**CPUE***
Fathead minnow	68	12.1	48.9	79	16.8	42.9	2,657	70.4	6,480.5	261	37.6	121.4	3,065	55.7	529.4
Blue chub	241	42.7	173.4	68	14.5	37.0	717	19.0	1,748.8	255	36.8	118.6	1,281	23.3	221.3
Tui chub	229	40.6	164.7	310	65.9	168.5	292	7.7	712.2	73	10.5	33.9	904	16.4	156.2
Yellow perch	5	0.9	3.6	3	0.6	1.6	16	0.4	39.0	8	1.2	3.7	32	0.6	5.5
Klamath largescale sucker	0	0	0	4	0.9	2.2	0	0	0	26	3.8	12.1	30	0.5	5.2
Shortnose sucker	15	2.6	10.8	4	0.9	2.2	0	0	0	6	0.9	2.8	25	0.5	4.3
Largemouth bass	3	0.5	2.2	0	0	0	0	0	0	4	0.6	1.9	7	0.1	1.2
Sacramento perch	0	0	0	0	0	0	1	<0.1	2.4	5	0.7	2.3	6	0.1	1.1
Sucker spp.	0	0	0	0	0	0	0	0	0	4	0.6	1.9	4	0.1	0.7
Pumpkinseed	1	0.2	0.7	0	0	0	1	<0.1	2.4	1	0.1	0.5	3	0.1	0.5
Sculpin spp.	0	0	0	0	0	0	1	<0.1	2.4	2	0.3	0.9	3	0.1	0.5
Klamath smallscale sucker	0	0	0	0	0	0	0	0	0	3	0.4	1.4	3	0.1	0.5
Bluegill	0	0	0	0	0	0	1	<0.1	2.4	1	0.1	0.5	2	<0.1	0.3
Lost River sucker	1	0.2	0.7	0	0	0	0	0	0	1	0.1	0.5	2	<0.1	0.3
Klamath speckled dace	0	0	0	0	0	0	2	<0.1	4.8	0	0	0	2	<0.1	0.3
Sucker (hybrid)	1	0.2	0.7	1	0.2	0.5	0	0	0	0	0	0	2	<0.1	0.3
Unidentified fish	0	0	0	1	0.2	0.5	87	2.3	212.2	44	6.3	20.4	132	2.4	22.8
Total	**564**	**100.0**	**405.7**	**470**	**100.0**	**255.4**	**3,775**	**100.0**	**9,207.3**	**694**	**100.0**	**322.8**	**5,503**	**100.0**	**950.4**

* Catch per unit effort (CPUE) represents number of fish collected per hour of sampling. Sampling (electrofishing) effort was 1.39 hours in fall 2001, 1.84 hours in spring 2002, 0.41 hour in summer 2002, 2.15 hours in fall 2002, and 5.79 hours total.

Table 3.7-30. Common and scientific names of fish species known to occur in the Klamath River and reservoirs upstream of Iron Gate dam and that likely occur in the Klamath River drainage system downstream of Iron Gate dam.[1]

Common Name	Scientific Name	Origin[2]	Status[3]	Temperature Preference[4]	Pollution Tolerance[5]	Present Upstream of Iron Gate Dam[6]	Present Downstream of Iron Gate Dam[6]
Lampreys	Petromyzontidae						
Pit-Klamath brook lamprey	*Lampetra lethophaga*	N	N	Cool	I	R	--
Klamath lamprey	*Lampetra similis*	N	N	Cool	I	R	--
Pacific lamprey	*Lampetra tridentata*	N	N, S	Cool	I	R	A
Sturgeons	Acipenseridae						
Green sturgeon	*Acipenser medirostris*	N	S	Cold	S	--	A
White sturgeon	*Acipenser transmontanus*	N	G	Cold	I	Stocked by ODFW in UKL[2]	A
Herrings	Clupeidae						
American shad	*Alosa sapidissima*	I	G	Cool	I	--	A
Pacific herring	*Clupea pallasi*	N	G	--	--	--	O
Carps and Minnows	Cyprinidae						
Tui chub	*Gila bicolor*	N	N	Cool	T	R	R
Blue chub	*Gila coerulea*	N	N	Cool	T	R	R
Golden shiner	*Notemigonus crysoleucas*	I	N	Warm	T	R	R
Fathead minnow	*Pimephales promelas*	I	N	Warm	T	R	--
Klamath speckled dace	*Rhinichthys osculus*	N	N	Cool	I	R	R
Suckers	Catostomidae						
Klamath smallscale sucker	*Catostomus rimiculus*	N	N	Cool	I	R	R
Klamath largescale sucker	*Catostomus snyderi*	N	S	Cool	I	R	R
Shortnose sucker	*Chasmistes brevirostris*	N	E, S	Cool	S	R	R
Lost River sucker	*Deltistes luxatus*	N	E, S	Cool	I	R	--
Bullhead catfishes	Ictaluridae						
Yellow bullhead	*Ameiurus natalis*	I	G	Warm	T	R	R
Brown bullhead	*Ameiurus nebulosus*	I	G	Warm	T	R	R

Table 3.7-30. Common and scientific names of fish species known to occur in the Klamath River and reservoirs upstream of Iron Gate dam and that likely occur in the Klamath River drainage system downstream of Iron Gate dam.[1]

Common Name	Scientific Name	Origin[2]	Status[3]	Temperature Preference[4]	Pollution Tolerance[5]	Present Upstream of Iron Gate Dam[6]	Present Downstream of Iron Gate Dam[6]
Channel catfish	*Ictalurus punctatus*	I	G	Warm	T	R	--
Smelts	Osmeridae						
Surf smelt	*Hypomesus pretiosus*	N	G	Cold	S	--	O
Delta smelt	*Hypomesus transpacificus*	I	T,S	--	--	--	R
Longfin smelt	*Spirinchus thaleichtys*	N	G	Cool	I	--	O
Eulachon	*Thaleichthys pacificus*	N	G	Cool	I	--	A
Trouts and Salmon	Salmonidae						
Cutthroat trout	*Oncorhynchus clarki*	N	G	Cold	S	--	R
Pink salmon	*Oncorhynchus gorbuscha*	N	G	Cold	S	--	A
Chum salmon	*Oncorhynchus keta*	N	G	Cold	S	--	A
Coho salmon	*Oncorhynchus kisutch*	N	G, T	Cold	S	--	A
Coastal Rainbow trout/Steelhead	*Oncorhynchus mykiss*	N	G	Cold	S	--	R, A
Redband/rainbow trout	*Oncorhynchus mykiss gairdneri*	N	G, S	Cold	S	R	--
Sockeye salmon	*Oncorhynchus nerka*	N	G	Cold	S	--	O, A
Kokanee	*Oncorhynchus nerka kennerlyi*	I	G	Cold	S	--	R
Chinook salmon	*Oncorhynchus tshawytscha*	N	G	Cold	S	--	A
Brown trout	*Salmo trutta*	I	G	Cold	I	R	R
Brook trout	*Salvelinus fontinalis*	I	G	Cold	I	--	R
Arctic grayling	*Thymallus arcticus*	I	G	Cold	S	--	R
Silversides	Atherinidae						
Topsmelt	*Atherinops affinis*	N	G	--	--	--	O
Sticklebacks	Gasterosteidae						
Threespine stickleback	*Gasterosteus aculeatus*	N	N	Cool	T	--	R
Sculpins	Cottidae						

Table 3.7-30. Common and scientific names of fish species known to occur in the Klamath River and reservoirs upstream of Iron Gate dam and that likely occur in the Klamath River drainage system downstream of Iron Gate dam.[1]

Common Name	Scientific Name	Origin[2]	Status[3]	Temperature Preference[4]	Pollution Tolerance[5]	Present Upstream of Iron Gate Dam[6]	Present Downstream of Iron Gate Dam[6]
Sharpnose sculpin	*Clinocottus acuticeps*	N	N	--	--	--	O
Coastrange sculpin	*Cottus aleuticus*	N	N	Cool	I	--	R
Prickly sculpin	*Cottus asper*	N	N	Cool	I	--	R
Marbled sculpin	*Cottus klamathensis*	N	N	Cool	I	R	R
Klamath Lake sculpin	*Cottus princeps*	N	N	Cold	I	R	--
Slender sculpin	*Cottus tenuis*	N	N, S	Cool	I	R	--
Pacific staghorn sculpin	*Leptocottus armatus*	N	N	Cold	I	--	R
<u>Sunfishes</u>	<u>Centrarchidae</u>						
Sacramento perch	*Archoplites interruptus*	I	G	Warm	T	R	R
Green sunfish	*Lepomis cyanellus*	I	G	Warm	T	R	R
Pumpkinseed	*Lepomis gibbosus*	I	G	Cool	T	R	R
Bluegill	*Lepomis macrochirus*	I	G	Warm	T	R	R
Largemouth bass	*Micropterus salmoides*	I	G	Warm	T	R	R
White crappie	*Pomoxis annularis*	I	G	Warm	T	R	--
Black crappie	*Pomoxis nigromaculatus*	I	G	Warm	T	R	--
<u>Perches</u>	<u>Percidae</u>						
Yellow perch	*Perca flavescens*	I	G	Cool	I	R	R
<u>Surfperches</u>	<u>Embiotocidae</u>						
Shiner perch	*Cymatogaster aggregata*	N	N	Cold	S	--	O
<u>Gobies</u>	<u>Gobiidae</u>						
Arrow goby	*Clevelandia ios*	N	N	--	--	--	O

Table 3.7-30. Common and scientific names of fish species known to occur in the Klamath River and reservoirs upstream of Iron Gate dam and that likely occur in the Klamath River drainage system downstream of Iron Gate dam.[1]

Common Name	Scientific Name	Origin[2]	Status[3]	Temperature Preference[4]	Pollution Tolerance[5]	Present Upstream of Iron Gate Dam[6]	Present Downstream of Iron Gate Dam[6]
Righteye Flounders	Pleuronectidae						
Starry flounder	*Platichthys stellatus*	N	G	Cold	S	--	R

[1] Source: Species upstream of Iron Gate dam from city of Klamath Falls (1986) and PacifiCorp (2000). Species downstream of Iron Gate dam based on Moyle (1976).

[2] Origin: N = native, I = introduced; UKL = Upper Klamath Lake.

[3] Status: N = nongame, G = game, E = federally listed as endangered, T = federally listed as threatened, S = federal or state sensitive species or species of concern.

[4] From Zaroban et al. (1999).

[5] Pollution Tolerance: T = tolerant, I = intermediate, S = sensitive. From Zaroban et al. (1999).

[6] R = resident, A = anadromous, O = occasional marine visitor.

-- None sampled.

CPUE values, expressed as number of fish collected per hour of electrofishing, were considerably higher for fathead minnow, blue chub, and Tui chub than any other species collected in Lake Ewauna during 2001 and 2002 (Table 3.7-29). Total CPUE values for these three species were 529 fathead minnow, 221 blue chub, and 156 Tui chub per hour of sampling. Seasonal CPUE values for these species were much higher in summer than spring or fall, exceeding 6,400 fathead minnow, 1,700 blue chub, and 700 Tui chub per hour of sampling during summer 2002. These high catch rates reflect large numbers of juvenile fathead minnow, blue chub, and Tui chub present in Lake Ewauna during this time of year. Minimum CPUE values for these three species occurred in spring 2002 for fathead minnow (49 individuals per hour) and blue chub (37 individuals per hour) and fall 2002 for Tui chub (34 individuals per hour) (Table 3.7-29).

Numbers of other species collected during nearly 6 hours of electrofishing in Lake Ewauna during 2001 and 2002 were very low compared to fathead minnow, blue chub, and Tui chub (Table 3.7-29). No other individual fish species collected in Lake Ewauna comprised more than 1 percent of the total catch, and only three other species accounted for more than 1 percent of any seasonal catch. They included shortnose sucker (2.6 percent of the fall 2001 catch), Klamath largescale sucker (3.8 percent of the fall 2002 catch), and yellow perch (1.2 percent of the fall 2002 catch). The category "unidentified fish" listed in Table 3.7-29, which accounted for 2.3 and 6.3 percent of the catch in summer and fall 2002, likely consists of very small fathead minnows and blue and Tui chubs whose taxonomies at early life stages are difficult to distinguish in the field.

CPUE values for species other than fathead minnow, blue chub, and Tui chub were quite low (Table 3.7-29). Except for these three species, total CPUE values only exceeded one fish per hour of sampling for five other species. They are yellow perch (total CPUE of 5.5), Klamath largescale sucker (5.2), shortnose sucker (4.3), largemouth bass (1.2), and Sacramento perch (1.1). Examples of seasonally high CPUE values for species other than fathead minnow, blue chub, and Tui chub are 39.0 yellow perch per hour in summer 2002, 10.8 shortnose sucker per hour in fall 2001, 2.4 Sacramento perch per hour in summer 2002, and 2.2 largemouth bass per hour in fall 2001. These data reflect the relatively low numbers of game fish and federally protected fish that were collected in Lake Ewauna during 2001 and 2002. Nearly 6 hours of electrofishing yielded 50 game fish (32 yellow perch, seven largemouth bass, six Sacramento perch, three pumpkinseed, and two bluegill), 25 endangered shortnose sucker, and two endangered Lost River sucker (Table 3.7-29).

Fish exhibiting a wide range of sizes were captured by boat electrofishing, including very small specimens that are typically most difficult to capture. Lengths of fathead minnow varied from 0.4 to 3.2 inches (10 to 82 mm). Size ranges of blue chub and Tui chub were wider than that of fathead minnow, as expected, varying from 0.8 to 9.3 inches (21 to 235 mm) for blue chub and from 0.4 to 11.5 inches (10 to 291 mm) for Tui chub. Size ranges of other fish species of interest captured in Lake Ewauna during 2001 and 2002 were: shortnose sucker, 12.0 to 25.3 inches (304 to 642 mm); Lost River sucker, 3.5 and 16.3 inches (89 and 414 mm); Klamath largescale sucker, 3.7 to 18.8 inches (95 to 478 mm); yellow perch, 1.9 to 4.8 inches (49 to 122 mm); largemouth bass, 3.9 to 16.1 inches (98 to 408 mm); and Sacramento perch, 2.5 to 5.4 inches (63 to 136 mm).

