Rocky Reach Fish Presence and Habitat Use Survey
Rocky Reach Hydroelectric Project
FERC No. 2145

Working Draft

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DRAFT
CHELAN COUNTY PUBLIC UTILITY DISTRICT
ROCKY REACH FISH PRESENCE AND HABITAT USE SURVEY

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SECTION 1: INTRODUCTION

1.1 General Description of the Relicensing Process

The Public Utility District No. 1 of Chelan County (hereinafter called Chelan PUD) owns and operates the Rocky Reach Hydroelectric Project (Project). Chelan PUD is permitted to operate the Project according to terms and conditions contained in an existing Federal Energy Regulatory Commission (FERC) license, No. 2145, that was issued on July 12, 1956. On September 1, 1966, the Chelan PUD filed an application with the Federal Power Commission (FPC) to amend the Project license for the addition of four generating units. The FPC, later FERC, issued the license amendment on May 23, 1968. The existing license expires on June 30, 2006.

Chelan PUD intends to seek a new federal license to operate the Rocky Reach Project and has begun the process referred to as "relicensing." The FERC relicensing process is based on laws and regulations that require years of extensive planning, including environmental studies, agency consensus and public involvement. The process to obtain a new license has changed considerably since the existing license was issued in 1956. The Federal Power Act (FPA) was amended in 1986 by the Electric Consumers Protection Act (ECPA). The amendment requires the FERC, in addition to power and development purposes, to give equal consideration to the purposes of enhancement of fish and wildlife, the protection of recreational opportunities, and the preservation of other aspects of environmental quality.

1.2 General Description of the Rocky Reach Region

The Rocky Reach hydroelectric project is located at river mile (RM) 473.7 on the Columbia River. This is downstream of Wells Dam and upstream from Rock Island Dam. It is the second project downstream in a series of five hydropower projects owned by Chelan, Douglas and Grant County Public Utility Districts (PUD's) between RM 515.1 and RM 397.1 on the mainstem Columbia River. Rocky Reach Dam consists of 11 generating units, producing a total peak capacity of approximately 1,287 megawatts of power, and 12 gated spillway openings. The hydraulic capacity of the Rocky Reach powerhouse is 217,000 cfs (Chelan PUD 1991a).

Hydropower projects in the Columbia River basin fall into two major categories: storage and run-of-river. The difference between the two categories helps to explain the amount and timing of flow in the Columbia River. Storage projects such as Grand Coulee Dam have a large usable storage space and are operated to alternately store and release water for flood control, power generation, irrigation, fish migration and other needs. They have a large operating range (the difference in elevation between minimum and maximum pool), draft and store large volumes of water, and shape downstream flows. Rocky Reach, as a run-of-river project, has little pondage and no usable storage volume. The project has a small operating range and must pass inflow most of the time. However, project discharges are shaped to meet power demands, which are significantly higher during daylight (heavy-load) hours than during nighttime (light-load) hours. As a result, flow patterns in the mid-Columbia River are primarily shaped by the operations at the Canadian and Federal storage projects upstream, particularly Grand

Coulee Dam. The releases from Grand Coulee Dam and regulation by Chief Joseph Dam affect the magnitude and timing of flows at Rocky Reach Dam.

The Columbia River and its tributaries drain an area of 219,000 square miles in seven western states and 39,500 square miles in British Columbia. The Columbia River originates at Columbia Lake on the west slope of Rocky Mountain Range in British Columbia and flows west and south, eventually draining into the Pacific Ocean between Washington and Oregon. Total river length is 1,214 miles (Bonneville Power Administration [BPA] et al. 1994a). Rocky Reach reservoir extends approximately 41 miles upstream to the tailrace of Wells Dam. Rocky Reach reservoir has a surface area of 8,167 acres, a volume of 431,500 acre-feet, a mean depth of 42 feet and a shoreline length of approximately 93 miles. The Entiat River is the primary tributary flowing into the reservoir.

Vegetation in the mid-Columbia region consists mainly of steppe and shrub-steppe vegetation, and forest vegetation is generally confined to mountain slopes with sufficient precipitation (Franklin and Dyrness 1984). Much of the area has been cultivated with a variety of crops or is grazed by domestic and wild livestock. Irrigated cropland and orchards dominate the river corridor around the Rocky Reach project and reservoir. Natural vegetation communities in the plan area consist of a shrub layer dominated by artemesia (*Artemesia tridentata*) along with a variety of perennial grasses. Moister sites, such as areas along streams or rivers, may be inhabited by Hawthorn/ snowberry (*Crataegus douglasii/Symphoricarpos albus*) and hawthorn/cow parsnip (*Crategus douglasii/Heracleum lanatum*). Other habitats with distinct vegetation communities include those with gravelly or sandy soils, shallow, stony sites; and sand dunes near the Columbia River (Franklin and Dyrness 1984).

Located in the rain shadow of the Cascade Range, the mid-Columbia region is classified as arid to semi-arid and experiences low precipitation, dry summers, with warm to hot temperatures, and relatively cold winters. Some marine influences are still felt, but continental-type climate conditions prevail. Most of the Columbia basin receives less than 20 inches of precipitation annually, with much of this precipitation occurring in winter. Deep snow may accumulate over the mountainous areas, where water is held as natural storage until the runoff in the spring.

Upper Columbia steelhead (*Oncorhynchus mykiss*) were listed as endangered by the National Marine Fisheries Service (NMFS) on August 18, 1997 [62 FR 43937]. Upper Columbia bull trout (*Salvelinus confluentus*) were listed as threatened on June 10, 1998 [63 FR 31647 31674]. Upper Columbia spring chinook upstream of Rock Island Dam and downstream of Chief Joseph Dam, excluding the Okanogan River, were listed as threatened on August 2, 1999 [64 FR 41835 41839]. No other aquatic plant or animal species in the mid-Columbia River reach is currently listed as threatened or endangered under either the ESA or Washington State laws or regulations. Summer/fall chinook salmon in the mid-Columbia River were petitioned for listing in 1993. The listing was found to be not warranted by the NMFS in 1994 and reaffirmed March 9, 1998, [63 FR 11482]. NMFS has determined that listing of the two sockeye ESUs in the mid-Columbia are also not warranted. The listing of any of these species could substantially affect operation of the Rocky Reach and other hydropower facilities throughout the basin.

1.3 General Description of the Rocky Reach Project

The Rocky Reach Hydroelectric Project consists of a 130-foot-high gravity dam at RM 473.7, twelve, 50-foot-wide spillway gates, powerhouse, non-overflow structures, power transmission facilities, fish passage system and visitor's center. The powerhouse contains 11 generating units. The first seven generating units began producing power in 1961. In 1968, the Federal Power Commission (FPC, later Federal Energy Regulatory Commission, FERC) issued a license amendment for the addition of four generating units, which increased the power plant's generating capacity to 1,287 megawatts (MW).

The reservoir formed by Rocky Reach Dam, also known as Lake Entiat, extends upstream approximately 41 miles, past the Lake Chelan Hydroelectric Project (FERC No. 637) to Douglas County PUD's Wells Dam (FERC No. 2149). Elevations of Lake Entiat establish the tailwater levels for the Lake Chelan and Wells Projects. Generally, depths are the greatest at the southernmost portion of the reservoir (Rocky Reach forebag) and is shallowest in the northernmost part (Wells Dam tailrace), where conditions are more riverine.

SECTION 2: STUDY GOALS

Currently, there is no locally-collected information available regarding habitat use by either rearing salmon or rearing or spawning resident fish species within the Rocky Reach Reservoir. The Chelan PUD intends to evaluate the project reservoir for existing fish presence and habitat use. The specific goals and objectives of the Fish Presence and Habitat Use Survey are to: 1) determine the presence/absence, habitat utilization, life stage and season of use for the principal habitat types found in the Project area; 2) determine habitat use by species; and 3) in combination with the Aquatic Habitat Survey data, predict habitat use and production of fish in other areas of the reservoir.

SECTION 3: STUDY AREA

The study area encompasses the entire Rocky Reach Hydroelectric Project boundary. The project extends from River Mile (RM) 473.5 to RM 515.1 of the Columbia River (the reach from Rocky Reach Dam to Wells Dam) as defined at the normal pool elevation of 707 feet above Mean Sea Level (MSL). Figure 3.0-1 shows the Rocky Reach Project and its reservoir, Lake Entiat.