Lake Ewauna Discussion

The fish community in Lake Ewauna during 2001 and 2002 generally appears similar to that described in Klamath reservoir studies over the past 10 years by ODFW (1996) and Hummel (1993) (see Section 2.7.4.1). Fathead minnow, blue chub, and Tui chub continue to be the dominant fish species, with considerably fewer numbers of game fish (perch, basses, sunfishes), endangered species (shortnose sucker, Lost River sucker), and other native species (Klamath largescale and smallscale suckers, Klamath speckled dace) also present. Rainbow trout were not collected in Lake Ewauna during the 2001 and 2002 electrofishing surveys, although their limited seasonal use and movements through the reservoir were described by Buchanan et al. (1989, 1991) and ODFW (1997) (see Section 2.7.4.1). Other species reported by ODFW (1997) as occurring in Lake Ewauna that were not collected during the 2001-2002 studies include white and black crappie, green sunfish, brown bullhead, and lamprey. Conversely, species collected during the 2001-2002 studies that were not reported by ODFW (1997) as occurring in Lake Ewauna include Klamath smallscale sucker. One Sacramento perch was collected; however, ODFW has questioned the validity of this finding. Unfortunately, the specimen was not preserved for species verification.

Reservoir habitat types and physical-chemical characteristics described in Section 2.7.4 probably continue to strongly influence fish species composition and relative abundance in Lake Ewauna. This is especially so during summer when water quality is degraded because of dense algal growths, high water temperatures and high pH, and low DO concentrations. Studies by ODFW (1996) and Hummel (1993) concluded that summer water quality throughout Lake Ewauna was poor for fish. The most abundant fish species collected during 2001-2002, fathead minnow, is non-native, prefers warm water, and is very pollution tolerant (Zaroban et al. 1999). Moyle (1976) stated that fathead minnow can survive in a variety of habitat types and can tolerate low DO, elevated turbidities and water temperatures, and high organic pollution.

All of the warm and cool water game fish species collected in Lake Ewauna during 2001-2002 are pollution tolerant or exhibit an intermediate pollution tolerance, and are typically associated with standing waters or slow-moving streams or rivers (Zaroban et al., 1999). All of the nongame species present in the lake also are usually associated with lake environments or slow-moving water. All of the native nongame species prefer cool water and all exhibit intermediate pollution tolerance, except for shortnose sucker (pollution sensitive) and blue and Tui chubs (pollution tolerant). The single cold water species, rainbow trout, that has been reported from Lake Ewauna in previous studies is pollution sensitive (Zaroban et al., 1999). Degraded summer water quality and habitat conditions described above likely limit year-round use of Lake Ewauna by rainbow trout.

Boat electrofishing appeared to effectively sample a wide size range of fish present in Lake Ewauna. Smaller individuals are often the most difficult to sample because they are less affected by an electrical field than larger specimens, and because they are more difficult to see in the water and more difficult to net than larger fish. However, as discussed previously, many small (young-of-the-year) fathead minnows, blue chubs, and Tui chubs approximately 1 to 2 inches (25 to 50 mm) long were captured during summer and fall 2002. Some very large specimens of other species (shortnose, Lost River, and Klamath largescale suckers) up to approximately 2 feet (610 mm) long also were captured in Lake Ewauna during 2001-2002.

Size ranges of fathead minnow, blue chub, and Tui chub as well as Klamath largescale sucker and largemouth bass indicated reproducing populations and the presence of at least several year classes for each of these species. Sizes of game species other than largemouth bass indicate captured individuals were juveniles or subadults. Sizes of shortnose and Lost River suckers captured indicate all were adults except for one juvenile Lost River sucker. These endangered suckers may represent individuals or their progeny (expatriates) that originated in Upper Klamath Lake but moved downstream in search of improved water quality, an observation reported for other reaches of the upper Klamath (Snedaker, 2002 and PacifiCorp, 2000).

ODFW management direction for Lake Ewauna includes the natural production of rainbow trout directed at wild fish management, and the natural production of warm water game fish directed at a basic yield fishery. ODFW management direction for all waters of the Klamath River basin includes the protection and management of the Lost River and shortnose suckers according to these species' recovery plan, and the management of other native nongame fish species exclusively for natural production (ODFW, 1997).

3.7.2.2 J.C. Boyle Reservoir

<u>J.C. Boyle Reservoir Results</u>

Table 3.7-31 summarizes catch data by gear type in J.C. Boyle reservoir during 1998 and 1999. Information is presented on the number of each species collected each year by gear type and gear types combined, together with the corresponding level of sampling effort. Scientific names of fish listed in Table 3.7-31 are provided in Table 3.7-30. The eight taxonomic categories of multiple species listed in Table 3.7-31 (for example, lamprey of no particular species [spp.], chub spp., and sucker spp.) reflect taxonomic difficulties in distinguishing species differences among small specimens. The sizes of the fish caught during the reservoir sampling effort are shown in Appendix 3F.

More than 7,000 fish representing 23 taxonomic categories were collected in J.C. Boyle reservoir (Desjardins and Markle, 2000) (Table 3.7-31). Approximately 3,000 fish representing 20 taxa and approximately 4,000 fish representing 20 taxa were collected in 1998 and 1999, respectively. The six most abundant taxa collected overall in 1998 were chub spp. (666 individuals), pumpkinseed (421), sunfish spp. (402), Tui chub (266), bullhead spp. (263), and fathead minnow (238). These six taxa collectively accounted for 75 percent of the total catch in 1998. Four of these taxa also were among the six most abundant taxa collected in the reservoir in 1999, which included chub spp. (1,105 individuals), fathead minnow (682), bullhead spp. (508), Klamath speckled dace (500), sucker spp. (282), and Tui chub (240). These six taxa together made up 82 percent of the total catch in J.C. Boyle reservoir in 1999 (Table 3.7-31).

Table 3.7-31. J.C. Boyle reservoir number of fish collected, by gear type, during 1998 and 1999.

*Targeted life stage in parentheses after gear type (A = adult, J = juvenile, L = larvae).**

Species	Trammel Net (A)		Trap Net (A, J)		Beach Seine (J)		Larval Trawl (J, L)		Dip Net (J, L)		Larval Drift Net (J, L)		Total	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
Lamprey spp.	2	0	4	3	0	0	0	0	0	0	0	1	6	4
Tui chub	123	166	133	70	10	2	0	2	0	0	0	0	266	240
Blue chub	39	30	25	87	8	5	2	0	0	0	0	0	74	122
Chub spp.	0	0	0	402	13	633	618	34	35	36	0	0	666	1,105
Golden shiner	0	0	0	0	0	1	0	1	0	3	0	0	0	5
Fathead minnow	0	0	5	280	65	190	168	14	0	198	0	0	238	682
Klamath speckled dace	0	0	0	61	8	62	11	28	0	349	0	0	19	500
Klamath smallscale sucker	62	97	2	26	0	0	0	0	0	0	0	0	64	123
Klamath largescale sucker	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Shortnose sucker	5	13	0	31	0	0	0	0	0	0	0	0	5	44
Lost River sucker	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Sucker spp.	4	2	0	8	75	105	49	34	0	126	5	7	133	282
Bullhead spp.	167	207	88	290	7	11	1	0	0	0	0	0	263	508
Redband/rainbow trout	33	24	1	3	0	0	0	0	0	0	2	1	36	28
Sculpin spp.	0	0	0	0	0	25	0	7	0	0	0	0	0	32
Sacramento perch	8	4	178	31	0	0	0	0	0	0	0	0	186	35
Pumpkinseed	1	1	415	59	5	89	0	2	0	0	0	0	421	151
Bluegill	0	0	0	0	2	0	0	0	0	0	0	0	2	0
Largemouth bass	9	4	0	0	17	65	0	0	0	0	0	0	26	69
Sunfish spp.	0	0	14	0	242	0	127	0	19	0	0	0	402	0
Crappie spp.	34	6	128	27	2	1	0	0	0	0	0	0	164	34
Yellow perch	35	4	0	5	0	1	1	1	0	0	0	0	36	11
Unidentified spp.	0	0	0	0	0	0	0	27	0	32	3	11	3	70
Total Individuals	523	560	993	1,383	454	1,190	977	150	54	744	10	20	3,011	4,047
Total Taxa	14	13	11	15	12	13	8	10	2	5	3	4	20	20

Table 3.7-31. J.C. Boyle reservoir number of fish collected, by gear type, during 1998 and 1999.

*Targeted life stage in parentheses after gear type (A = adult, J = juvenile, L = larvae).**

Species	Trammel Net (A)		Trap Net (A, J)		Beach Seine (J)		Larval Trawl (J, L)		Dip Net (J, L)		Larval Drift Net (J, L)		Total	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
Sampling Effort														
Sets/Pulls	16	8	10	13	17	18	19	17	7	10	7	16		
Hours	173	119	118	197	—	—	—	—	—	—	25	79		

*Catch data from Desjardins and Markle (2000).

Dominant fish species captured varied somewhat among gear types, depending on the life stage targeted by the sampling method. Dominant species also varied between years for some but not all gear types. These findings are reflected in catch data summarized in Table 3.7-31 and in Figures 3.7-7 through 3.7-11, which compare relative species abundance during 1998 and 1999 for five gear types. Catch results for each gear type are discussed briefly in the following text.

Catches in trammel nets, which targeted adults, totaled 523 individuals and 14 taxa in 1998 (173 hours of sampling) and 560 individuals and 13 taxa in 1999 (119 hours of sampling) (Table 3.7-31). Trammel net catches were dominated both years by bullhead spp. and Tui chub, followed by lesser numbers of Klamath smallscale sucker, blue chub, and rainbow trout (Figure 3.7-11 and Table 3.7-31). These dominant species represent a broad range of water temperature preferences and pollution tolerances, varying from warm/tolerant for bullhead, cool/tolerant for Tui chub and blue chub, cool/intolerant for Klamath smallscale sucker, to cold/sensitive for rainbow trout. Other species of interest captured by trammel net in J.C. Boyle reservoir over the 2-year period included 18 endangered shortnose sucker, two endangered Lost River sucker, 13 largemouth bass, 40 crappie spp., and 39 yellow perch. Fifty-seven of the 64 trout collected during the study were captured by trammel net (Table 3.7-31).

Catches in trap nets, which targeted adults and juveniles, totaled 993 individuals and 11 taxa in 1998 (118 hours of sampling) and 1,383 individuals and 15 taxa in 1999 (197 hours of sampling) (Table 3.7-31). Dominant species varied somewhat between years, perhaps reflecting an emphasis on night sampling with this gear in 1999. The five most abundant taxa collected in 1998 were all introduced game fish (pumpkinseed, Sacramento perch, crappie sp., bullhead spp.) except for Tui chub (Figure 3.7-12). In 1999, native chubs (chub spp., blue chub, Tui chub) were among the dominant species collected, together with bullhead spp. and fathead minnow. Other species of interest captured by trap net in J.C. Boyle reservoir during the 2-year period included 31 shortnose sucker and four rainbow trout (Table 3.7-31).

Beach seine hauls, which targeted juveniles, collected 454 individuals and 12 taxa in 1998 (17 hauls) and 1,190 individuals and 13 taxa in 1999 (18 hauls) (Table 3.7-31). Dominant species collected were very similar between years. Chub spp., fathead minnow, sucker spp., and largemouth bass were among the five most abundant taxa collected each year, although their order of abundance and relative abundance varied between years (Figure 3.7-11). Sunfish spp., the dominant taxa collected in 1998, were not collected in 1999, while pumpkinseed were among the five most abundant taxa collected in 1999 (Table 3.7-31). This may reflect differences between years in being able to identify this particular centrarchid to species. No endangered sucker species or redband/rainbow trout were collected by beach seining.

The remaining three gear types that were used to sample J.C. Boyle reservoir (larval trawl, dip net, and larval drift net) targeted larval and juvenile fish. Some similarity existed in species composition between larval trawl and dip net catches over the 2-year period, but very few fish (30 individuals, four taxa) were captured by larval drift net (Table 3.7-31). Catches in the larval trawl totaled 977 individuals and eight taxa in 1998 (19 pulls) and 150 individuals and 10 taxa in 1999 (17 pulls). Dip net catches totaled 54 individuals and two taxa in 1998 (seven hauls) and 744 individuals and five taxa in 1999 (10 hauls).

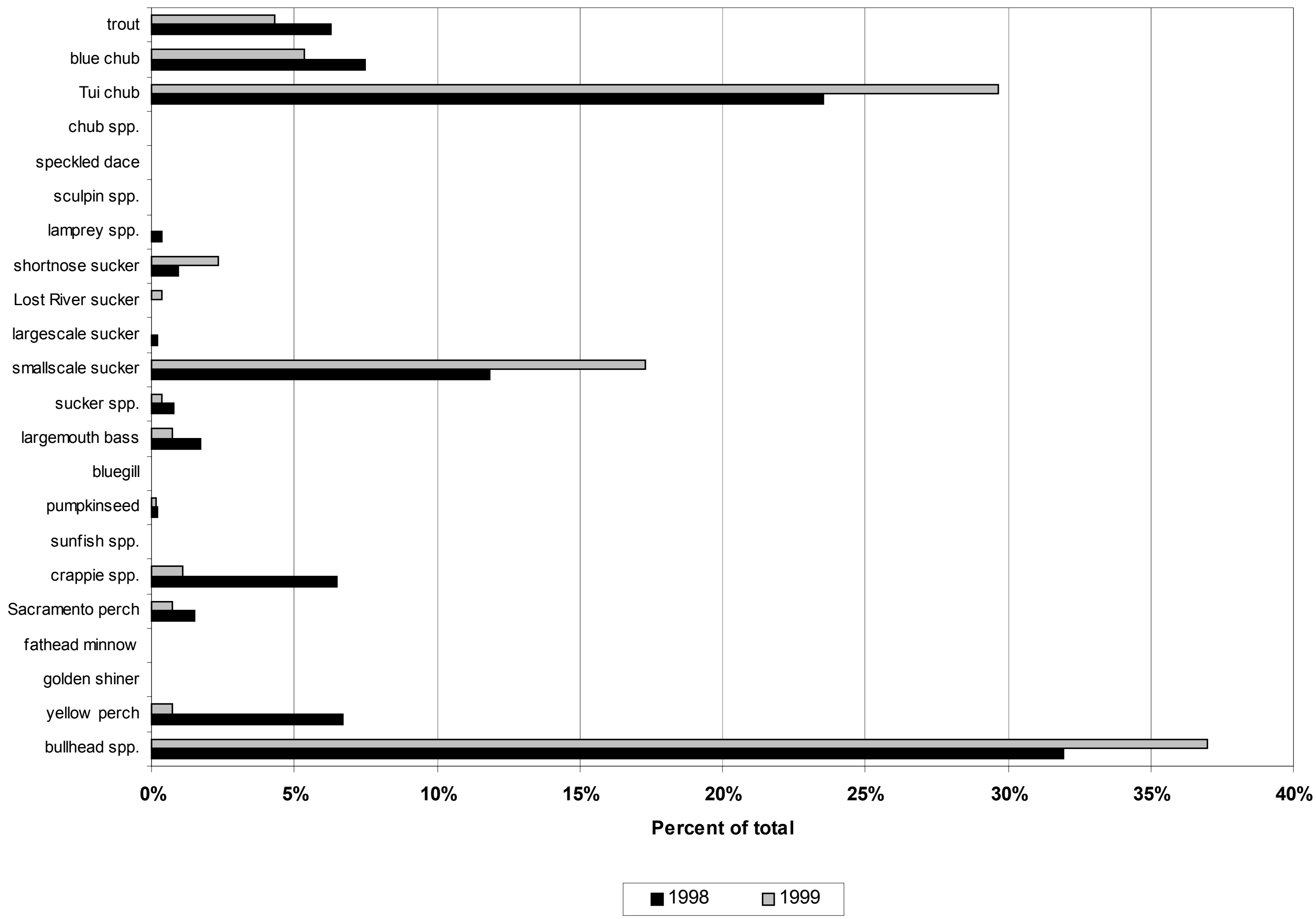

Figure 3.7-7. J.C. Boyle reservoir relative species abundance (1998–1999 OSU)—trammel net.

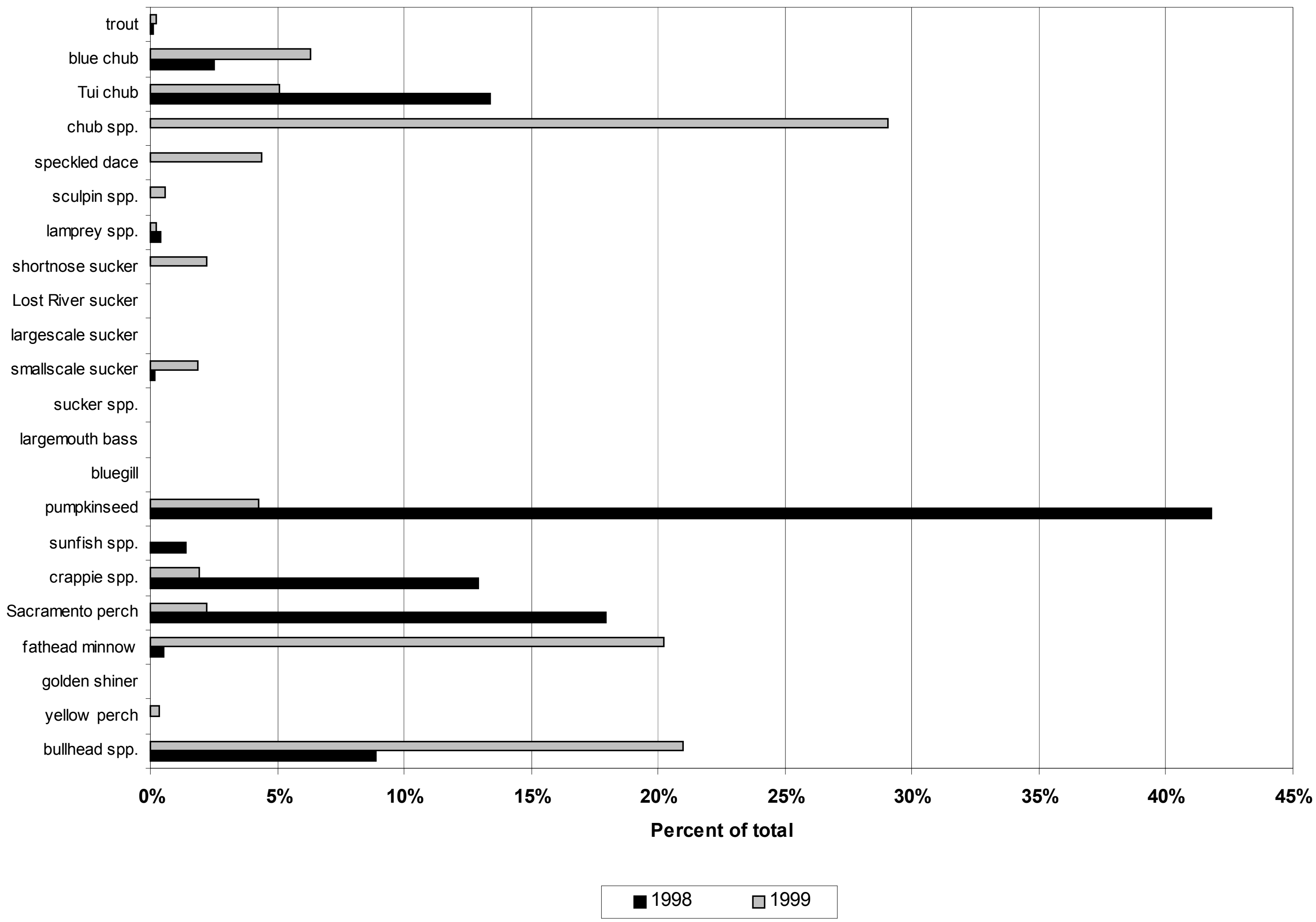

Figure 3.7-8. J.C. Boyle reservoir relative species abundance (1998–1999 OSU)—trap net.

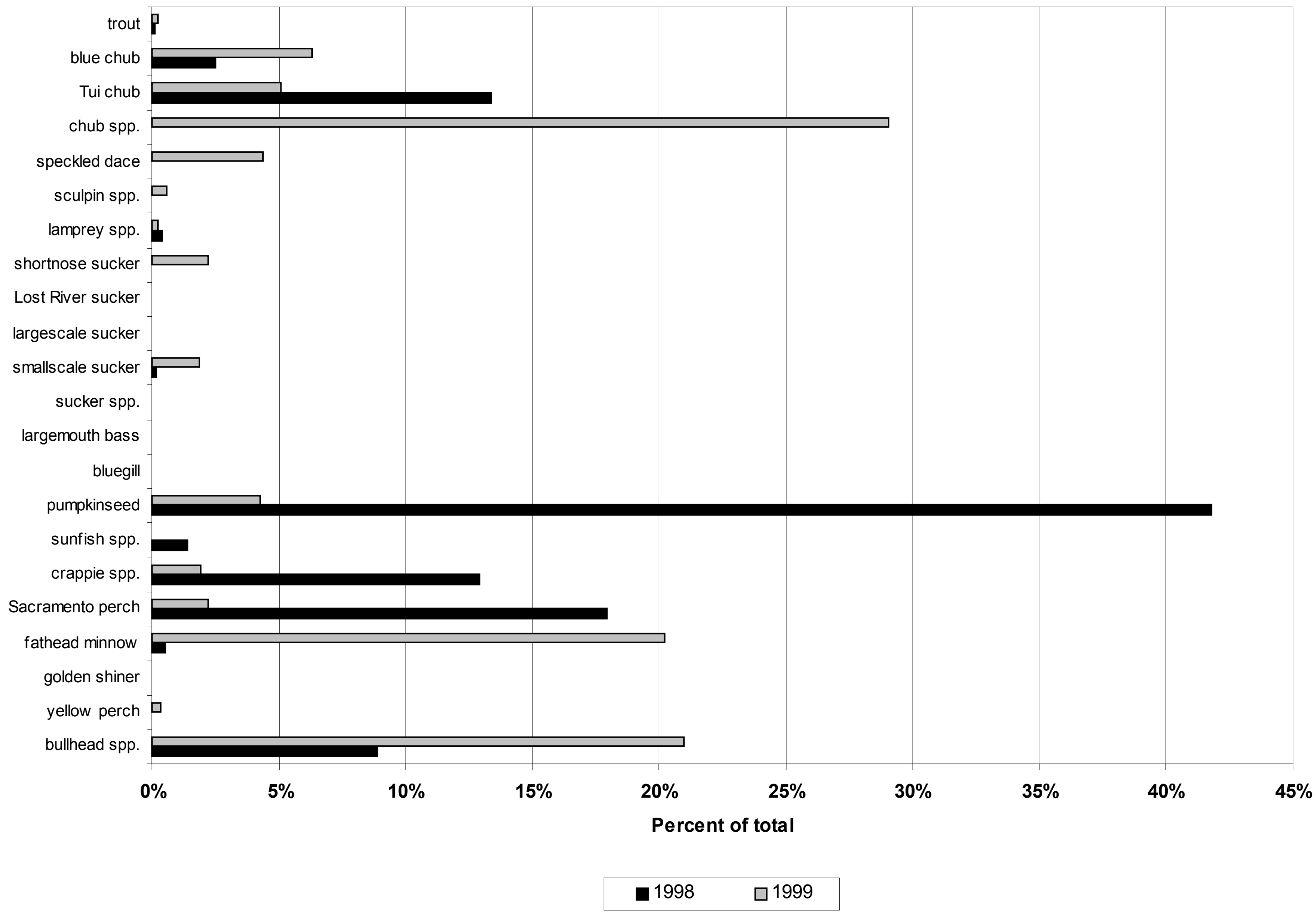

Figure 3.7-9. J.C. Boyle reservoir relative species abundance (1998–1999 OSU)–seine.

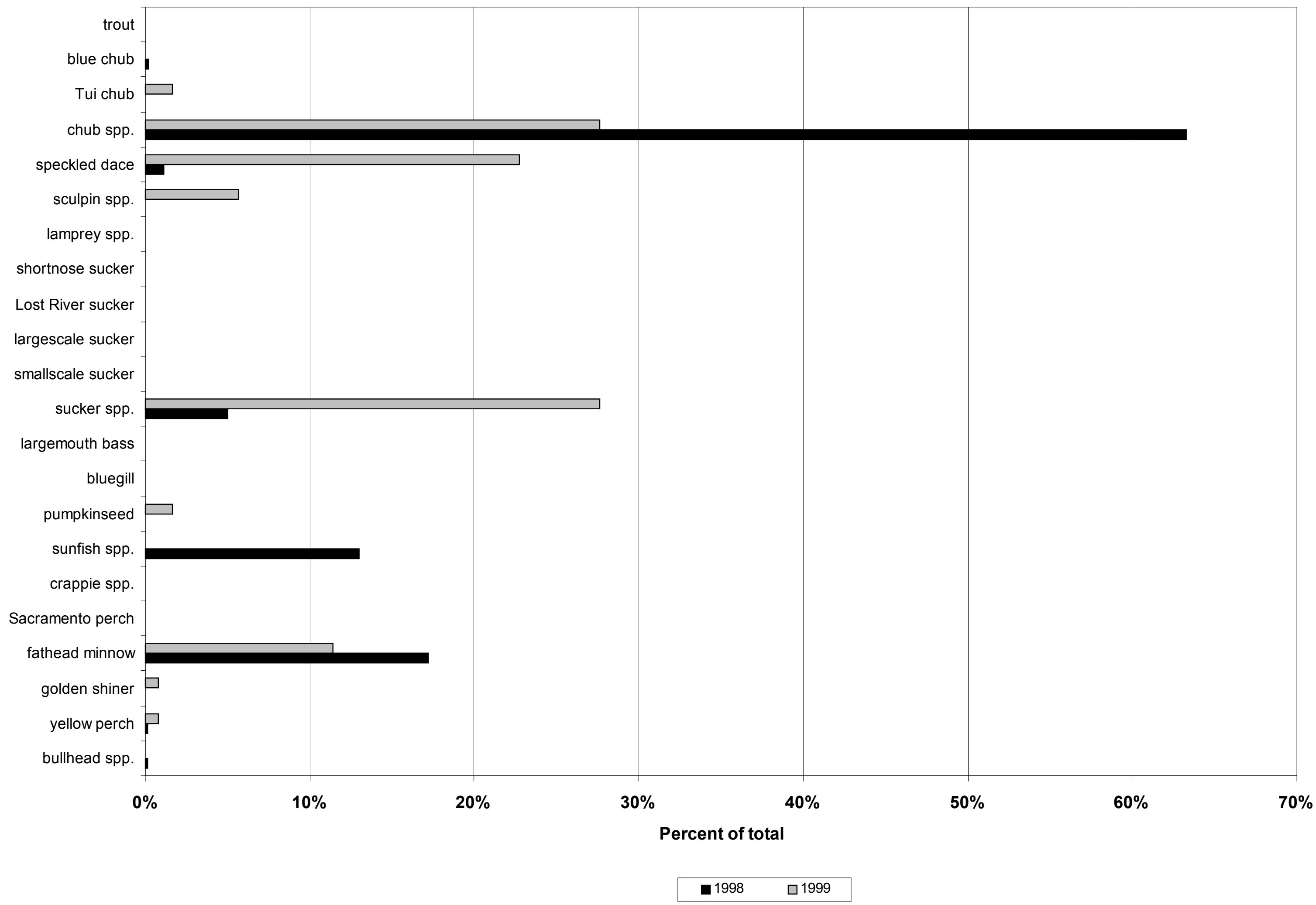

Figure 3.7-10. J.C. Boyle reservoir relative species abundance (1998–1999 OSU)—trawl.