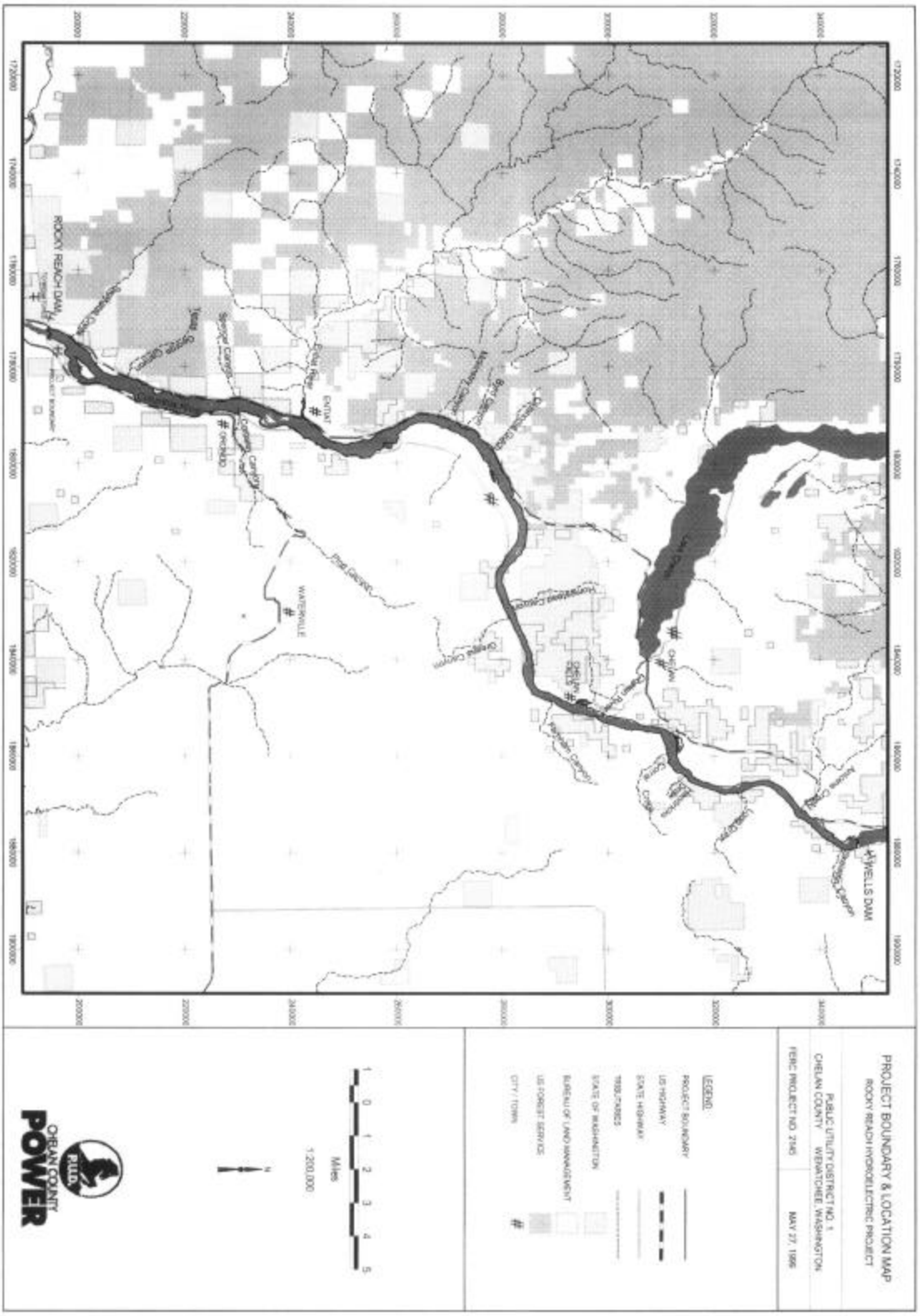
PROJECT BOUNDARY & LOCATION MAP
ROCKY REACH HYDROELECTRIC PROJECT
PUBLIC UTILITY DISTRICT NO. 1
CHELAN COUNTY WENATCHEE, WASHINGTON
FERC PROJECT NO. 2145
MAY 27, 1998
LEGEND
PROJECT BOUNDARY
US HIGHWAY
STATE HIGHWAY
TRIBAL LANDS
STATE OF WASHINGTON
BUREAU OF LAND MANAGEMENT
US FOREST SERVICE
CITY / TOWN
Miles
1:250,000
CHELAN COUNTY PUD
POWER
ROCKY REACH DAM
WELLS DAM
WATERVILLE
CHELAN
ENTIAT
ORONDO

Figure 3.0-1 Rocky Reach Study Area

SECTION 4: METHODS

As called for in the Final Rocky Reach Fish Presence and Habitat Use Survey Study Plan (produced by the Public Utility District No. 1 of Chelan County) dated October 15, 1999, the Rearing and Habitat Use Survey was designed to ground-truth the physical reservoir characteristics in terms of potential fish habitat and production in the reservoir. This study has been conducted in concert with the Aquatic Habitat Mapping Survey. Data collected by the Aquatic Habitat Team was used to identify potential rearing and spawning locations within the Project area. Information regarding habitat utilization is being compiled and provided to the Aquatic Habitat Mapping Team to document those habitats currently in use by the target species/life stages and to identify potential use of similar habitat types in the Project area.

This survey consisted of two simultaneous efforts in the Rocky Reach area: 1) determining the presence and absence of anadromous and resident fishes; and 2) determining the habitat utilization for anadromous and resident fishes. Additionally, DE&S was contracted to evaluate the spawning timing and habitat requirements for resident fish in Rocky Reach Reservoir. For anadromous fish, surveys are covered under the Mid-Columbia Habitat Conservation Plan. Please see the August 13, 1999 meeting minutes from the Fisheries Working Group for additional details.

4.1 Fish Collections

4.1.1 Sampling Schedule and Site Locations

To obtain seasonal information on fish presence, relative density, abundance, distribution, and habitat utilization, a descriptive inventory of fish populations was conducted during each of three sampling sessions (fall, spring, and summer). Sampling for the fall session was conducted from October 19 to October 30, 1999. Spring sampling occurred from May 19 to May 25, 2000 and the summer session sampling was conducted from August 9 to August 17, 2000.

Fish collection activities were conducted at a variety of locations within each of three major regions of Rocky Reach Reservoir between Rocky Reach Dam and Wells Dam. Results of the Aquatic Habitat mapping effort were used to help identify sampling area. The lower section (RRL) of the reservoir represented deep, slow-water habitat typically found near the forebay of dams. The upper section (RRU) had more riverine characteristics, with higher velocities and generally well-armored banks with bedrock, cobble, and sandy soil shorelines. This section included the Wells Dam tailrace. The middle section (RRM) of the reservoir represented a transition zone between the predominantly slower moving, deeper habitat in the lower section and the riverine habitat in the upper section. The middle section includes the confluences of the Entiat and Chelan rivers. Locations of these three sections of Rocky Reach Reservoir are shown in Figure 4.1-1. There is little irrigation in the reach, so there is little riparian habitat.

Within each section of the reservoir, fish sampling was done with fyke nets, Gee minnow traps, beach seining, angling, and snorkel surveys. Sampling in the lower section was conducted at one angling site, five beach seine sites, five Gee minnow trap sites, five snorkel surveys, and one fyke net site. In the middle section, there were three angling sites, five beach seine sites, nine Gee minnow trap sites, nine snorkel surveys, and one fyke net site. Sampling within the upper section of the reservoir included three angling sites, five beach seine sites, six Gee minnow trap sites, six snorkel surveys, and one fyke net site. All sampling sites, and their locations, are listed in Table 4.1 and are also shown on Figure 4.1-1.

4.1.2 Fish Capture and Observation Methods

Fyke Nets

Fyke nets were used to capture fish moving along shoreline areas. A fyke net set consisted of two fyke net traps attached side by side, with the trap openings facing the shore. A block net made of panels of seine mesh, with lead line and float line, was set perpendicular to the shoreline and extended from shore out to the attachment point between the two traps. Wing nets, made of the same material as the block net, were attached to the side of each trap and set parallel to the shoreline. With this arrangement, one fyke trap captured fish on the downstream side of the block net and the other captured fish on the upstream side of the block net. Where possible, fyke nets were set at depths slightly less than the height of the trap opening (1.7 m).

The fyke net traps had entrances measuring 1.8 m wide and 1.7 m high, leading to a series of four smaller compartments. Each compartment had a small tapered entrance designed to allow fish to move into the next section, and to inhibit fish from returning. The traps were constructed of net material with a 1 cm (stretched measure) mesh size. Wing nets were 14 m long and 2 m deep, with a 2 cm (stretched measure) mesh size. Block nets also had a 2 cm mesh size, and the length was variable, depending upon distance from shore to the fyke traps.

In all cases, fyke nets were set for two days and were checked at approximately 24-hour intervals. Catch-per-unit-effort was calculated as the number of fish captured per 24 hours.

Beach Seining

Beach seining was used to capture fish in shallow (less than 1 m deep) shoreline areas. Use of this sampling method was limited to gently sloping shoreline areas that were relatively unobstructed by debris or large substrate material. The beach seine used was 8 m long and 1.5 m deep, with a mesh size of 0.2 cm. Length and width of the area seined was estimated and the CPUE was calculated as the number of fish captured per 100 ft^2.

Gee Minnow Traps

Gee minnow traps were used to sample a variety of shoreline habitat types, including areas that could not be effectively sampled by beach seining (e.g., areas with steep banks or large uneven substrates).

Gee traps were set in pairs at each sampling site for two consecutive periods of approximately 24 hours each. Traps were baited with dog food and cheese. The CPUE for Gee minnow traps was calculated as number of fish per 24 trap-hours.

Snorkel Surveys

Snorkel surveys were conducted to observe fish along shoreline areas in the vicinity of the Gee minnow trap sites. A crew member wearing a dry suit, snorkel, and mask floated along a transect approximately parallel to the shoreline and visually identified and counted the fish observed. The length of a snorkel survey transect was 100 m at all locations.

Angling

Angling was used as an additional sampling method, primarily as an attempt to capture fish that were not effectively sampled by the other collection methods used. Shore-based angling was done at some sites established for other sampling methods. During boat angling, the boat drifted mid-stream down the reservoir, enabling the crew to angle in offshore areas and deep water. Angling was done using casting rods, and with a variety of lures and cast-retrieve techniques. Angling effort was generally between 2 and 3 angler-hours at each site.

Life History Data Collection

Length and weight were recorded for all fish captured by fyke nets and for some fish captured by beach seining or Gee minnow traps. Fork lengths were measured to the nearest millimeter and weights were recorded to the nearest gram.

4.2 Habitat Assessment

Data collection of habitat variables associated with the sampled fish species and life stages occurred simultaneously with field efforts to characterize the fisheries assemblages for the Rocky Reach Project, using the techniques described below. A Trimble Pathfinder Pro XRS Differential GPS was used to geo-reference sampling sites and habitat types. All locations were recorded using state plan coordinates by the Trimble Pathfinder GPS unit. This GPS system, with independent satellite subscription, allowed us to record accurate locations in real-time without the need to post-process the data relative to a base station. Daily average flows were also obtained from Chelan PUD.

Substrate and cover parameters were recorded using WDFW substrate and cover codes (WDFW 1994 – Table 4.1-1). Substrate coding used the WDFW convention of *xy.z* where:

x = the dominant substrate
y = the subdominant substrate
z = the percentage of the dominant substrate as compared to the subdominant substrate.

For example, a substrate coded 36.8 would denote a dominant substrate of small gravel, the subdominant substrate of small cobble, with 80% of the two substrates being small gravel.

4.2.1 Nearshore, Shallow Habitat Types

When shallow, near-shore habitats were sampled, three transects were placed perpendicular to the shore through the sample area (i.e. beach seine sites). These transects were usually situated with one transect at the upstream end of the sampling site, one in the middle, with the final transect placed on the downstream portion of the site. Three measurements of depth and mean velocity taken at each transect: one shallow near the bank, one in the center of the transect, and one on the main channel portion of the transect. Mean column velocity was measured using a digital Swoffer current meter and USGS top-set wading rod. Substrate and cover were recorded at each sampling site using the WDFW substrate/cover codes and the convention listed in Table 4.2-1.

4.2.2 Deeper and Pelagic Habitats

When sampled habitats were deeper and more extensive, we used an Acoustic Doppler Current Profiler (ADCP), by RD Instruments, to determine depths and mean column velocities. The ADCP measures depths and velocities down to 100 ft and 55 ft, respectively, calculates real-time discharges, replicates discharge measurements within 2%; and measures velocity to +/- 0.033 ft/sec. The ADCP with Bottom Tracking accurately measures depth and velocity along a course while simultaneously indexing each measurement relative to the point of origin. The Bottom Tracking and depth stratification features make the instrument compatible with the transect method of measuring hydraulic variables and fish habitat availability. The water column was stratified into as many as 128 depth bins (depending upon the water depth being measured), which allowed for an examination of velocities within the water column.

In these deeper water situations, we employed a data collection system which interfaced the ADCP with the Trimble Pathfinder Pro XRS differential GPS receiver, and an underwater video camera. This system gave us the capability to simultaneously collect real-time, map-grade locations of fish habitat features. Location coordinates were stored in a Trimble TSC1 data logger and later exported to a computer for analysis and to create map products. Field methodologies are described below.

This system also was used to interface with the depth sounder, accurately recording depth and location when reservoir depth exceeded the capabilities of the ADCP.

If depth precluded visually identifying substrates and cover at the sampling site, we deployed a Fish Eye™ underwater camera with modified underwater lighting system mounted on a boom. A scale bar mounted in the viewing screen was used to determine the size of the substrates found along the transect.

In the office, we combined the ADCP data with PHABSIM 2.0, written by Thomas R. Payne &

Associates to measure, model and analyze fish habitat availability.

4.3 Salmonid Spawning Surveys

Surveys to identify resident salmonid spawning habitat and utilization were conducted in the fall of 1999 and the spring of 2000. The purpose of the surveys was to measure habitat parameters associated with fall and spring spawning salmonids, principally resident species. Areas of suitable spawning gravel were identified from data collected in the habitat characterizations surveys conducted in August 1999. These areas were targeted for observations of spawning salmonids. Initial observations of spawning areas were conducted by aerial surveys. The flights generally began below the Rocky Reach Dam and continued upstream towards Wells Dam. After spawning areas were identified, data collection was conducted from a boat. A remote underwater video camera was towed to locate spawning activity. Where redds were observed, GPS coordinates were recorded along with water depth, water velocity, and substrate measurements. Water depth and water velocity were measured with the ADCP and substrate was characterized visually from the video image. Substrate was characterized using the WDFW substrate codes and notation. Nose velocity and mean column velocity was calculated from the ADCP data. These data represent "point in time" measurements and would likely change with operations of Rocky Reach Dam, Wells Dam and the Columbia River system.

Surveys were conducted from the boat by slowly drifting downstream along transects selected along depth contours. The first transect was located at 5 ± 2 ft depth, the second at 10 ± 2 ft, the third at 15 ± 2 ft and, the fourth at 20 ± 2 ft. Additional transects were placed where redds were observed.

Table 4.1-1 Site locations for fish sampling conducted within Rocky Reach Reservoir during the 1999/2000 sampling season.

Reservoir Section[a]	Site Number	Site Location		Sampling Method[d]
		Bank[b]	Miles[c]	
RRL	AN1	RUB	474.6	AN
RRL	BS1	LUB	475.4	BS
RRL	BS2	RUB	475.9	BS
RRL	BS3	LUB	477.0	BS
RRL	BS4	LUB	475.6	BS
RRL	BS5	RUB	474.6	BS
RRL	GT1	LUB	474.4	GT
RRL	GT2	LUB	475.8	GT
RRL	GT3	RUB	475.8	GT
RRL	GT4	LUB	474.9	GT
RRL	GT5	RUB	475.0	GT
RRL	SS1	LUB	474.4	SS
RRL	SS2	LUB	475.8	SS
RRL	SS3	LUB	475.8	SS
RRL	SS4	LUB	474.9	SS
RRL	SS5	RUB	475.0	SS
RRL	FN1	LUB	475.4	FN
RRM	AN1	LUB	500.3	AN
RRM	AN2	MID	488.2	AN
RRM	AN3	MID	504.0	AN
RRM	BS1	LUB	483.8	BS
RRM	BS2	RUB	483.8	BS
RRM	BS3	RUB	486.6	BS
RRM	BS4	LUB	488.2	BS
RRM	BS5	LUB	500.2	BS
RRM	GT1	LUB	483.8	GT
RRM	GT2	RUB	483.8	GT
RRM	GT3	RUB	486.6	GT
RRM	GT4	LUB	488.2	GT
RRM	GT5	LUB	500.3	GT
RRM	GT6	RUB	504.0	GT
RRM	GT7	LUB	504.0	GT
RRM	GT8	LUB	503.7	GT
RRM	GT9	RUB	503.6	GT

[a] Rocky Reach section: RRL = lower, RRM = middle, RRU = upper

[b] Bank: LUB = left bank (facing upstream), RUB = right bank (facing upstream), MID = midstream

[c] Distance measured from the mouth of the Columbia River

[d] Sampling method: AN = angling, BS = beach seine, GT = Gee minnow trap, SS = snorkel survey, FN = fyke net

Table 4.1-1 Site locations for fish sampling conducted within Rocky Reach Reservoir during the 1999/2000 sampling season.

Reservoir Section[a]	Site Number	Site Location		Sampling Method[d]
		Bank[b]	Miles[c]	
RRM	SS1	LUB	483.8	SS
RRM	SS2	RUB	483.8	SS
RRM	SS3	RUB	486.6	SS
RRM	SS4	LUB	488.2	SS
RRM	SS5	LUB	500.3	SS
RRM	SS6	RUB	504.0	SS
RRM	SS7	LUB	504.0	SS
RRM	SS8	LUB	503.7	SS
RRM	SS9	RUB	503.6	SS
RRM	FN1	LUB	483.8	FN
RRU	AN1	RUB	510.6	AN
RRU	AN2	MID	506.8	AN
RRU	AN3	MID	515.3	AN
RRU	BS1	LUB	514.4	BS
RRU	BS2	RUB	513.4	BS
RRU	BS3	RUB	509.7	BS
RRU	BS4	RUB	508.1	BS
RRU	BS5	LUB	506.8	BS
RRU	GT1	LUB	514.4	GT
RRU	GT2	LUB	513.5	GT
RRU	GT3	RUB	513.5	GT
RRU	GT4	RUB	508.1	GT
RRU	GT5	LUB	506.8	GT
RRU	GT6	LUB	504.5	GT
RRU	SS1	LUB	514.4	SS
RRU	SS2	LUB	513.5	SS
RRU	SS3	RUB	513.5	SS
RRU	SS4	RUB	508.1	SS
RRU	SS5	LUB	506.8	SS
RRU	SS6	LUB	504.5	SS
RRU	FN1	RUB	509.7	FN

[a] Rocky Reach section: RRL = lower, RRM = middle, RRU = upper

[b] Bank: LUB = left bank (facing upstream), RUB = right bank (facing upstream), MID = midstream

[c] Distance measured from the mouth of the Columbia River

[d] Sampling method: AN = angling, BS = beach seine, GT = Gee minnow trap, SS = snorkel survey, FN = fyke net

Table 4.2-1 WDFW substrate and cover codes (1994)

Substrate				Cover	
Code	**Description**	**Mm**	**Inches**	**Code**	**Description**
0	Organic Detritus	*a*	*a*	0.0	Organic Substrate
1	Silt, Clay	<2	< 0.1	0.1	Undercut Bank
2	Sand	<2	< 0.1	0.2	Overhanging Vegetation
3	Small Gravel	2 – 12	0.1 – 0.5	0.3	Root Wad
4	Medium Gravel	12- 38	0.5 – 1.5	0.4	Log Jam
5	Large Gravel	38 – 76	1.5 - 3.0	0.5	Single Log Parallel to Bank
6	Small Cobble	76- 152	3.0 – 6.0	0.6	Submerged Vegetation
7	Large Cobble	152 – 306	6.0 – 12.0	0.7	Submerged Terrestrial Grass
8	Boulder	> 305	> 12.0	0.8	Overhead Cover
9	Bedrock			0.9	Fine Organic Substrate

a Material smaller than that which will provide cover

[1] *By convention: if b=substrate code then bb.9 denotes substrate is exclusively that type*

Figure 4.1-1 Site Location

SECTION 5: RESULTS

5.1 Inventory Of Fish Populations

5.1.1 Species Composition

The fish resources of Rocky Reach Reservoir include native resident species, introduced resident species, and some anadromous species. The native resident fish species include white sturgeon, mountain whitefish, rainbow trout, bull trout, northern pikeminnow, peamouth, chiselmouth, largescale sucker, bridgelip sucker, redside shiner, sculpins, and threespine stickleback. Commonly occurring introduced resident species include carp, tench, largemouth bass, smallmouth bass, pumpkinseed, walleye, yellow perch, and black bullhead (Chelan PUD 1991c). Anadromous salmonids present in the Rocky Reach area include spring, summer, and fall chinook salmon, sockeye salmon, and summer steelhead. Pacific lamprey is a non-salmonid anadromous fish species that is also present in the area. There are 37 species of fish, representing 12 families, that are either known to occur or thought to occur in Rocky Reach Reservoir (Table 5.1-1).

Of the 37 species of fish believed to occur in Rocky Reach Reservoir, 20 species were captured or observed during the 1999-2000 investigations (Table 5.1-1). These included three salmonids (chinook salmon, rainbow trout, and mountain whitefish) as well as walleye, largemouth bass, smallmouth bass, and bluegill. Two sucker species (largescale sucker and longnose sucker), two sculpin species (prickly sculpin and torrent sculpin), and threespine stickleback were also recorded. Cyprinid species recorded during the 1999-2000 studies included carp, northern pikeminnow, redside shiner, chiselmouth, peamouth, tench, longnose dace, and speckled dace.