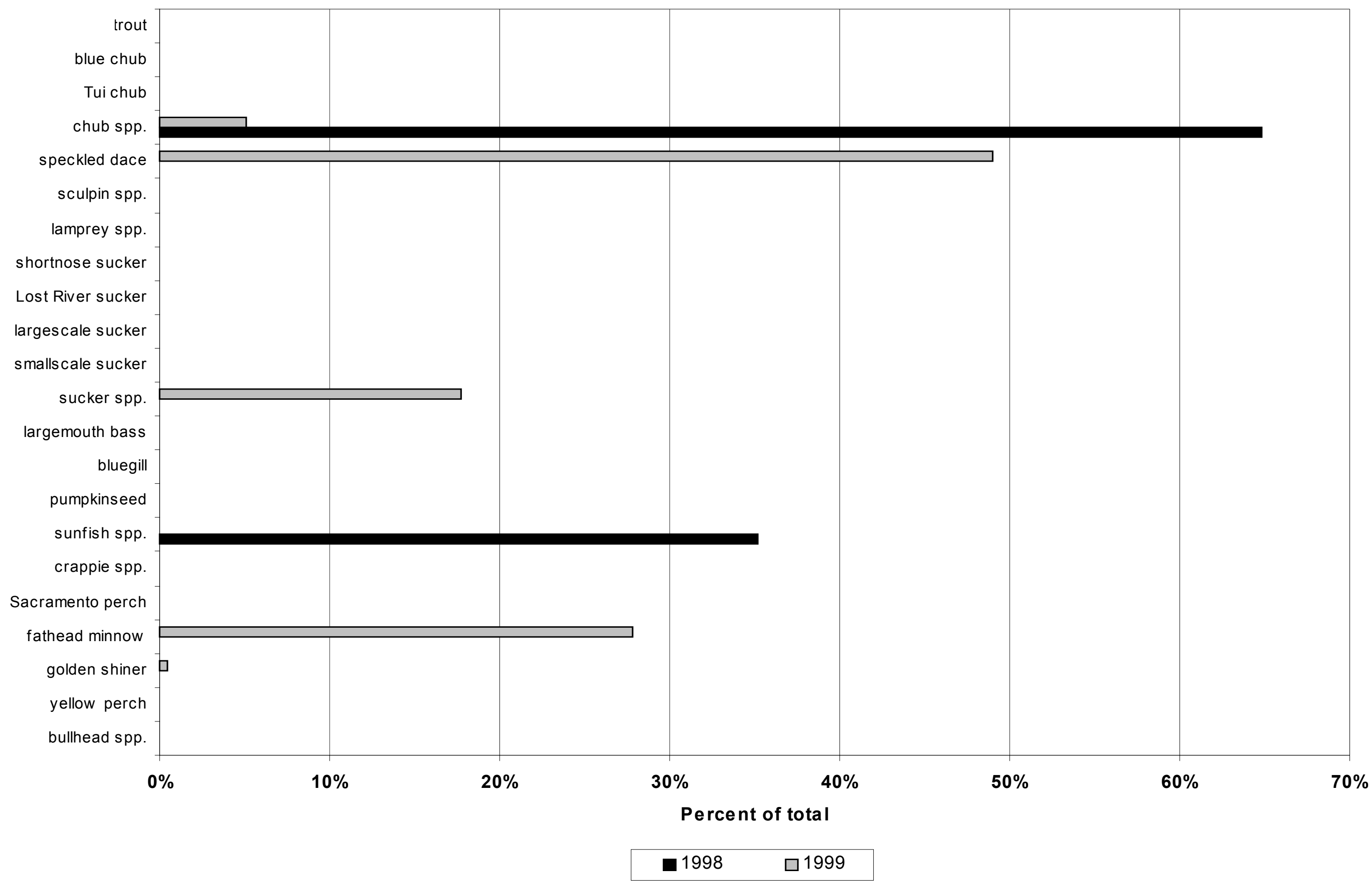

Figure 3.7-11. J.C. Boyle reservoir relative species abundance (1998–1999 OSU)—dip net.

Chub spp., sucker spp., fathead minnow, and speckled dace were among the five most abundant taxa collected by larval trawl each year (Figure 3.7-10). They were also the most abundant species collected by dip net over the 2-year period (Figure 3.7-11). Sunfish spp. were the third most abundant taxa collected by larval trawl in 1998, but they were not collected by larval trawl or dip net in 1999. Larval trawl and dip net catches consisted primarily of native, cool water species, except for fathead minnow and sunfish spp., which are both introduced, warm water taxa. No endangered species of sucker and only three rainbow trout (present in larval drift nets) were captured by the three larval/juvenile gear types.

J.C. Boyle Reservoir Discussion

Six different gear types targeting a range of fish life stages and sizes were used by OSU to sample J.C. Boyle reservoir during 1998 and 1999 (Desjardins and Markle, 2000). The overall dominant fish taxa collected (all gears combined) represent a mix of native and introduced species with warm or cool water temperature preferences that are either pollution tolerant or intolerant. Many of these same characteristics were noted for the fish community in Lake Ewauna. Table 3.7-30 lists origin, status, thermal preference, and pollution tolerance values for fish species present in Upper Klamath Lake and reservoirs.

Chub spp., a combination of unidentified blue or Tui chub spp., was the most abundant taxa collected in J.C. Boyle reservoir during 1998 and 1999, are native, pollution tolerant species with cool water temperature preferences. Two other dominant taxa, sucker spp. and Klamath speckled dace, also are native, cool water species, but are pollution intolerant (shortnose sucker is pollution sensitive). The other overall dominant taxa (fathead minnow, bullhead, pumpkinseed, sunfish spp.) are introduced, pollution tolerant species that exhibit a warm water temperature preference (pumpkinseed prefer cooler water). Bullhead, pumpkinseed, and sunfish spp. are game species while the rest of the dominant taxa are nongame species.

Section 2.7.4.2 includes a discussion of results related to previous fisheries studies in J.C. Boyle reservoir. That section included a brief summary discussion and comparison of results of the 1998/1999 fisheries studies by OSU with results of reservoir studies conducted some 15 years earlier by ODFW. The discussion noted that among adult fish collected in J.C. Boyle reservoir during 1998 and 1999, native species accounted for approximately 55 percent of the total (Desjardins and Markle, 2000). Tui chub was the most abundant species and rainbow trout the fifth most abundant species of adult native fishes collected. The discussion also noted that results of previous fisheries studies in J.C. Boyle reservoir generally indicate the fish community has not changed greatly over the past 15 years, except perhaps in the increased abundance of several popular warm water game species (largemouth bass and white crappie) that now support a popular recreational fishery (ODFW, 1997). Information on rainbow trout spawning and post-spawning movements through J.C. Boyle reservoir and their use of Spencer Creek and on juvenile migrations through the reservoir are discussed in Section 2.7.5.2.

The endangered shortnose and Lost River suckers accounted for about 1.5 percent of the native fish captured in J.C. Boyle reservoir during 1998 and 1999, and may represent individuals or their progeny that originated in Upper Klamath Lake (Desjardins and Markle, 2000). Shortnose sucker were much more abundant in the catch than Lost River sucker. J.C. Boyle reservoir was the only reservoir of the three reservoirs sampled by OSU where all life stages of suckers (adults, juveniles, larvae) were collected during both 1998 and 1999 (Desjardins and Markle, 2000). This may reflect the effects of several factors, as described by Desjardins and Markle (2000). These include J.C. Boyle reservoir serving as a downstream sink for larvae and juvenile suckers dispersed from upstream spawning in Upper Klamath Lake. In addition, the presence of juveniles and younger adults suggests that there is sufficient habitat in the reservoir to support these life stages. Also, fewer numbers of introduced, dominant predators such as yellow perch, crappie, and largemouth bass in J.C. Boyle reservoir than in downstream reservoirs may contribute to sucker survival (Desjardins and Markle, 2000).

ODFW management direction for J.C. Boyle reservoir is the same as described for Lake Ewauna. It includes the natural production of redband/rainbow trout directed at wild fish management, the natural production of warm water game fish directed at a basic yield fishery, the protection and management of the Lost River and shortnose suckers according to these species recovery plan, and the management of other native nongame fish species exclusively for natural production (ODFW, 1997).

3.7.2.3 Copco No. 1 Reservoir

Copco No. 1 Reservoir Results

Table 3.7-32 summarizes catch data and sampling information by gear type in Copco No. 1 reservoir during 1998 and 1999. Scientific names of fish captured are provided in Table 3.7-32. As noted for J.C. Boyle reservoir, the taxonomic categories of multiple species listed in Table 3.7-33 reflect difficulties in identifying small specimens to species. The sizes of the fish caught during the reservoir sampling effort are shown in Appendix 3F.

Approximately 4,000 fish representing 22 taxonomic categories were collected in Copco No. 1 reservoir (Desjardins and Markle, 2000) (Table 3.7-32). Nearly 8,000 fish representing 18 taxa and over 37,000 fish representing 19 taxa were collected in 1998 and 1999, respectively. The five most abundant taxa collected overall in 1998 were yellow perch (5,990 individuals), golden shiner (596), chub spp. (229), sucker spp. (213), and bullhead spp. (202). Largemouth bass (160 individuals) was the sixth most abundant species collected. These taxa collectively accounted for 94 percent of the total catch in 1998. Yellow perch alone accounted for 76 percent of the total catch (Table 3.7-32).

The same five taxa that dominated the overall catch in Copco No l. reservoir in 1998 also were dominant in 1999 collections, although the order of abundance varied slightly for several species. Numbers of yellow perch collected in 1999 again exceeded the total number of all other species collected. The five most abundant taxa collected in 1999 included yellow perch (21,337 individuals), sucker spp. (8,519), golden shiner (6,143), bullhead spp. (399), and chub spp. (208). These taxa together made up nearly 99 percent of the total catch in the reservoir in 1999. Yellow perch accounted for 57 percent of the total catch (Table 3.7-32).

The order of dominant fish species captured varied somewhat among gear types, depending on the life stage targeted by the sampling method. However, yellow perch was often by far the most abundant species captured by a range of gears targeting adults, juveniles, and larvae, and was usually among the most abundant species captured regardless of gear type. Dominant species also were somewhat consistent between years for a given gear type. These findings are reflected in catch data summarized in Table 3.7-32 and in species relative abundance depicted in

Figures 3.7-12 through 3.7-16. Catch results for each gear type are discussed briefly in the following text.

Catches in trammel nets, which targeted adults, totaled 1,049 individuals and 14 taxa in 1998 (204 hours of sampling) and 532 individuals and nine taxa in 1999 (123 hours of sampling) (Table 3.7-32). Trammel net catches were dominated both years by yellow perch, bullhead spp., and Tui chub, followed by lesser numbers of the endangered shortnose sucker and crappie spp. (Figure 3.7-12 and Table 3.7-32). These dominant species represent a relatively broad range of water temperature preferences and pollution tolerances, varying from warm/tolerant for bullhead and crappie spp., cool/tolerant for Tui chub, cool/intolerant for yellow perch, to cool/sensitive for shortnose sucker. Other species of interest captured by trammel net in Copco No. 1 reservoir over the 2-year period included three rainbow trout, two endangered Lost River sucker, and 18 largemouth bass. No other shortnose or Lost River suckers were collected in this reservoir during the 2-year study, and the only other rainbow trout collected was a single individual by larval drift net in 1999 (Table 3.7-32).

Catches in trap nets, which targeted adults and juveniles, totaled 185 individuals and seven taxa in 1998 (35 hours of sampling) and 1,755 individuals and nine taxa in 1999 (219 hours of sampling) (Table 3.7-32). Dominant species were very similar between years. Yellow perch was the most abundant species collected both years, followed by crappie spp., pumpkinseed, and bullhead spp. in varying order of abundance (Figure 3.7-21). All of these species are introduced game fish. Very few individuals of any other species were collected by trap net in Copco No. 1 reservoir during 1998 or 1999 (Table 3.7-32).

Table 3.7-32. Number of fish collected in Copco No. 1 reservoir by gear type during 1998 and 1999.

*Targeted Life Stage in Parentheses After Gear Type (A = adult, J = juvenile, L = larvae)**

Species	Trammel Net (A)		Trap Net (A, J)		Beach Seine (J)		Larval Trawl (J, L)		Dip Net (J, L)		Larval Drift Net (J, L)		Total	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
Lamprey spp.	2	0	0	0	0	0	0	0	0	0	0	0	2	0
Tui chub	136	101	2	8	0	0	0	0	0	0	0	0	138	109
Blue chub	52	17	0	1	0	0	0	0	0	0	0	0	52	18
Chub spp.	0	0	0	0	0	4	140	53	89	146	0	5	229	208
Golden shiner	0	0	3	1	593	129	0	397	0	5,616	0	0	596	6,143
Fathead minnow	0	0	0	1	0	1	0	0	0	1	0	0	0	3
Klamath speckled dace	0	0	0	0	0	10	0	0	0	0	0	0	0	10
Klamath smallscale sucker	16	1	0	0	0	0	0	0	0	0	0	0	16	1
Klamath largescale sucker	2	0	0	0	0	0	0	0	0	0	0	0	2	0
Shortnose sucker	94	64	0	0	0	0	0	0	0	0	0	0	94	64
Lost River sucker	2	0	0	0	0	0	0	0	0	0	0	0	2	0
Sucker spp.	3	0	0	0	0	54	41	2,979	18	5,160	151	326	213	8,519
Bullhead spp.	182	221	15	178	5	0	0	0	0	0	0	0	202	399
Redband/rainbow trout	3	0	0	0	0	0	0	0	0	0	0	1	3	1
Sculpin spp.	0	0	0	0	0	3	0	0	0	0	0	0	0	3
Sacramento perch	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Pumpkinseed	8	3	30	31	0	5	0	8	0	1	0	0	38	48
Largemouth bass	12	6	2	0	128	8	18	1	0	2	0	0	160	17
Sunfish spp.	0	0	0	0	17	0	9	3	0	1	0	0	26	4
Crappie spp.	57	44	41	30	0	0	7	5	2	18	0	0	107	97
Yellow perch	480	75	92	1,504	16	16,301	5,000	3,274	400	183	2	0	5,990	21,337
Unidentified spp.	0	0	0	0	0	1	12	71	0	73	5	14	17	159
Total Individuals	1,049	532	185	1,755	759	16,516	5,227	6,791	509	11,201	158	346	7,887	37,141
Total Taxa	14	9	7	9	5	10	7	9	4	10	3	4	18	19
Sampling Effort														
Sets/Pulls	17	8	2	14	21	21	18	32	5	14	8	16		

Table 3.7-32. Number of fish collected in Copco No. 1 reservoir by gear type during 1998 and 1999.

*Targeted Life Stage in Parentheses After Gear Type (A = adult, J = juvenile, L = larvae)**

Species	Trammel Net (A)		Trap Net (A, J)		Beach Seine (J)		Larval Trawl (J, L)		Dip Net (J, L)		Larval Drift Net (J, L)		Total	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
Hours	204	123	35	219	—	—	—	—	—	—	30	73		

*Catch data from Desjardins and Markle (2000).