The species composition of fish captured or observed by the different sampling methods during the 1999-2000 investigations is presented in Table 5.2. Data included in this table are for all reservoir sections and all sampling sessions combined. Angling is not included as one of the sampling methods because angling did not result in any fish captures during these investigations. In total, 72,558 fish were captured or observed and, of these, 26,027 fish (35.87%) were unidentified fry recorded during the August sampling session. These unidentified fry were primarily cyprinids and catostomids. The next most abundant fish was the threespine stickleback, which contributed 33.24% to the total catch by all sampling methods. Northern pikeminnow, redside shiner, chiselmouth, peamouth, tench, and sculpins contributed 13.25%, 8.17%, 1.33%, 0.20%, 0.03%, and 0.02%, respectively, to the total catch. Sucker spp. contributed 6.42% to the total catch by all sampling methods. This included a number of suckers that could not be identified to species. This group of unidentified suckers included sucker fry, captured primarily by beach seining, as well as unidentified juvenile and adult suckers that were observed during snorkel surveys. Of the suckers that could be identified, largescale sucker contributed 0.55% and longnose sucker contributed 0.02% to the total catch. One dead bridgelip sucker was observed along the banks, but was not in a study area and therefore, was not included. Several smaller suckers, suspected in the field to be bridgelip suckers, were later identified in the laboratory as largescale suckers. Chinook salmon, rainbow trout, and mountain whitefish contributed 0.76%, 0.09%, and 0.01%, respectively, to the total catch. The other species recorded (walleye, largemouth bass,

smallmouth bass, bluegill, carp, longnose dace, and speckled dace) each contributed 0.01% or less to the total catch. No sandrollers were observed in the catch of any areas.

Fyke nets captured more species and a broader range of size classes than the other sampling methods. Fyke net catches were dominated by redside shiner, chiselmouth, and northern pikeminnow, which contributed 34.57%, 23.63%, and 18.31%, respectively, to the total catch by fyke nets. Other species represented in fyke net catches were, in order of decreasing abundance, threespine stickleback (9.58%), largescale sucker (4.78%), peamouth (3.57%), chinook salmon (3.40%), tench (0.54%), longnose sucker (0.44%), rainbow trout (0.32%), mountain whitefish (0.25%), sculpins (0.12%), speckled dace (0.07%), bluegill (0.07%), and walleye (0.02%).

The most abundant species in beach seine catches were northern pikeminnow, threespine stickleback, and redside shiner, which contributed 44.51%, 20.81%, and 7.30%, respectively, to the total catch by beach seines. Large numbers of unidentified fry, which were primarily cyprinids, were captured by beach seine and they contributed 19.27% to the total of all beach seine catches. Unidentified suckers contributed 7.64% to the total catch by beach seines. These were sucker fry, which could generally be distinguished from other species of fry but could not accurately be identified to species in the field. Chinook salmon contributed 0.29% to the total catch by beach seines, and a single largemouth bass was also captured, contributing 0.01% to the total catch. Other species captured by beach seines included largescale sucker (0.12%), chiselmouth (0.01%), tench (0.01%), longnose dace (0.02%), and prickly sculpin (0.02%).

Gee minnow traps captured fewer species of fish than did the other collection methods during the 1999-2000 investigations. The most abundant species was the threespine stickleback, which contributed 86.79% to the total catch by Gee traps. Northern pikeminnow, redside shiner, chiselmouth, and sculpins contributed 9.60%, 1.92%, 0.72%, and 0.72%, respectively, to the total catch by this method. One largescale sucker and one smallmouth bass also were captured by Gee minnow traps.

Fish observed during snorkel surveys were predominantly threespine stickleback, which contributed 38.70% to the total of fish observed, and unidentified fry, which contributed 45.27% to the total. Large numbers of unidentified fry were observed during the August sampling session, and these were primarily cyprinid and catostomid fry. Redside shiner contributed 6.44% and northern pikeminnow contributed 1.78% to the total observations. Suckers contributed 6.97% to the total and most of these (6.61% of the total of all species) were not identified to species. Suckers that were identified during snorkel surveys were all largescale suckers, and these contributed 0.36% to the total of all snorkel survey observations. Chinook salmon and rainbow trout contributed 0.72% and 0.10% to the total number of observations. Other species that were observed, in very low numbers, included six smallmouth bass, one carp, one chiselmouth, two peamouth, one tench, and one sculpin.

The species composition of fish captured or observed in each of the three sections of Rocky Reach Reservoir is presented in Table 5.1-3. Data included in this table are for all sampling methods and all sampling sessions combined. In the lower section of the reservoir, the most abundant species were northern pikeminnow, threespine stickleback, unidentified fry, and redside shiner; these contributed

32.61%, 27.14%, 19.78%, and 13.57%, respectively to the total number of fish of all species. Chiselmouth contributed 3.60% and peamouth contributed 0.57% to the total number of fish. Suckers recorded in the lower section of the reservoir included longnose sucker, largescale sucker, and sucker spp., and these contributed 0.07%, 0.75%, and 1.65%, respectively, to the total number of fish recorded. Chinook salmon and rainbow trout contributed 0.12% and 0.02%, respectively to the total number of fish recorded in the lower reservoir section. Tench and speckled dace, contributed 0.10% and 0.01%, respectively, to the total number of fish in the lower reservoir section. A single bluegill individual also was recorded in this section.

In the middle section of the reservoir, northern pikeminnow, redside shiner, chiselmouth, and peamouth all represented smaller proportions of the total number of fish (5.95%, 4.79%, 0.44%, and 0.02%, respectively) than did those species in the lower section of the reservoir. Tench also appeared to be less abundant in the middle section; only one individual was recorded. Threespine stickleback contributed a larger proportion (46.01%) to the total number of fish recorded in the middle section than in the lower section. Unidentified fry also contributed a larger proportion (40.62%) to the total number of fish recorded in the middle section. Suckers contributed a similar proportion to the total number of fish recorded in the middle section of the reservoir as they did in the lower section. In total, ten sculpins were recorded in the middle section of the reservoir, whereas sculpins were not recorded in the lower section. Chinook salmon and rainbow trout contributed 0.36% and 0.02%, respectively, to the total number of fish recorded in the middle section of the reservoir. Mountain whitefish were also recorded in the middle section of the reservoir, and contributed 0.03% to the total number of fish. Mountain whitefish were not recorded from either the lower or upper sections of the reservoir. Other fish recorded in the middle section of the reservoir, in low numbers, were one largemouth bass, seven smallmouth bass, one bluegill, one carp, and two longnose dace.

The most abundant fish species in the upper section of the reservoir were sucker spp. and unidentified fry, which contributed 32.71% and 49.89% to the total number of fish recorded. Most of the sucker spp. (3,047 of 3,766 fish) were suckers observed (i.e., not identified to species) while conducting snorkel surveys. Largescale sucker contributed 0.89% to the total number of fish recorded in the upper section of the reservoir. Northern pikeminnow, redside shiner, chiselmouth, and peamouth in the upper section of the reservoir contributed 1.78%, 9.57%, 0.14%, and 0.15%, respectively, to the total number of fish recorded. All of these species were less abundant in the upper section of the reservoir than they were in the lower section. Northern pikeminnow and chiselmouth also appeared to be less abundant in the upper section than in the lower section of the reservoir. Threespine stickleback were much less abundant in the upper section of the reservoir than in either the lower or middle sections, contributing 1.05% to the total number of fish recorded in the upper section. Chinook salmon and rainbow trout were more abundant in the upper section of the reservoir than in either the lower or middle sections, and contributed 3.32% and 0.43%, respectively, to the total number of fish recorded in the upper section. Other species recorded in low numbers in the upper section of the reservoir were one walleye, one bluegill, one tench, two longnose dace, and four sculpins. None of the rainbow trout captured in the traps was of a size (160-300mm) to be considered a steelhead.

5.1.2 Distribution and Relative Abundance

For the purpose of making comparisons of relative fish abundance among seasons and among reservoir sections, catch-per-unit-effort (CPUE) values were calculated for each fish species in each collection or observation at each sample site. The CPUE values were based on the duration of sampling (for fyke nets and Gee minnow traps), the area sampled (for beach seines), or the distance covered (for snorkel surveys). For fyke net sets, the CPUE was expressed as the number of fish per 24 hours and for Gee minnow traps as the number of fish per 24 trap-hours (there were usually two Gee traps at each site). Beach seine CPUE values were calculated as the number of fish per 100 ft^2 of seined area and snorkel survey values were calculated as the number of fish per 100 lineal ft of shoreline examined. The detailed results of all fish collections and observations, including numbers of fish and CPUE values for each sample site and each sampling session, are included in Appendix A. The detailed data for fyke nets are contained in Table A1 (numbers of fish) and A2 (CPUE values) of Appendix A. Data for beach seines, Gee minnow traps, and snorkel surveys are contained in Tables A3, A4, and A5, respectively, of Appendix A.

A summary of the fyke net catch and CPUE data is presented in Table 5.1-4. Catch-rates for chinook salmon ranged from 1.6 fish/24 h (in the upper reservoir section during the May session) to 54.9 fish/24 h (in the middle section during the August session). In the lower and upper sections of the reservoir, catch-rates for chinook salmon were highest during the May session, and in the middle section, they were highest during the August session. Catch-rates of rainbow trout were very low in all reservoir sections and during all sampling sessions. The CPUE for rainbow trout ranged from 0.0 fish/24 h to 2.2 fish/24 h. Mountain whitefish were present only in fyke net catches in the middle reservoir section during the August session, with a CPUE value of 5.4 fish/24 h.

Largescale suckers were present in fyke net catches from all three reservoir sections, but were most abundant in the lower section. CPUE values for largescale sucker ranged from 0.0 fish/24 h to 45.9 fish /24 h. In the lower and upper reservoir sections, catch-rates of largescale sucker were highest during the October session, and in the middle section, they were highest during the August session. Longnose suckers were present in low abundance in fyke net catches, and were captured primarily in the lower section of the reservoir.

Based on fyke net catches, northern pikeminnow, redside shiner, and chiselmouth exhibited similar patterns of distribution in the reservoir and seasonal variation in catch-rates. Catch-rates of all three species were generally highest in the lower reservoir section and were typically higher than catch-rates for other species. Catch rates of northern pikeminnow and chiselmouth were also lowest in the upper section of the reservoir. Redside shiner, however, exhibited catch-rates in the upper section, during October and May, that were similar to catch-rates in the lower section. In the middle section of the reservoir, catch-rates of all three species were much higher in the October and August sessions than during the May session. The maximum CPUE values for northern pikeminnow, redside shiner, and chiselmouth captured in fyke nets were 151.6, 163.8, and 229.8 fish/24 h, respectively. Peamouth were present in fyke net catches from all three reservoir sections but were most abundant in the lower section, where the maximum CPUE for this species was 60.3 fish/24 h. Tench occurred in low abundance (maximum CPUE of 5.0 fish/24 h) and were captured primarily in the lower reservoir section. Threespine stickleback were also most abundant in fyke net catches from the lower section of

the reservoir, where the maximum CPUE for this species was 138.3 fish/24 h. In the lower reservoir section, the catch-rate of threespine stickleback was considerably greater during the fall session than in either May or August. In the middle and upper reservoir sections, threespine stickleback were captured during the October and August sessions, but not in May.