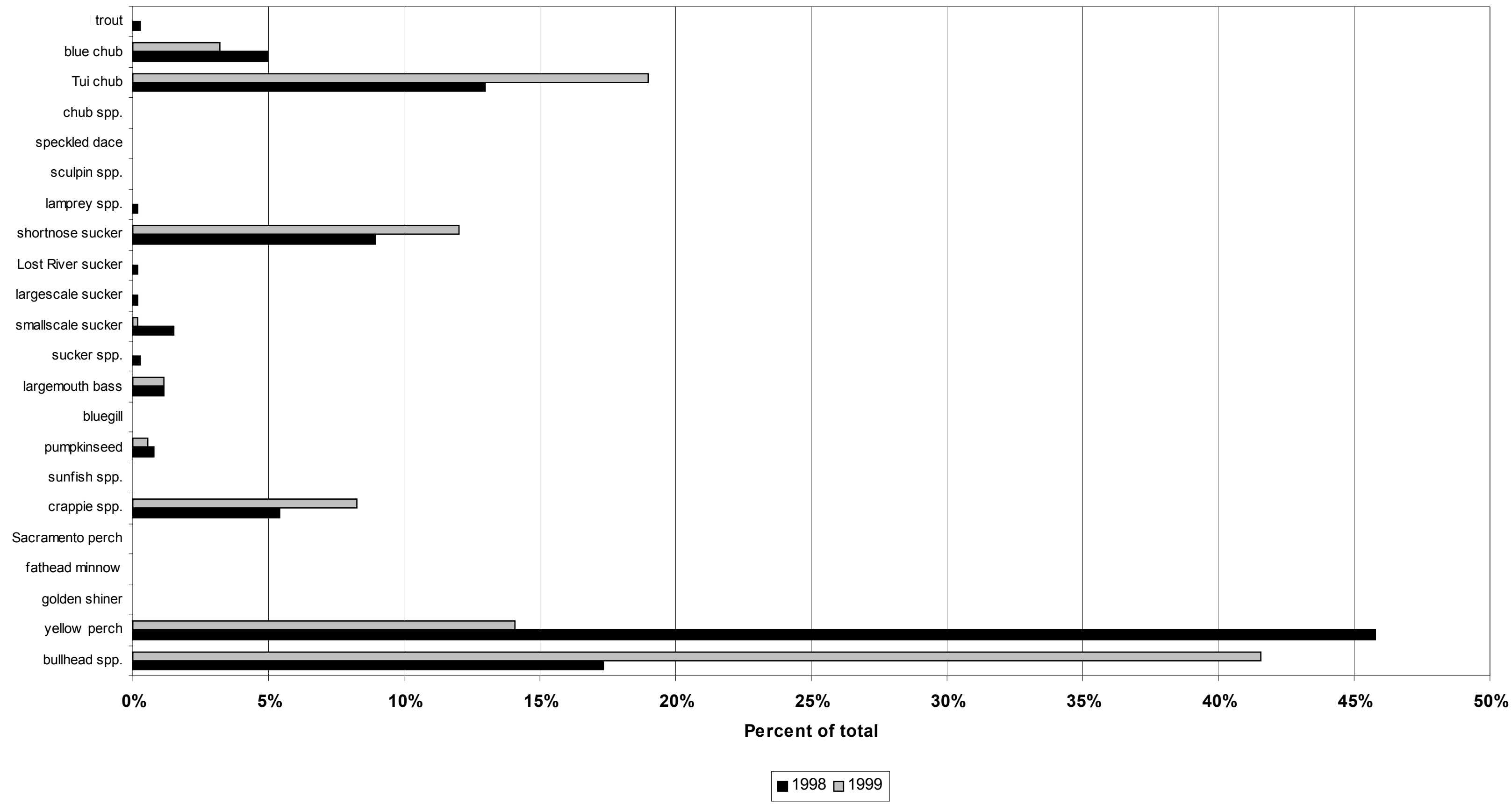

Figure 3.7-12. Copco reservoir relative species abundance (1998–1999 OSU)—trammel net.

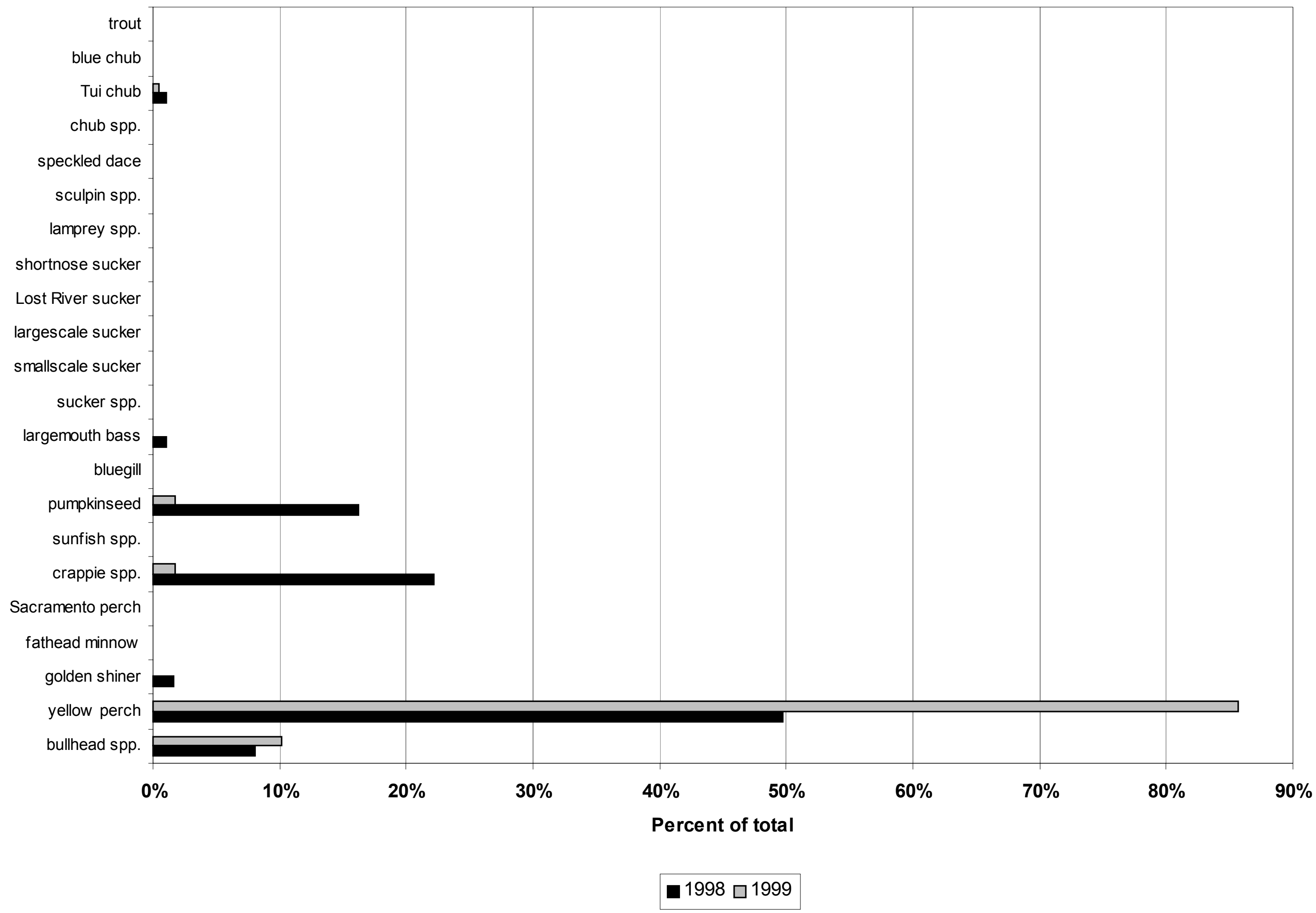

Figure 3.7-13. Copco reservoir relative species abundance (1998–1999 OSU)—trap net.

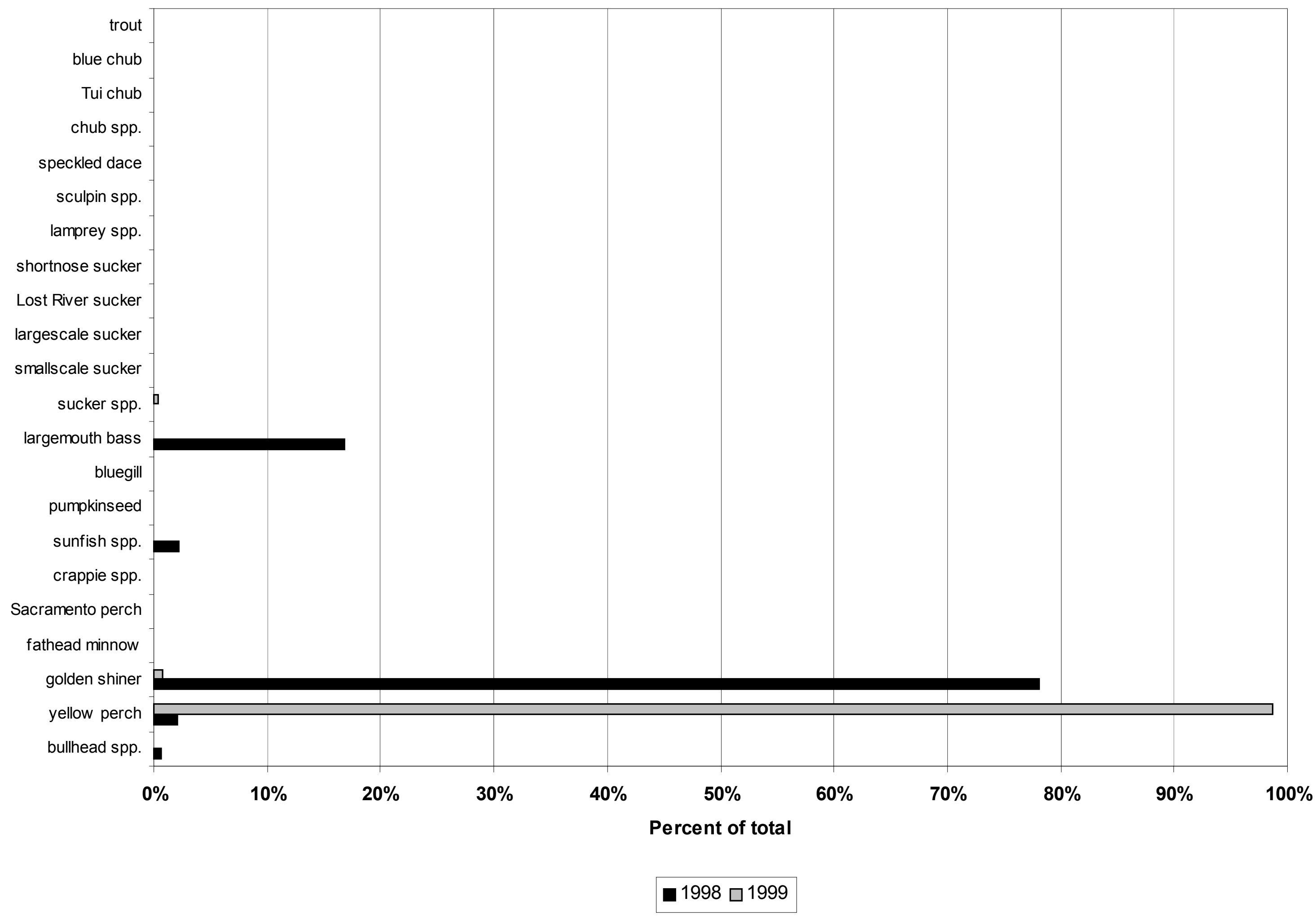

Figure 3.7-14. Copco reservoir relative species abundance (1998–1999 OSU)—seine.

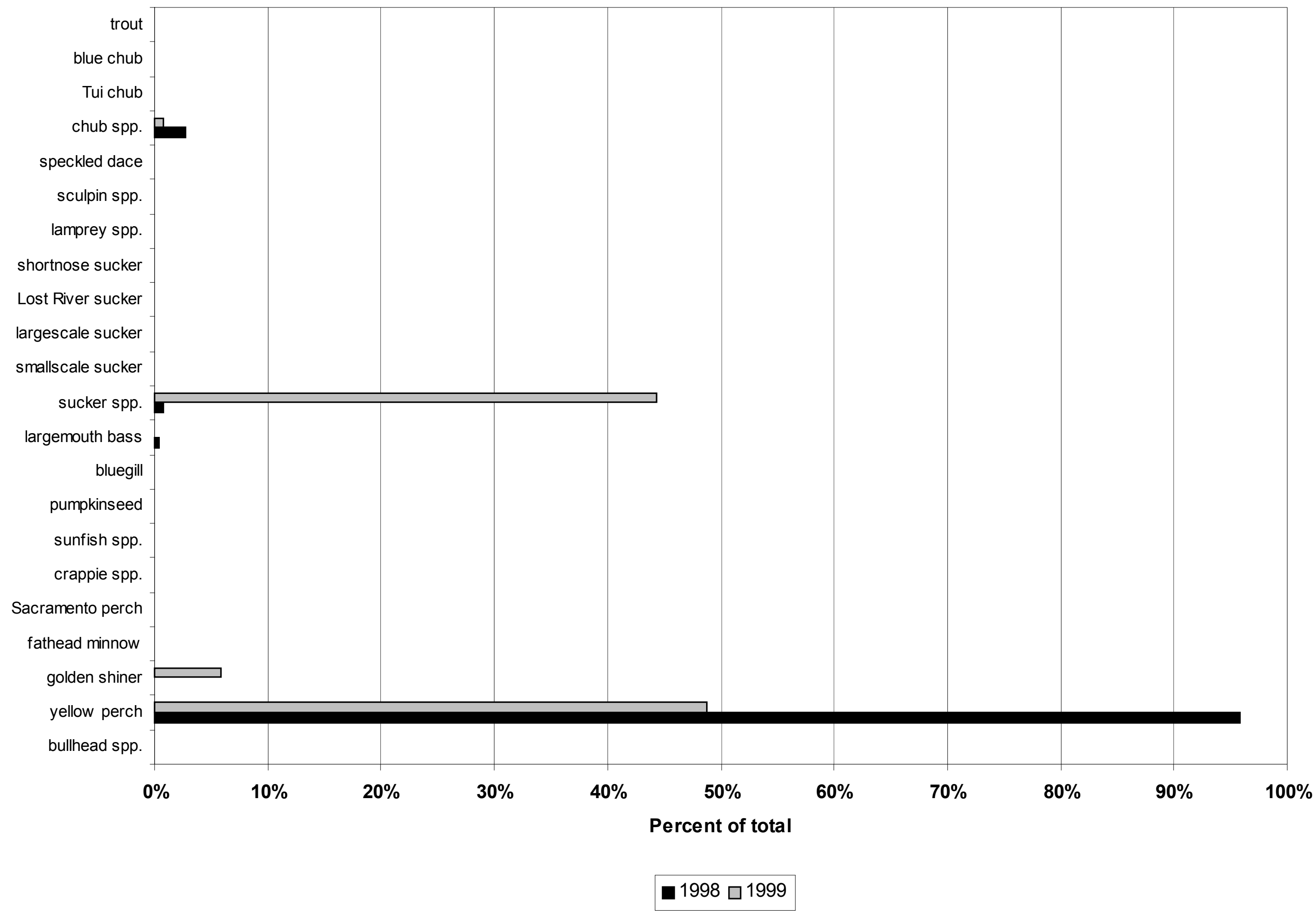

Figure 3.7-15. Copco reservoir relative species abundance (1998–1999 OSU)—trawl.

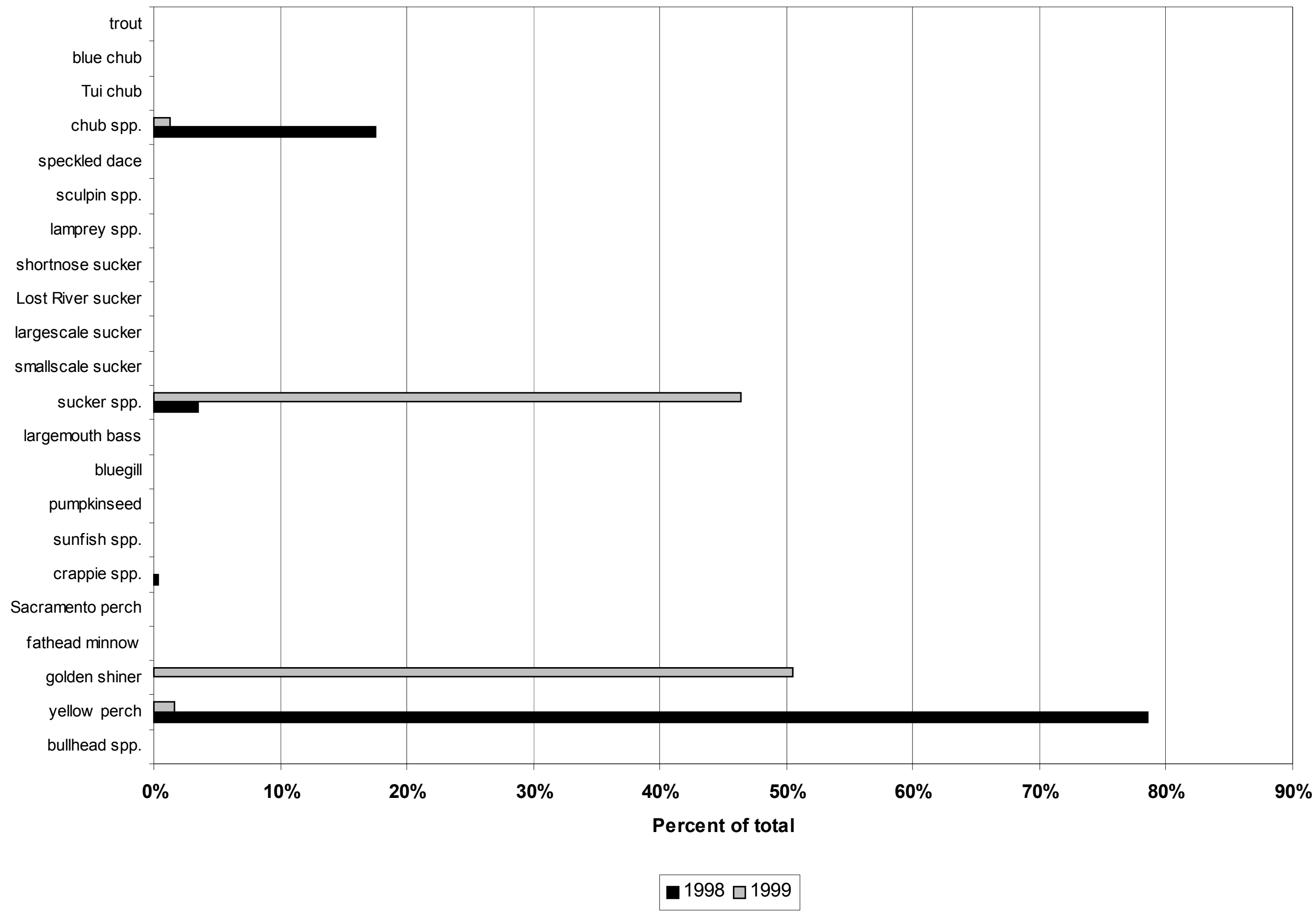

Figure 3.7-16. Copco reservoir relative species abundance (1998–1999 OSU)—dip net.

Beach seine hauls, which targeted juveniles, collected 759 individuals and five taxa in 1998 (21 hauls) and 16,516 individuals and 10 taxa in 1999 (21 hauls) (Table 3.7-32). Dominant species collected varied somewhat between years. Golden shiner and largemouth bass comprised much of the total catch in 1998, but, in 1999, yellow perch (over 16,000 individuals) was by far the dominant species collected, followed by considerably fewer golden shiner and sucker spp. (Figure 3.7-14).

The remaining three gear types that were used to sample Copco No. 1 reservoir (larval trawl, dip net, larval drift net) targeted larval and juvenile fish. There was some similarity in the most abundant taxa collected among gears although the total catch and species composition varied. Catches by larval trawl totaled 5,227 individuals and seven taxa in 1998 (18 pulls) and 6,791 individuals and nine taxa in 1999 (32 pulls). Dip net catches totaled 509 individuals and four taxa in 1998 (five hauls) and 11,201 individuals and 10 taxa in 1999 (14 hauls). Larval drift net catches totaled 158 individuals and three taxa in 1998 (30 hours of sampling) and 346 individuals and four taxa in 1999 (73 hours of sampling) (Table 3.7-32). Yellow perch were dominant in larval trawl catches both years (Figure 3.7-15), while dip net collections were dominated by yellow perch in 1998 and golden shiner and sucker spp. in 1999 (Figure 3.7-16). Sucker spp. comprised nearly the entire larval drift net catch both years; one rainbow trout was collected by larval drift net in 1999 (Table 3.7-32).

In addition to the net sampling, hydroacoustic techniques were used to assess the general characteristics of the deep-water fisheries in Copco and Iron Gate reservoirs. Traditional netting methods were also used to help verify the hydroacoustic results and verify the fish species "targets" identified with the hydroacoustic equipment. Both impoundments were sampled in August and October 2003. Additional sampling is scheduled for April 2004. The interim analysis presented here summarizes the initial findings from August 2003. The final report will include the findings of the October 2003 and April 2004 sampling. The interim Hydroacoustic Technical Report is presented in Appendix 3E (with sampling result figures).

The survey paths of the hydroacoustic sampling were comprised of transects 150 m apart to provide adequate spatial representation of the fish populations while also minimizing the incidence of multiple acquisition of targets. For each reservoir, a prescribed path was developed over the areas of the impoundments greater than 5 m deep. Two daytime surveys and one nighttime survey were conducted over each survey path during the investigation. Gas bubbles were abundant in the deeper areas of both impoundments during the August survey, but were generally easy to distinguish from the fish targets based on target strength.

The results from the August survey indicate that the vast majority of fish were observed above the thermoclines in both impoundments. This appears to be a valid conclusion because the hypolimnions of both impoundments were found to be anoxic. Fish abundance along the survey paths was similar across both day and night sampling runs. Fish netting conducted in the pelagic zone concurrently with the hydroacoustic activities showed that most of the fish targets were yellow perch.

Most of the fish targets observed in Copco reservoir were generally towards the middle and eastern end of the lake. There were relatively few differences in spatial distribution of the targets in Copco reservoir between the day (Appendix 3E, Figures 4 and 5) and night run. Most of the fish in Copco reservoir were distributed between 3 and 11 m during the day, but the fish were typically deeper at night, with an average depth of 11 m.

The distribution of fish in Iron Gate reservoir showed few fish present in the open-water area. Most fish were observed adjacent to the shorelines, especially the eastern shore, and in the inlet arm. During the night run, a large number of fish were congregated in the thalweg, 2 km west of the inlet. The fish were generally observed at depths from 3 to 13 m, with a considerable aggregation near the bottom end of this range.

The results for the fish netting show that most of the fish caught were yellow perch within the size range of 130 to 285 mm. The median size of fish netted in Copco reservoir was 193 mm and 200 mm in Iron Gate reservoir. The only nonperch fish caught were two black crappie in Copco reservoir.

Copco No. 1 Reservoir Discussion

The six different gear types that were used to sample a range of fish sizes and life stages in Copco No. 1 reservoir provide information on the fish community in that water body. The overall dominant fish taxa collected was yellow perch, followed by considerably fewer numbers of sucker spp., golden shiner, bullhead spp., and chub spp. These species represent a mix of native (chubs, suckers) and introduced (yellow perch, golden shiner, bullheads) taxa, with warm water (golden shiner, bullheads) or cool water (yellow perch, chubs, suckers) temperature preferences that are pollution tolerant (chubs, golden shiner, bullheads) or intolerant (yellow perch, suckers).

This same mix of species origins, thermal preferences, and pollution tolerances was observed in fish collections upstream in J.C. Boyle reservoir during 1998 and 1999. However, a major difference between the two reservoirs is the greater relative abundance and apparently absolute abundance of game species, particularly yellow perch, in Copco No. 1 reservoir. A striking example of this difference was the collection over a 2-year period of over 27,000 yellow perch in Copco No. 1 reservoir and only 47 yellow perch in J.C. Boyle reservoir. Thirty-two yellow perch were collected farther upstream in Lake Ewauna during sampling in 2001 and 2002. Conversely, fathead minnow, an introduced species that is prey for game fish, dominated the total catch in Lake Ewauna during 2001 and 2002, was among the most abundant species collected in J.C. Boyle reservoir, but was represented by only three individuals in the total catch in Copco No. 1 reservoir.

Results of previous fisheries investigations in Copco No. 1 reservoir are discussed in Section 2.7.4.3. That section included a brief summary discussion and comparison of results of the 1998/1999 fisheries studies by OSU with results of reservoir studies conducted some 10 to 15 years earlier by CDFG and the City of Klamath Falls. Yellow perch was the dominant species collected in the reservoir by CDFG during a 3-year study in the late 1980s, the same as in 1998 and 1999. That discussion also noted that fisheries studies in Copco No. 1 reservoir in 1998 and 1999 showed that warm water fish species are far more abundant than cold water species, and that over 60 percent of the fish collected were non-native species. Catch data indicate adult redband/rainbow trout are very uncommon in the reservoir (Desjardins and Markle, 2000).

Approximately 13 percent of the adult fish collected in Copco No. 1 reservoir during 1998 and 1999 were the endangered shortnose and Lost River suckers, and almost all of these were shortnose sucker (Desjardins and Markle, 2000). Older shortnose sucker and Lost River sucker expatriates from Upper Klamath Lake are reported to move downstream to waters such as Copco No. 1 reservoir (Snedaker, 2002). Few juvenile suckers were collected in the reservoir, which suggests little sucker recruitment is occurring. This may reflect the presence of non-native predators, such as yellow perch, largemouth bass, and crappie, and the reservoir's lack of rearing habitat for larval and juvenile suckers (Desjardins and Markle, 2000).

Other aspects of Copco No. 1 reservoir, including its popularity as a sport fishery for primarily warm water species and as the site of several largemouth bass tournaments during the summer, are discussed in Section 2.0.

3.7.2.4 Iron Gate Reservoir

Iron Gate Reservoir Results

Table 3.7-33 summarizes catch data and sampling information by gear type for Iron Gate reservoir during 1998 and 1999. Scientific names of fish captured are provided in Table 3.7-30**.** As noted for J.C. Boyle and Copco No. 1 reservoirs, the taxonomic categories of multiple species listed in Table 3.7-30 reflect difficulties in identifying small specimens to species. The sizes (lengths) of the fish caught during the reservoir sampling effort are shown in graphs in Appendix 3F.

Approximately 25,000 fish representing 21 taxonomic categories were collected in Iron Gate reservoir (Desjardins and Markle, 2000) (Table 3.7-33). Over 5,000 fish representing 18 taxa and nearly 20,000 fish representing 21 taxa were collected in 1998 and 1999, respectively. The five most abundant taxa collected overall in 1998 were tui chub (3,128 individuals), chub spp. (1,314), largemouth bass (336), crappie spp. (168), and golden shiner and yellow perch (133 individuals each). All but tui chub and chub spp. are introduced species.

A slightly different set of taxa dominated the overall catch in Iron Gate reservoir in 1999. Dominant taxa in 1999 included golden shiner (13,829 individuals), pumpkinseed (2,325), sucker spp. (1,138), yellow perch (1,108), and largemouth bass (419). All but sucker spp. are introduced species. The five most abundant taxa collected each year in Iron Gate reservoir constituted approximately 93 percent of the total catch in 1998 and 96 percent of the total catch in 1999. Other species of interest collected included 13 shortnose sucker and 33 redband/rainbow trout. No Lost River suckers were collected in Iron Gate reservoir either year (Table 3.7-33).

The order of dominant fish species captured varied somewhat among gear types, depending on the life stage targeted by the sampling method. Yellow perch was again among the most abundant species captured by a range of gears targeting adults, juveniles, and larvae, but it appeared to be far less abundant than upstream in Copco No. 1 reservoir. Dominant species also were somewhat consistent between years for a given gear type, although the order of species abundance often varied. These findings are reflected in catch data summarized in Table 3.7-33 and in species relative abundance depicted in Figures 3.7-17 through 3.7-21. Catch results for each gear type are discussed briefly in the following text.

Table 3.7-33. Number of fish collected in Iron Gate reservoir by gear type during 1998 and 1999.