The results of beach seine collections for all reservoir sections and sampling sessions are summarized in Table 5.1-5. Chinook salmon were captured by beach seine only in the middle and upper reservoir sections, and only during the May sampling session. The beach seine CPUE for this species was low, with a maximum value of 0.3 fish/100 ft^2. The catch-rates of northern pikeminnow were highly variable, and were typically greater than catch-rates of other species captured by beach seine; they ranged from 0.0 fish/100 ft^2 to 109.4 fish/100 ft^2. Catch-rates of northern pikeminnow were much higher during the August sampling session than in either October or May, and this species was most abundant in the lower and middle reservoir sections.

Redside shiner also occurred predominantly in the lower and middle reservoir sections and beach seine catch-rates were highest during the May and August Sessions. The maximum CPUE recorded for redside shiner captured by beach seine was 6.3 fish/100 ft^2. Threespine stickleback were captured by beach seine, during all seasons, at catch-rates up to 7.6 fish/100 ft^2. This species was captured primarily in the lower and middle reservoir sections, but was also present in low abundance in the upper section. During the August sampling session, large numbers of unidentified fry were captured by beach seine at many sites, particularly in the middle section of the reservoir, where the CPUE of unidentified fry was 61.0 fish/100 ft^2. These fish were primarily cyprinid fry that could not be readily identified in the field, but some small catostomid fry were likely also included in this category. The sucker spp. reported in Table 5.1-5 include fry and juveniles, captured by beach seine during the August session, that could be identified as suckers, but could not be identified to species. The CPUE for sucker spp. was similar in all three reservoir sections, and ranged from 5.6 to 8.9 fish/100 ft^2.

The data from Gee minnow trap collections for all sampling sessions and all reservoir sections are summarized in Table 5.1-6. These traps captured relatively few species consistently, and catch-rates were typically low for most species. The most abundant species in Gee trap catches was the threespine stickleback. Catch-rates for this species were as high as 10.6 fish/24 trap-hours. Gee trap catch-rates of threespine stickleback were highest in the lower section of the reservoir during the October and August sessions. During the May session, catch-rates of threespine stickleback were highest in the middle section of the reservoir. In the upper reservoir section, catch-rates of threespine stickleback were low during all sampling sessions. Northern pikeminnow were also captured by Gee minnow traps, predominantly in the lower and middle sections of the reservoir, where catch-rates ranged from 0.12 to 1.13 fish/24 trap-hours. Redside shiner and chiselmouth were captured in relatively low numbers by Gee minnow traps, and primarily in the middle section of the reservoir. The maximum CPUE values for redside shiner and chislemouth were 0.21 and 0.06 fish/24 trap-hours, respectively. Sculpins were also captured in low numbers by Gee traps (maximum CPUE was 0.10 fish/24 trap-hours) and only in the middle section of the reservoir.

Snorkel survey observations and CPUE values are summarized in Table 5.1-7 for all reservoir sections and sampling sessions. Chinook salmon were observed primarily during snorkel surveys conducted in the May sampling session, and the number observed were much higher in the upper section of the reservoir than in either the middle or lower sections. The snorkel survey CPUE for chinook salmon in the upper section during May was 17.6 fish/100 ft. Rainbow trout observed during snorkel surveys were also primarily in the upper reservoir section during the May session, when the CPUE was 1.5 fish/100 ft. Based on snorkel surveys, largescale sucker appeared to be distributed throughout the reservoir. The CPUE for largescale sucker was quite variable (from 0.0 to 2.8 fish/100 ft) and appeared to be slightly higher during the October session than in either May or August. During the August session, large numbers of sucker spp. were observed in snorkel surveys in the upper reservoir section (*n*=3047; CPUE=154.8 fish/100 ft) and, to a lesser extent, in the middle reservoir section (*n*=254; CPUE=8.6 fish/100 ft). Most of these suckers were fry or small juveniles that were observed in high densities at sites SS1 and SS6 in the upper reservoir section, but some unidentified adults were also included in these counts. Northern pikeminnow observed during snorkel surveys were most abundant in the lower section of the reservoir, where they were observed during October (CPUE=21.3 fish/100 ft) and August (CPUE=30.5 fish/100 ft) but not during the May session. Northern pikeminnow were also observed, at lower densities, in the middle reservoir section during August, but were not observed during snorkel surveys in the upper reservoir section. Redside shiners were observed during snorkel surveys in all reservoir sections, with CPUE values as high as 41.9 fish/100 ft. In general, redside shiner densities were highest in the lower and middle reservoir sections and were higher in August than in either October or May. Threespine stickleback observed during snorkel surveys occurred primarily in the lower and middle sections of the reservoir, where CPUE values up to 322.0 fish/100 ft were recorded. Few threespine stickleback were observed during snorkel surveys in the upper reservoir section. During the August sampling session, large numbers of unidentified fry were recorded in all reservoir sections while conducting snorkel surveys (CPUE from 250.0 to 436.9 fish/100 ft). These were primarily cyprinid fry, but some sucker fry were likely also included in these counts.

5.2 Habitat Assessment

Fish habitat measurements were taken at the same time as the fish sampling. Summaries of habitat parameters associated with different gear types are presented below. Habitat data were aggregated by a range of depths and velocities, as well as mean and standard deviation values, for each gear type. Depth and velocity values were then compared from one season to the next at each site, as well as among sites.

It is important to note that habitat measurements were taken during different seasons, at different flows (see Table 5.2-1). As a result, analysis is conducted on the utilization of habitat by fish, not by preference of habitat use by fish. Fish preference takes into account not only the utilization of habitat, but also its availability to the species and life stages of interest. Please refer to Appendices B and C for complete habitat analysis.

Please note that in the figure of habitat utilization in the Appendices, that frequency denotes

the number of measurements observed within that range. For example, if the frequency of depths for 2.0-2.1 feet was 16 for X species, that means 20 measurements of depth between 20 and 21 were taken in areas where this species of fish was captured.

5.2.1 Fyke Nets

Table 5.2-2 summarizes depths, mean column velocities, and predominant substrates found at the fyke net sites in Rocky Reach reservoir. Measurements were taken on 9 different occasions (3 times at three sites), and involved a total of 167 measurements. Depth measurements at the sites ranged from 0.4 ft to 8.4 ft, with a mean depth of 3.25 ft. Mean column velocities ranged from 0.00 ft/sec to 2.95 ft/sec, averaging 1.03 ft/sec.

Depths and mean column velocities were highest during the spring 2000 sampling season, with depths and mean column velocities fairly similar between the fall 1999 and summer 2000 sampling. This can be explained by examining the daily flows through Rocky Reach reservoir during sampling. Although highly variable among days, mean daily discharge averaged 91.3 kcfs in the fall 1999, which was similar to the summer 2000 mean daily discharge of 118.7 kcfs. The spring 2000 sampling period, averaged 140.5 kcfs.

The predominant substrates found at the fyke net sampling sites were sand, large cobble and boulder (Table 5.2-3). The gradient of substrates generally progressed from sand and silt near shore, where velocities were less, to larger substrates farther from shore where the velocities were higher.

5.2.2 Gee Minnow Traps

Twenty Gee minnow sites were sampled throughout the three major reaches in the reservoir. A total of 167 depth and mean column velocity measurements were taken (Table 5.2-4). In general the traps were placed in areas near shorelines with steep banks resulting in deepwater areas where velocities were relatively slow. Depth of sampled areas ranged up to 47 ft. while mean column velocities extended from 0.00 ft/sec to 4.12 ft/sec. Mean column velocities, however, averaged 0.83 ft/sec (Table 5.2-5). Depths and mean column velocities were slightly higher during the spring 2000 sampling period due to the higher flows during this time.

Gee minnow traps were set at a variety of sites; as a result, substrate types were also well represented. The most commonly associated habitat type was boulder, followed closely by large cobble (Table 5.2-6). Typically the Gee minnow sites were set off of rocky bluffs.

5.2.3 Beach Seines

Table 5.2-7 summarizes depths, mean column velocities, and predominant substrates found at all 15 of the beach seine sites in Rocky Reach reservoir involving a total of 398 depth and mean column velocity measurements. Both depth and mean column velocity measurements were consistent across sampling periods and areas. Depth measurements at the sites ranged from 0.25ft to nearly 4.5 ft, with a mean

depth sampled of 2.1 ft. Mean column velocities ranged from 0.00 ft/sec to 2.95 ft/sec, averaging 0.24 ft/sec (Table 5.2-8).

The predominant substrates found at the beach seine sites were sand and silt (Table 5.2-9). Although other substrates were observed, over 60% of the substrate documented in these habitats consisted of silt and sand, which is consistent with the greatly reduced velocities observed in this area.

5.2.4 Snorkeling

A total of 20 snorkeling sites were sampled throughout the three major reaches of the reservoir. A total of 579 depth, velocity and substrate measurements were taken. Generally, snorkeling occurred in the vicinity of the Gee minnow traps. Depth measurements at the sites ranged from 0-47.10 feet, with a mean depth sampled of 10.2 feet. Mean column velocities range from 0-4.1 ft/second, averaging 0.85 ft/second. The most abundant substrates observed at the snorkeling sites were boulder and cobble, followed by sand.

5.3 Salmonid Spawning Survey

Redds were observed on October 20, 1999 during an aerial survey. The redds were located along the west bank of the Columbia River below the Wells Dam near River Mile 514.4. The redds were fairly large and were likely built by fall-spawning chinook salmon, which were also observed in the area. Redds were also observed in the Chelan and Entiat rivers but upstream of the Rocky Reach Project Area. In the fall of 1999 additional surveys for habitat utilization were conducted in targeted areas where suitable spawning habitat was identified. However, spawning activity was not observed in any other areas. Table 5.3-1 lists the areas that were surveyed using the underwater video system. Aerial surveys were also conducted in the spring from April 1 through June 27, 2000 at about 14-day intervals and no spawning activity was observed in the Project Area.