*Targeted Life Stage in Parentheses After Gear Type (A = adult, J = juvenile, L = larvae)**

Species	Trammel Net (A)		Trap Net (A, J)		Beach Seine (J)		Larval Trawl (J, L)		Dip Net (J, L)		Larval Drift Net (J, L)		Total	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
Lamprey spp.	0	0	0	4	0	0	0	0	0	0	1	0	1	4
Tui chub	102	40	0	0	0	0	59	0	2,967	7	0	0	3,128	47
Blue chub	50	48	0	0	0	0	0	0	0	0	8	0	58	48
Chub spp.	0	0	0	0	9	0	1,298	9	0	0	7	6	1,314	15
Golden shiner	0	0	0	8	73	32	60	221	0	13,566	0	2	133	13,829
Fathead minnow	0	0	0	0	0	1	0	0	0	2	0	0	0	3
Klamath speckled dace	0	0	0	9	0	0	0	0	0	5	0	0	0	14
Klamath smallscale sucker	11	10	1	0	0	0	0	0	0	0	0	0	12	10
Shortnose sucker	2	11	0	0	0	0	0	0	0	0	0	0	2	11
Sucker spp.	0	1	0	0	0	0	3	114	14	604	25	419	42	1,138
Bullhead spp.	87	83	25	273	1	0	0	0	0	0	0	0	113	356
Channel Catfish	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Redband/rainbow trout	6	2	0	1	0	2	2	4	0	16	0	0	8	25
Sculpin spp.	0	0	0	0	0	0	0	0	0	0	52	24	52	24
Pumpkinseed	18	8	1	41	22	90	6	5	0	2,179	0	2	47	2,325
Green Sunfish	0	0	0	2	2	1	0	0	0	0	0	0	2	3
Largemouth bass	7	5	1	1	277	62	51	9	0	342	0	0	336	419
Sunfish spp.	0	0	0	0	33	0	11	0	0	1	0	0	44	1
Crappie spp.	22	41	12	24	48	0	72	3	14	0	0	3	168	71
Yellow perch	52	247	38	180	9	18	1	17	0	1	33	645	133	1,108
Unidentified spp.	0	0	0	0	0	0	0	4	0	17	7	217	7	238
Total Individuals	357	497	78	543	474	206	1,563	386	2,995	16,740	133	1,318	5,600	19,690
Total Taxa	10	12	6	10	9	7	10	9	3	11	7	8	18	21
Sampling Effort														
Sets/Pulls	19	10	3	12	13	13	17	27	6	25	12	20		
Hours	227	118	56	206	—	—	—	—	—	—	44	87		

Table 3.7-33. Number of fish collected in Iron Gate reservoir by gear type during 1998 and 1999.

*Targeted Life Stage in Parentheses After Gear Type (A = adult, J = juvenile, L = larvae)**

Species	Trammel Net (A)		Trap Net (A, J)		Beach Seine (J)		Larval Trawl (J, L)		Dip Net (J, L)		Larval Drift Net (J, L)		Total	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999

*Catch data from Desjardins and Markle (2000).

Catches in trammel nets, which targeted adults, totaled 357 individuals and 10 taxa in 1998 (227 hours of sampling) and 497 individuals and 12 taxa in 1999 (118 hours of sampling) (Table 3.7-33). Trammel net catches were dominated by the same five species both years, although their order of abundance varied. These species were yellow perch, bullhead spp., Tui chub, blue chub, and crappie spp. (Figure 3.7-17 and Table 3.7-33). These dominant species represent a relatively broad range of water temperature preferences and pollution tolerances, varying from warm/tolerant for bullhead and crappie spp., cool/tolerant for tui chub and blue chub, to cool/intolerant for yellow perch. Other species of interest captured by trammel net in Iron Gate reservoir over the 2-year period included eight redband/ rainbow trout, 13 endangered Lost River sucker, and 12 largemouth bass. Shortnose sucker and Lost River sucker were not collected in this reservoir during the 2-year study (Table 3.7-33).

Catches in trap nets, which targeted adults and juveniles, totaled 78 individuals and six taxa in 1998 (56 hours of sampling) and 543 individuals and 10 taxa in 1999 (206 hours of sampling) (Table 3.7-33). Dominant species were very similar between years. They were bullhead spp. yellow perch, crappie spp. and, in 1999, pumpkinseed (Figure 3.7-18). All of these species are introduced game fish with a warm water or cool water thermal preference. Very few individuals of any other species were collected by trap net in Iron Gate reservoir during 1998 or 1999 (Table 3.7-33).

Beach seine hauls, which targeted juveniles, collected 474 individuals and nine taxa in 1998 (13 hauls) and 206 individuals and seven taxa in 1999 (13 hauls) (Table 3.7-33). Catches were dominated by warm water and cool water game fish, including largemouth bass, pumpkinseed, crappie spp., sunfish spp. and yellow perch, and by one nongame species, golden shiner. Largemouth bass was the most abundant species captured in 1998, while pumpkinseed was the most abundant species captured in 1999 (Figure 3.7-19). Except for two native redband/rainbow trout captured in 1999, all fish collected by beach seine in Iron Gate reservoir during the 2-year study are introduced species.

The remaining three gear types that were used to sample Iron Gate reservoir (larval trawl, dip net, and larval drift net) targeted larval and juvenile fish. There was some similarity in the most abundant taxa collected among gears, although the total catch and species composition varied. Catches by larval trawl totaled 1,563 individuals and 10 taxa in 1998 (17 pulls) and 386 individuals and nine taxa in 1999 (27 pulls). Dip net catches totaled 2,995 individuals and three taxa in 1998 (6 hauls) and 16,740 individuals and 11 taxa in 1999 (25 hauls). Larval drift net catches totaled 133 individuals and seven taxa in 1998 (44 hours of sampling) and 1,318 individuals and eight taxa in 1999 (87 hours of sampling) (Table 3.7-33). Dominant species collected by year and gear type included chub spp. (1998) and golden shiner (1999) by larval trawl (Figure 3.7-21); Tui chub (1998) and golden shiner (1999) by dip net (Figure 3.7-21); and sculpin spp. (1998) and yellow perch (1999) by larval drift net. Six redband/rainbow trout were collected by larval trawl and 16 redband/rainbow trout were collected by dip net during the 2-year study (Table 3.7-33).

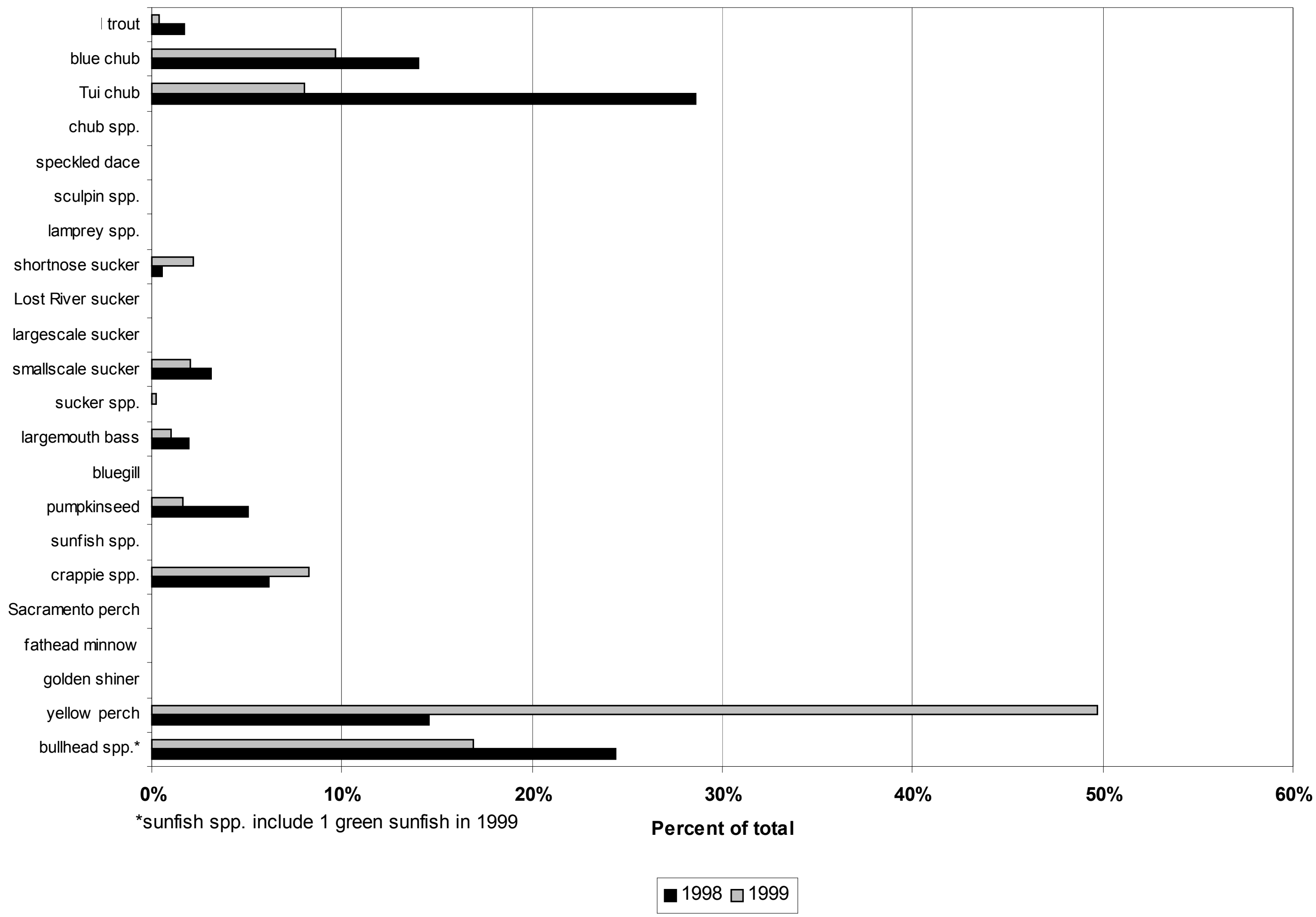

Figure 3.7-17. Iron Gate reservoir relative species abundance (1998–1999 OSU)—trammel net.

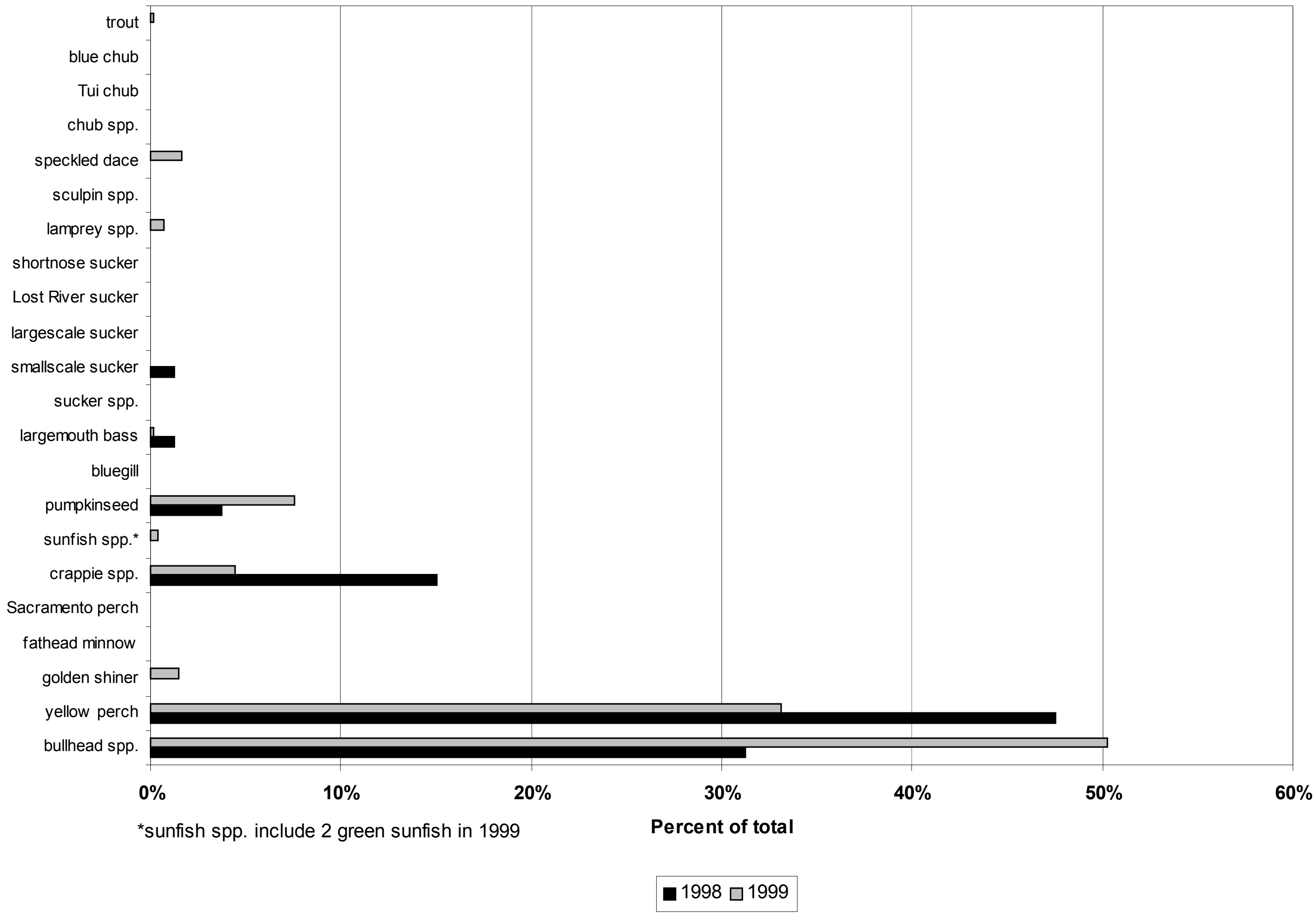

Figure 3.7-18. Iron Gate reservoir relative species abundance (1998–1999 OSU)—trap net.