Over two survey periods, the location, water depth, water velocity, and substrate were recorded for 42 redds at the study site below Wells Dam. The last survey was conducted on Nov 30, 1999 and 15 redds were located, however the ADCP was not operational and velocity data was not collected. Table 5.3-2 lists the location, water depth, mean column water velocity, nose depth and nose velocity of the 42 redds observed on November 9 and 16, 1999.

Water depth where redds were observed ranged from 6.4 ft to 21.4 ft, with an average depth of 13.3 ft. Mean column water velocity at these redds ranged from 2.34 to 6.80 ft/sec with an average velocity of 4.70 ft/sec. Nose velocity measured at approximately 0.75 ft from the bottom, ranged from 0.32 to 5.74 ft/sec with an average of 2.94 ft/sec. Substrate utilized by spawning fall chinook consisted of medium to large gravel with small cobbles.

Table 5.1-1 Fish species known to occur, or believed to occur, in Rocky Reach Reservoir.

Family	Common Name	Scientific Name	Recorded in 1999-2000
Acipenseridae	White sturgeon	*Acipenser transmontanus*	
Salmonidae	Chinook salmon	*Oncorhynchus tshawytscha*	**X**
	Sockeye salmon	*Oncorhynchus nerka*	
	Kokanee	*Oncorhynchus nerka*	
	Rainbow trout	*Oncorhynchus mykiss*	**X**
	Steelhead	*Oncorhynchus mykiss*	
	Cutthroat trout	*Oncorhynchus clarki*	
	Brown trout	*Salmo trutta*	
	Bull trout	*Salvelinus confluentus*	
	Mountain whitefish	*Prosopium williamsoni*	**X**
Percidae	Walleye	*Stizostedion vitreum*	**X**
	Yellow perch	*Perca flavescens*	
Centrarcidae	Largemouth bass	*Micropterus salmoides*	**X**
	Smallmouth bass	*Micropterus dolomieui*	**X**
	Black crappie	*Pomoxis nigromaculatus*	
	Bluegill	*Lepomis macrochirus*	**X**
	Pumpkinseed	*Lepomis gibbosus*	
Gadidae	Burbot	*Lota lota*	
Ictaluridae	Channel catfish	*Ictalurus punctatus*	
	Black bullhead	*Ictalurus melas*	
Catostomidae	Largescale sucker	*Catostomus macrocheilus*	**X**
	Bridgelip sucker	*Catostomus columbianus*	
	Longnose sucker	*Catostomus catostomus*	**X**
	Mountain sucker	*Catostsomus platyrhynchus*	
Cyprinidae	Carp	*Cyprinus carpio*	**X**
	Northern pikeminnow	*Ptychocheilus oregonensis*	**X**
	Redside shiner	*Richardsonius balteatus*	**X**
	Chiselmouth	*Acrocheilus alutaceus*	**X**
	Peamouth	*Mylocheilus caurinus*	**X**
	Tench	*Tinca tinca*	**X**
	Longose dace	*Rhinichthys cataractae*	**X**
	Speckled dace	*Rhinichthys osculus*	**X**
Percopsidae	Sand roller	*Percopsis transmontana*	
Cottidae	Prickly sculpin	*Cottus asper*	**X**
	Torrent sculpin	*Cottus rhotheus*	**X**
Gasterosteidae	Threespine stickleback	*Gasterosteus aculeatus*	**X**
Petromyzontidae	Pacific lamprey	*Entosphenus tridentatus*	

Table 5.1-2 Numbers of fish captured and observed, and percent composition by species, for the different sampling methods (all seasons and reservoir sections combined) in Rocky Reach Reservoir, October 1999 to August 2000.

	Sampling Method									
	Fyke Nets		Beach Seining		Gee Minnow Traps		Snorkel Surveys		All Methods	
Species	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Chinook salmon	138	3.40	52	0.29	0	0.00	359	0.72	**549**	**0.76**
Rainbow trout	13	0.32	0	0.00	0	0.00	49	0.10	**62**	**0.09**
Mountain whitefish	10	0.25	0	0.00	0	0.00	0	0.00	**10**	**0.01**
Walleye	1	0.02	0	0.00	0	0.00	0	0.00	**1**	**0.00**
Largemouth bass	0	0.00	1	0.01	0	0.00	0	0.00	**1**	**0.00**
Smallmouth bass	0	0.00	0	0.00	1	0.12	6	0.01	**7**	**0.01**
Bluegill	3	0.07	0	0.00	0	0.00	0	0.00	**3**	**0.00**
Largescale sucker	194	4.78	22	0.12	1	0.12	181	0.36	**398**	**0.55**
Longnose sucker	18	0.44	0	0.00	0	0.00	0	0.00	**18**	**0.02**
Carp	0	0.00	0	0.00	0	0.00	1	0.00	**1**	**0.00**
Northern pikeminnow	743	18.31	7900	44.51	80	9.60	889	1.78	**9,612**	**13.25**
Redside shiner	1,403	34.57	1296	7.30	16	1.92	3,213	6.44	**5,928**	**8.17**
Chiselmouth	959	23.63	1	0.01	6	0.72	1	0.00	**967**	**1.33**
Peamouth	145	3.57	0	0.00	0	0.00	2	0.00	**147**	**0.20**
Tench	22	0.54	1	0.01	0	0.00	1	0.00	**24**	**0.03**
Longnose dace	0	0.00	4	0.02	0	0.00	0	0.00	**4**	**0.01**
Speckled dace	3	0.07	0	0.00	0	0.00	0	0.00	**3**	**0.00**
Prickly sculpin	1	0.02	3	0.02	4	0.48	0	0.00	**8**	**0.01**
Torrent sculpin	2	0.05	0	0.00	0	0.00	0	0.00	**2**	**0.00**
Threespine stickleback	389	9.58	3694	20.81	723	86.79	19,315	38.70	**24,121**	**33.24**
Sculpin spp.	1	0.02	0	0.00	2	0.24	1	0.00	**4**	**0.01**
Sucker spp.	4	0.10	1356	7.64	0	0.00	3,301	6.61	**4,661**	**6.42**
Unidentified fry	10	0.25	3420	19.27	0	0.00	22,597	45.27	**26,027**	**35.87**
Total	**4,059**	**100.00**	**17750**	**100.00**	**833**	**100.00**	**49,916**	**100.00**	**72,558**	**100.00**

Table 5.1-3 Numbers of fish captured and observed in each reservoir section, and percent composition by species, for all sampling methods and all seasons combined, in Rocky Reach Reservoir, October 1999 to August 2000.

	Reservoir Section							
	Lower		Middle		Upper		All Sections	
Species	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Chinook salmon	26	0.12	141	0.36	382	3.32	**549**	**0.76**
Rainbow trout	4	0.02	9	0.02	49	0.43	**62**	**0.09**
Mountain whitefish	0	0.00	10	0.03	0	0.00	**10**	**0.01**
Walleye	0	0.00	0	0.00	1	0.01	**1**	**0.00**
Largemouth bass	0	0.00	1	0.00	0	0.00	**1**	**0.00**
Smallmouth bass	0	0.00	7	0.02	0	0.00	**7**	**0.01**
Bluegill	1	0.00	1	0.00	1	0.01	**3**	**0.00**
Largescale sucker	163	0.75	133	0.34	102	0.89	**398**	**0.55**
Longnose sucker	16	0.07	2	0.01	0	0.00	**18**	**0.02**
Carp	0	0.00	1	0.00	0	0.00	**1**	**0.00**
Northern pikeminnow	7,064	32.61	2,343	5.95	205	1.78	**9,612**	**13.25**
Redside shiner	2,939	13.57	1,887	4.79	1,102	9.57	**5,928**	**8.17**
Chiselmouth	779	3.60	172	0.44	16	0.14	**967**	**1.33**
Peamouth	124	0.57	6	0.02	17	0.15	**147**	**0.20**
Tench	22	0.10	1	0.00	1	0.01	**24**	**0.03**
Longnose dace	0	0.00	2	0.01	2	0.02	**4**	**0.01**
Speckled dace	3	0.01	0	0.00	0	0.00	**3**	**0.00**
Prickly sculpin	0	0.00	5	0.01	3	0.03	**8**	**0.01**
Torrent sculpin	0	0.00	2	0.01	0	0.00	**2**	**0.00**
Threespine stickleback	5,880	27.14	18,120	46.01	121	1.05	**24,121**	**33.24**
Sculpin spp.	0	0.00	3	0.01	1	0.01	**4**	**0.01**
Sucker spp.	358	1.65	537	1.36	3,766	32.71	**4,661**	**6.42**
Unidentified fry	4,286	19.78	15,997	40.62	5,744	49.89	**26,027**	**35.87**
Total	**21,665**	**100.00**	**39,380**	**100.00**	**11,513**	**100.00**	**72,558**	**100.00**

Table 5.1-4 Summary of fish catch, and catch-per-unit-effort (CPUE = number of fish/24 hours), for fyke net collections in the lower, middle, and upper sections of Rocky Reach Reservoir, October 1999 to August 2000.

	Lower Section						Middle Section						Upper Section					
	Oct-99		May-00		Aug-00		Oct-99		May-00		Aug-00		Oct-99		May-99		Aug-00	
Species	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**
Chinook salmon	0	0.00	24	13.04	0	0.00	0	0.00	10	6.08	101	54.88	0	0.00	3	1.59	0	0.00
Rainbow trout	1	0.52	3	1.63	0	0.00	0	0.00	1	0.61	4	2.17	1	0.50	3	1.59	0	0.00
Mountain whitefish	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	10	5.42	0	0.00	0	0.00	0	0.00
Walleye	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00
Bluegill	0	0.00	1	0.54	0	0.00	1	0.54	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00
Largescale sucker	88	45.91	29	15.76	3	1.68	10	5.41	7	4.25	26	14.16	19	9.53	4	2.12	0	0.00
Longnose sucker	1	0.52	6	3.26	9	5.06	2	1.08	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Northern pikeminnow	91	47.48	279	151.60	94	52.77	97	52.43	0	0.00	64	34.75	71	35.58	15	7.94	32	16.79
Redside shiner	314	163.83	239	129.86	61	34.30	104	56.20	3	1.82	120	65.71	327	163.68	210	111.18	25	13.12
Chiselmouth	302	157.57	423	229.84	52	29.24	126	68.03	1	0.61	39	21.14	2	1.00	0	0.00	14	7.35
Peamouth	13	6.78	111	60.31	0	0.00	2	1.08	0	0.00	2	1.08	16	8.00	1	0.53	0	0.00
Tench	4	2.09	8	4.35	9	4.99	1	0.54	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Speckled dace	0	0.00	0	0.00	3	1.69	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Prickly sculpin	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.53	0	0.00
Torrent sculpin	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	1.10	0	0.00	0	0.00	0	0.00
Threespine stickleback	265	138.26	41	22.28	28	15.66	12	6.49	0	0.00	5	2.71	15	7.51	0	0.00	23	12.07
Sculpin spp.	0	0.00	0	0.00	0	0.00	1	0.54	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Sucker spp.	0	0.00	4	2.17	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Unidentified fry	0	0.00	0	0.00	0	0.00	10	5.42	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	1079	562.96	1168	634.64	259	145.39	366	197.75	22	13.37	373	203.13	453	226.80	237	125.48	94	49.33

Table 5.1-5 Summary of fish catch, and catch-per-unit-effort (CPUE = number of fish/100 ft2), or beach seine collections in the lower, middle, and upper sections of Rocky Reach Reservoir, October 1999 to August 2000.

	Lower Section						Middle Section						Upper Section					
	Oct-99		May-00		Aug-00		Oct-99		May-00		Aug-00		Oct-99		May-99		Aug-00	
Species	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**
Chinook salmon	0	0.00	0	0.00	0	0.00	0	0.00	20	0.30	0	0.00	0	0.00	32	0.21	0	0.00
Largemouth bass	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.02	0	0.00	0	0.00	0	0.00
Largescale sucker	16	0.06	0	0.00	0	0.00	0	0.00	4	0.06	0	0.00	0	0.00	2	0.01	0	0.00
Northern pikeminnow	597	2.27	69	0.69	5063	109.38	124	0.87	302	4.53	1659	32.79	0	0.00	29	0.19	57	0.71
Redside shiner	82	0.31	633	6.32	274	5.92	4	0.03	81	1.21	165	3.26	0	0.00	0	0.00	57	0.71
Chiselmouth	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Tench	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Longnose dace	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	0.04	0	0.00	1	0.01	1	0.01
Prickly sculpin	0	0.00	0	0.00	0	0.00	1	0.01	0	0.00	0	0.00	0	0.00	2	0.01	0	0.00
Threespine stickleback	2006	7.62	37	0.37	283	6.11	702	4.90	433	6.49	212	4.19	6	0.04	15	0.10	0	0.00
Sucker spp.	0	0.00	0	0.00	354	7.65	0	0.00	0	0.00	283	5.59	0	0.00	0	0.00	719	8.91
Unidentified fry	0	0.00	0	0.00	186	4.02	0	0.00	0	0.00	3086	61.00	0	0.00	0	0.00	148	1.83
Total	2702	10.27	739	7.38	6160	133.08	831	5.80	840	12.59	5408	106.89	6	0.04	81	0.54	983	12.18

Table 5.1-6 Summary of fish catch, and catch-per-unit-effort (CPUE = number of fish/24 trap-hours), for Gee minnow trap collections in the lower, middle, and upper sections of Rocky Reach Reservoir, October 1999 to August 2000.

	Lower Section						Middle Section						Upper Section					
	Oct-99		May-00		Aug-00		Oct-99		May-00		Aug-00		Oct-99		May-99		Aug-00	
Species	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**
Smallmouth bass	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.03	0	0.00	0	0.00	0	0.00
Largescale sucker	0	0.00	0	0.00	0	0.00	1	0.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Northern pikeminnow	9	0.47	7	0.37	5	0.26	4	0.12	40	1.13	14	0.46	0	0.00	1	0.04	0	0.00
Redside shiner	1	0.05	0	0.00	0	0.00	7	0.21	2	0.06	3	0.10	0	0.00	3	0.13	0	0.00
Chiselmouth	0	0.00	1	0.05	0	0.00	2	0.06	2	0.06	1	0.03	0	0.00	0	0.00	0	0.00
Prickly sculpin	0	0.00	0	0.00	0	0.00	0	0.00	1	0.03	3	0.10	0	0.00	0	0.00	0	0.00
Threespine stickleback	205	10.64	23	1.21	200	10.55	56	1.69	162	4.57	54	1.78	7	0.30	1	0.04	15	0.70
Sculpin spp.	0	0.00	0	0.00	0	0.00	2	0.06	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	215	11.16	31	1.64	205	10.81	72	2.18	207	5.84	76	2.50	7	0.30	5	0.21	15	0.70

Table 5.1-7 Summary of fish recorded, and count-per-unit-effort (CPUE = number of fish/100 ft), for snorkel survey observations in the lower, middle, and upper sections of Rocky Reach Reservoir, October 1999 to August 2000.

	Lower Section						Middle Section						Upper Section					
	Oct-99		May-00		Aug-00		Oct-99		May-00		Aug-00		Oct-99		May-99		Aug-00	
Species	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**	***n***	**CPUE**
Chinook salmon	0	0.00	2	0.12	0	0.00	0	0.00	9	0.30	1	0.03	0	0.00	347	17.63	0	0.00
Rainbow trout	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	4	0.14	0	0.00	30	1.52	15	0.76
Smallmouth bass	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	6	0.20	0	0.00	0	0.00	0	0.00
Largescale sucker	13	0.79	3	0.18	11	0.67	52	1.76	7	0.24	26	0.88	56	2.84	13	0.66	0	0.00
Carp	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.03	0	0.00	0	0.00	0	0.00
Northern pikeminnow	350	21.34	0	0.00	500	30.48	0	0.00	0	0.00	39	1.32	0	0.00	0	0.00	0	0.00
Redside shiner	360	21.95	320	19.51	655	39.93	143	4.84	19	0.64	1236	41.86	0	0.00	25	1.27	455	23.11
Chiselmouth	0	0.00	0	0.00	0	0.00	1	0.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Peamouth	0	0.00	0	0.00	0	0.00	0	0.00	2	0.07	0	0.00	0	0.00	0	0.00	0	0.00
Tench	0	0.00	0	0.00	1	0.06	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Threespine stickleback	1660	101.19	1045	63.70	87	5.30	9509	322.04	335	11.35	6640	224.87	18	0.91	21	1.07	0	0.00
Sculpin spp.	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.05
Sucker spp.	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	254	8.60	0	0.00	0	0.00	3047	154.79
Unidentified fry	0	0.00	0	0.00	4100	249.94	0	0.00	0	0.00	12901	436.91	0	0.00	0	0.00	5596	284.28
Total	2383	145.27	1370	83.52	5354	326.38	9705	328.68	372	12.60	21108	714.86	74	3.76	436	22.15	9114	462.99

Table 5.2-1 Rocky Reach reservoir mean daily flows for sampling period.

Sample Session	Date	Mean Daily Flow (kcfs)
1	10/19/99	110.7
1	10/20/99	123.0
1	10/21/99	111.8
1	10/22/99	101.1
1	10/23/99	82.8
1	10/24/99	73.9
1	10/25/99	111.4
1	10/26/99	90.3
1	10/27/99	109.1
1	10/28/99	82.1
1	10/29/99	86.4
1	10/30/99	55.4
1	10/31/99	49.3
2	5/16/00	162.9
2	5/17/00	158.6
2	5/18/00	166.4
2	5/19/00	161.5
2	5/20/00	146.3
2	5/21/00	132.3
2	5/22/00	174.4
2	5/23/00	162.1
2	5/24/00	141.0
2	5/25/00	124.3
2	5/26/00	122.2
2	5/27/00	105.1
2	5/28/00	97.0
2	5/29/00	103.1
2	5/30/00	150.3
3	8/9/00	149.4
3	8/10/00	154.1
3	8/11/00	139.4
3	8/12/00	121.7
3	8/13/00	103.2
3	8/14/00	131.9
3	8/15/00	132.8
3	8/16/00	123.2
3	8/17/00	125.5
3	8/18/00	124.2
3	8/19/00	54.4
3	8/20/00	64.4

Table 5.2-2 Depth, velocity, and substrate characteristics of Rocky Reach reservoir fyke net sites.

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Dominant	Subdominant
All	Min:	1.10	0.04	1.20	0.00	0.40	0.00	0.40	0.00	2	1,6
	Mean:	3.58	0.85	3.37	1.34	1.88	0.15	3.25	1.03		
	Max:	4.81	2.95	8.40	2.84	3.70	0.39	8.40	2.95		
	Std:	0.78	0.72	1.20	0.59	0.99	0.11	1.18	0.72		
	Count:	55	55	91	91	21	21	167	167		
Lower	Min:	1.10	0.04	1.20	0.02	0.40	0.01	0.40	0.01	1,0	1
	Mean:	3.04	0.06	3.32	1.03	1.26	0.12	2.78	0.45		
	Max:	4.00	0.24	8.40	1.65	2.50	0.39	8.40	1.65		
	Std:	0.76	0.05	1.35	0.42	0.78	0.11	1.30	0.53		
	Count:	18	18	17	17	9	9	44	44		
Middle	Min:	2.47	0.04	1.60	0.66	1.60	0.00	1.60	0.00	7,2	6,1
	Mean:	3.73	1.09	2.94	1.63	2.47	0.14	3.12	1.35		
	Max:	4.81	2.32	4.24	2.84	3.10	0.23	4.81	2.84		
	Std:	0.82	0.48	0.55	0.53	0.54	0.10	0.75	0.66		
	Count:	20	20	45	45	6	6	71	71		
Upper	Min:	3.58	0.19	1.60	0.00	0.90	0.07	0.90	0.00	8,2	2,8,7
	Mean:	3.99	1.39	4.06	1.08	2.22	0.20	3.82	1.08		
	Max:	4.48	2.95	7.41	2.21	3.70	0.36	7.41	2.95		
	Std:	0.26	0.59	1.50	0.53	1.08	0.11	1.32	0.63		
	Count:	17	17	29	29	6	6	52	52		

Table 5.2-3 Analysis of substrate frequency at Rocky Reach Reservoir fyke net sites.