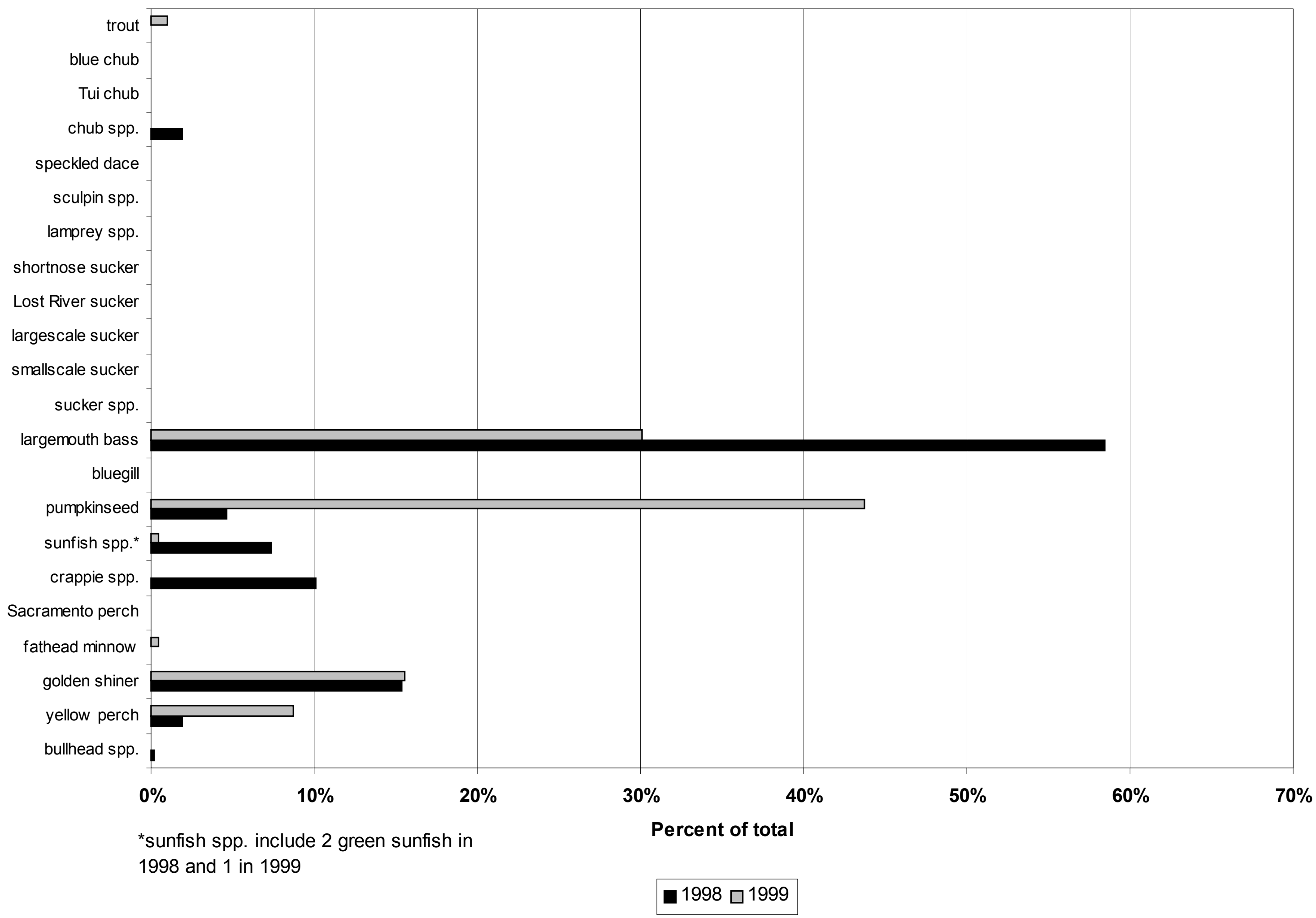

Figure 3.7-19. Iron Gate reservoir relative species abundance (1998–1999 OSU)—seine.

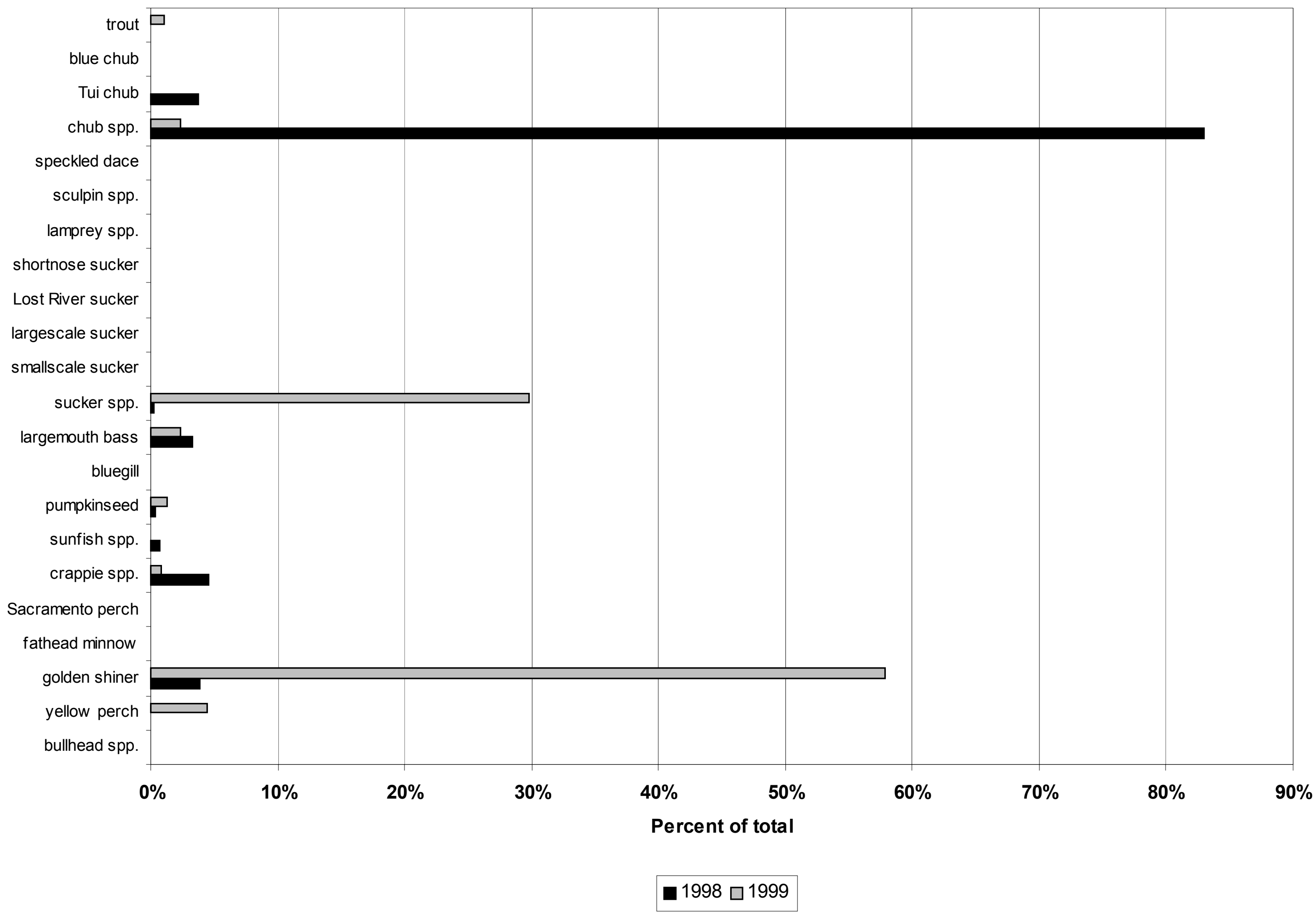

Figure 3.7-20. Iron Gate reservoir relative species abundance (1998–1999 OSU)—trawl.

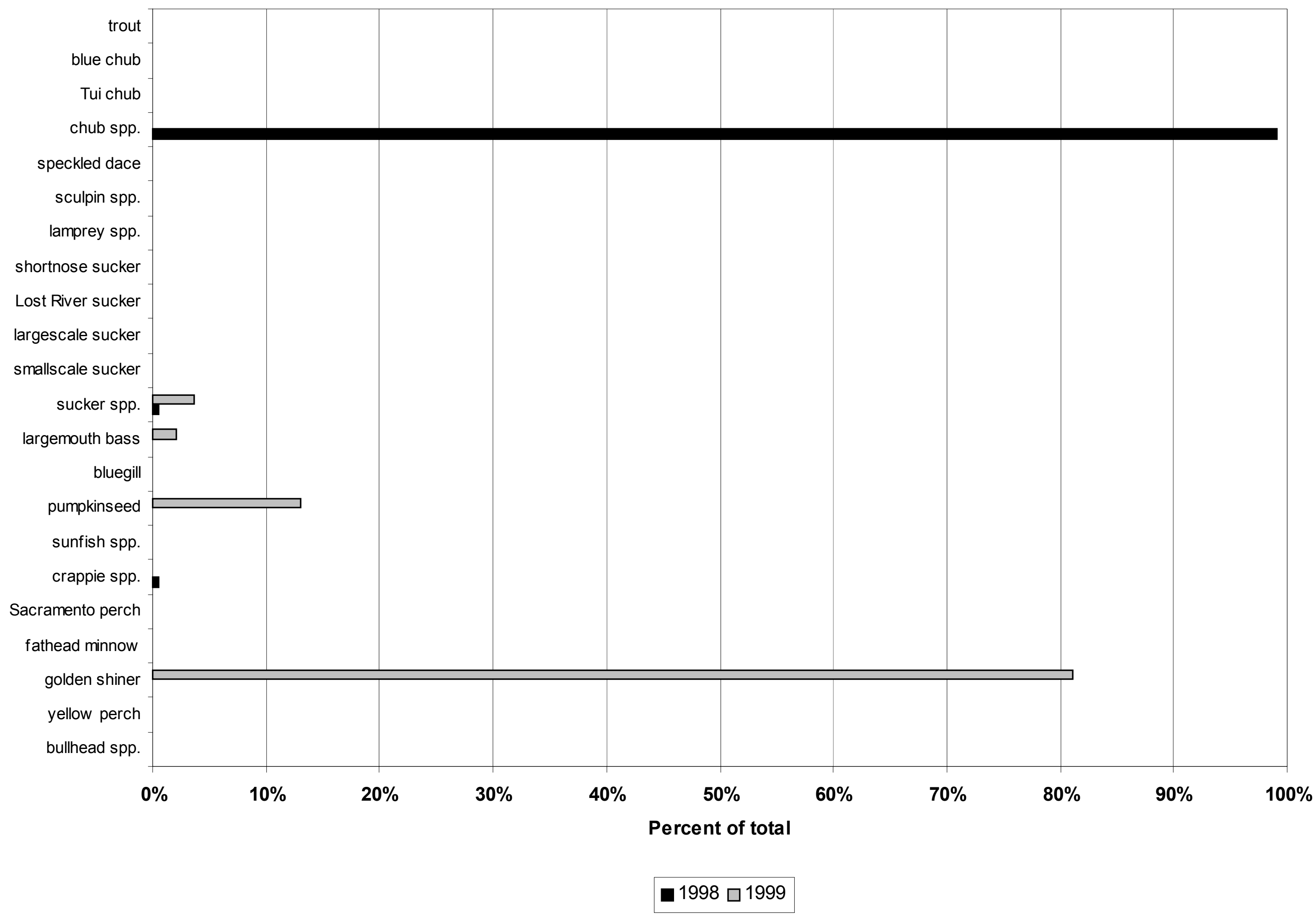

Figure 3.7-21. Iron Gate reservoir relative species abundance (1998–1999 OSU)—dip net.

Hydroacustic techniques were also used to characterize the deep water fisheries of Iron Gate reservoir. These results were presented in the Copco reservoir section and the Hydroacoustic Technical Report is included in Appendix 3E.

Iron Gate Reservoir Discussion

Gear types used by OSU in 1998 and 1999 to sample adult, juvenile, and larval fish sizes and life stages in Iron Gate reservoir provide information on the fish community in that water body. Dominant taxa collected over the 2-year study period consisted primarily of introduced species, many of which are game fish (e.g., largemouth bass, yellow perch, crappie spp., and pumpkinseed). However, some of the most abundant taxa collected in Iron Gate reservoir, such as Tui chub, chub spp., and sucker spp., are native species.

Dominant species collected in Iron Gate reservoir during 1998 and 1999 represented a mix of native and introduced, warm water and cool water, and pollution-tolerant and pollution-intolerant taxa, the same as noted for Copco No. 1 and J.C. Boyle reservoirs. Yellow perch continued to be abundant in the catch, but less so than upstream in Copco No. 1 reservoir. Several other game species, such as largemouth bass and pumpkinseed, appeared to be somewhat more abundant than in upstream reservoirs, perhaps compensating for comparatively fewer numbers of yellow perch. Fathead minnow were very uncommon in the catch in Iron Gate reservoir (three individuals captured), the same as in Copco No. 1 reservoir, and may indicate predation effects on this species by numerous game fishes.

Results of previous fisheries investigations in Iron Gate reservoir are discussed in Section 2.0. That section included a brief summary discussion and comparison of results of the 1998/1999 fisheries studies by OSU with results of reservoir studies conducted 10 years earlier by CDFG. In those earlier studies, introduced species consisting primarily of warm water and cool water game fish accounted for 96 percent of the total catch. Yellow perch was the dominant species collected by CDFG in 1988, comprising 53 percent of the total catch. That discussion also noted that non-native warm water game species account for an increasingly greater proportion of the catch proceeding downstream among the Klamath River reservoirs. Non-native species accounted for 77 percent of the adult fish collected in Iron Gate reservoir during 1998 and 1999. Catch data indicate that redband/ rainbow trout are present but not commonly collected in Iron Gate reservoir (Desjardins and Markle, 2000).

The endangered shortnose and Lost River suckers made up only 1 percent of the total adult catch in Iron Gate reservoir during 1998 and 1999 (versus 13 percent in Copco No. 1 reservoir), and all endangered suckers collected during the study were either adults or larvae. The lack of sucker juveniles in Iron Gate reservoir suggests little recruitment is occurring, the same as noted for Copco No. 1 reservoir. This may reflect the presence of predators (for example, yellow perch, largemouth bass, and crappie) and the reservoir’s lack of rearing habitat for larval and juvenile suckers (Desjardins and Markle, 2000).

Other aspects of Iron Gate reservoir, including its popularity as a recreational fishery for yellow perch and as the site of largemouth bass tournaments during the summer, are discussed in Section 2.0.

Deep-Water Copco and Iron Gate Reservoirs

In 2003, PacifiCorp sampled deep-water areas of Copco and Iron Gate reservoirs with hydroacoustics and vertical gill nets to characterize the open water fish community and assess vertical distribution of fish relative to stratification and water quality conditions. The study plan for this task calls for additional sampling in the spring 2004. Below is a brief summary of the study effort conducted in 2003. A complete interim report for 2003 is included as Appendix 3E . A final report will be prepared following the analysis of the spring 2004 sampling data.

Hydroacoustic techniques were used together with traditional netting to assess the general attributes of the deep-water fisheries in Copco and Iron Gate reservoirs as part of the relicensing activities for the Project. The study design calls for sampling both impoundments in August and October 2003 and April 2004. The interim analysis presented in this section summarizes the initial findings from August 2003, with the understanding that a final report will be prepared following the completion of the third seasonal survey in 2004.

Each survey path consists of transects 150 m apart to provide adequate spatial representation of the fish populations while also minimizing the incidence of multiple acquisition of targets. For each reservoir, a prescribed path was developed over the areas of the impoundments greater than 5 m deep. Two daytime surveys and one nighttime survey were conducted over each survey path during the investigation. Gas bubbles were abundant in the deeper areas of both impoundments during the August survey, but were generally easy to distinguish from the fish targets based on target strength. The results from the August survey indicate that the vast majority of fish targets were above the thermoclines in both impoundments. This is consistent with anoxia present in the hypolimnions of both impoundments. Fish abundance along the survey paths was similar between day and night runs. Fish netting conducted in the pelagic zone concurrently with the hydroacoustic activities showed that most of the targets were yellow perch.

3.7.3 2003 Reservoir Studies Results and Discussion

This text to be added at a later date.