Substrate	Dominant	Subdominant1	Subdominant 2
Organic detritus - 0	17	0	0
Silt, clay - 1	18	74	0
Sand - 2	45	20	40
Small Gravel - 3	0	3	0
Medium Gravel - 4	0	0	0
Large Gravel - 5	2	0	0
Small Cobble - 6	1	41	0
Large Cobble - 7	42	14	0
Boulder - 8	42	15	0
Bedrock - 9	0	0	0

Table 5.2-4 Depth, velocity and substrate characteristics of Rocky Reach reservoir Gee minnow trap sites

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Dominant	Subdominant
Lower GT1	Min:	5.13	0.86	15.29	0.72	20.88	0.39	5.13	0.39	9,6	5
	Mean:	20.23	1.06	25.14	0.98	33.74	0.54	24.93	0.91		
	Max:	38.83	1.53	36.10	1.57	41.47	0.65	41.47	1.57		
	Std:	12.44	0.15	7.56	0.22	6.48	0.08	11.42	0.27		
	Count:	25	25	14	14	13	13	52	52		
Lower GT2	Min:	3.91	0.19	1.00	0.00	0.90	0.22	0.90	0.00	1	1,6
	Mean:	5.77	0.85	2.53	0.36	1.47	0.33	3.38	0.53		
	Max:	8.37	1.36	3.80	0.73	2.80	0.43	8.37	1.36		
	Std:	1.51	0.34	0.91	0.28	0.66	0.07	2.11	0.36		
	Count:	8	8	9	9	6	6	23	23		
Lower GT3	Min:	2.80	0.54	7.34	0.00	0.00	0.00	0.00	0.00	7,1	8,9
	Mean:	6.35	0.97	8.25	0.89	0.93	0.00	6.21	0.74		
	Max:	8.67	1.26	9.08	1.47	2.50	0.00	9.08	1.47		
	Std:	1.89	0.26	0.63	0.47	1.03	0.00	3.03	0.52		
	Count:	6	6	10	10	4	4	20	20		
Lower GT4	Min:	2.90	0.52	1.20	0.03	1.50	0.00	1.20	0.00	8,7	1,8
	Mean:	5.17	1.29	2.47	0.23	2.12	0.20	3.62	0.71		
	Max:	14.53	2.86	3.50	0.58	3.10	0.80	14.53	2.86		
	Std:	3.04	0.72	0.79	0.19	0.52	0.27	2.56	0.74		
	Count:	11	11	7	7	6	6	24	24		
Lower GT5	Min:	9.73	0.66	6.13	0.00	2.20	0.00	2.20	0.00	7,8	8,4
	Mean:	10.48	0.91	15.33	0.48	11.42	0.18	13.34	0.58		
	Max:	11.30	1.31	47.10	0.84	29.46	0.53	47.10	1.31		
	Std:	0.38	0.15	8.80	0.30	9.97	0.22	7.82	0.35		
	Count:	26	26	47	47	10	10	83	83		

Table 5.2-4 Depth, velocity and substrate characteristics of Rocky Reach reservoir Gee minnow trap sites

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Dominant	Subdominant
Middle GT1	Min:	3.78	0.50	12.37	1.16	---	---	3.78	0.50	1,2	2,1
	Mean:	7.89	0.99	13.24	1.37	---	---	10.89	1.20		
	Max:	13.99	1.34	13.61	1.84	---	---	13.99	1.84		
	Std:	3.82	0.23	0.33	0.17	---	---	3.68	0.28		
	Count:	11	11	14	14	---	---	25	25		
Middle GT2	Min:	0.80	0.00	1.20	0.00	0.70	0.00	0.70	0.00	1,2	1,2
	Mean:	1.37	0.05	2.72	0.01	1.76	0.01	2.04	0.02		
	Max:	2.00	0.11	3.80	0.06	3.00	0.11	3.80	0.11		
	Std:	0.49	0.04	0.81	0.02	0.76	0.03	0.90	0.03		
	Count:	3	3	9	9	15	15	27	27		
Middle GT3	Min:	1.20	0.03	0.80	0.02	1.40	0.00	0.80	0.00	2,8	7,2
	Mean:	2.10	0.07	2.68	0.05	2.14	0.02	2.42	0.04		
	Max:	2.90	0.12	4.00	0.10	2.80	0.07	4.00	0.12		
	Std:	0.70	0.04	1.08	0.02	0.55	0.03	0.93	0.03		
	Count:	3	3	9	9	5	5	17	17		
Middle GT4	Min:	2.30	0.01	1.10	0.00	0.90	0.00	0.90	0.00	8,7	8,4
	Mean:	3.37	0.22	2.43	0.50	1.90	0.11	2.47	0.29		
	Max:	6.00	0.51	3.60	1.03	3.50	0.26	6.00	1.03		
	Std:	1.27	0.21	0.82	0.37	0.85	0.11	1.12	0.31		
	Count:	6	6	9	9	9	9	24	24		
Middle GT5	Min:	7.72	0.73	10.02	0.70	31.10	1.68	7.72	0.70	8	9
	Mean:	12.63	1.22	21.90	2.14	34.66	2.18	20.92	1.83		
	Max:	25.66	1.64	31.03	3.27	37.86	2.59	37.86	3.27		
	Std:	5.07	0.25	7.58	0.74	1.96	0.29	9.67	0.71		
	Count:	18	18	26	26	9	9	53	53		
Middle GT6	Min:	0.80	0.11	4.30	0.14	1.00	0.00	0.80	0.00	2,5	1,2
	Mean:	1.40	0.18	4.68	0.67	1.90	0.17	3.59	0.48		
	Max:	2.20	0.24	5.24	1.18	2.80	0.76	5.24	1.18		
	Std:	0.59	0.05	0.24	0.32	0.63	0.30	1.47	0.38		
	Count:	3	3	20	20	9	9	32	32		

Table 5.2-4 Depth, velocity and substrate characteristics of Rocky Reach reservoir Gee minnow trap sites

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Dominant	Subdominant
	Min:	1.00	0.09	4.53	0.18	1.10	0.00	1.00	0.00	8,1	2,7
Middle	Mean:	1.60	0.11	4.69	0.45	2.05	0.05	3.12	0.24		
GT7	Max:	2.10	0.14	4.80	0.70	3.00	0.21	4.80	0.70		
	Std:	0.45	0.02	0.09	0.16	0.63	0.08	1.46	0.22		
	Count:	3	3	7	7	6	6	16	16		
Middle	Min:	1.70	0.31	5.61	2.11	1.00	0.00	1.00	0.00	8,6	7,6
GT8	Mean:	2.53	0.43	5.96	2.60	2.52	0.23	4.49	1.61		
	Max:	3.50	0.50	6.66	3.07	3.70	0.48	6.66	3.07		
	Std:	0.74	0.08	0.31	0.26	1.03	0.18	1.83	1.16		
	Count:	3	3	12	12	6	6	21	21		
Middle	Min:	1.60	0.01	11.28	1.11	1.10	0.16	1.10	0.01	8,6	7,6
GT9	Mean:	2.48	0.06	11.64	1.52	2.33	0.22	8.18	1.01		
	Max:	3.20	0.09	12.08	2.13	3.80	0.33	12.08	2.13		
	Std:	0.66	0.04	0.28	0.29	1.11	0.08	4.51	0.71		
	Count:	3	3	10	10	3	3	16	16		
Upper	Min:	0.18	0.10	6.82	0.41	1.20	0.06	0.18	0.06	2,5	1
GT1	Mean:	0.29	0.15	7.04	0.67	2.39	0.38	3.83	0.45		
	Max:	0.50	0.19	7.34	0.91	3.40	0.63	7.34	0.91		
	Std:	0.15	0.04	0.19	0.20	0.86	0.19	2.79	0.27		
	Count:	3	3	6	6	6	6	15	15		
Upper	Min:	4.79	1.00	5.65	0.24	6.64	0.61	4.79	0.24	5,8	3,7
GT2	Mean:	5.68	1.49	14.48	1.10	6.77	0.69	12.15	1.15		
	Max:	8.28	2.02	25.20	4.12	6.84	0.79	25.20	4.12		
	Std:	1.28	0.30	6.23	0.75	0.09	0.07	6.56	0.68		
	Count:	9	9	32	32	3	3	44	44		
Upper	Min:	4.95	0.69	9.46	0.64	6.67	0.33	4.95	0.33	8	7
GT3	Mean:	7.35	1.38	14.04	1.76	9.54	0.62	12.58	1.60		
	Max:	9.99	1.88	20.51	4.06	13.76	1.00	20.51	4.06		
	Std:	2.05	0.36	3.34	0.87	2.71	0.27	4.07	0.84		
	Count:	8	8	37	37	4	4	49	49		
Upper GT4	Min:	1.80	0.22	---	---	1.10	0.02	1.10	0.02	2	3,2

	Mean:	2.60	0.24	---	---	2.15	0.43	2.30	0.37
	Max:	3.30	0.28	---	---	3.00	0.97	3.30	0.97
	Std:	0.62	0.03	---	---	0.74	0.36	0.73	0.31
	Count:	3	3	---	---	6	6	9	9

Table 5.2-4 Depth, velocity and substrate characteristics of Rocky Reach reservoir Gee minnow trap sites

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Dominant	Subdominant
Upper	Min:	1.20	0.01	1.10	0.03	0.80	0.00	0.80	0.00	1,2	1,4
GT5	Mean:	2.13	0.02	2.23	0.12	1.88	0.29	2.10	0.11		
	Max:	3.30	0.03	3.20	0.22	2.80	0.57	3.30	0.57		
	Std:	0.64	0.01	0.71	0.06	0.75	0.22	0.70	0.15		
	Count:	12	12	8	8	6	6	26	26		
Upper	Min:	0.80	0.11	0.60	0.02	1.40	0.05	0.60	0.02	5,8	6,5
GT6	Mean:	1.40	0.19	1.35	0.34	1.83	0.51	1.48	0.34		
	Max:	2.10	0.25	2.20	0.64	2.60	0.74	2.60	0.74		
	Std:	0.54	0.06	0.53	0.24	0.54	0.32	0.57	0.26		
	Count:	3	3	6	6	3	3	12	12		

Table 5.2-5 Summary of depth, velocity and substrate characteristics of Rocky Reach reservoir Gee minnow trap sites by reach.

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Dominant	Subdominant
All	Min:	0.18	0.00	0.60	0.00	0.00	0.00	0.00	0.00	8,2	7,8
	Mean:	8.60	0.84	11.59	1.03	8.51	0.38	10.07	0.83		
	Max:	38.83	2.86	47.10	4.12	41.47	2.59	47.10	4.12		
	Std:	8.02	0.53	8.46	0.86	12.47	0.56	9.50	0.76		
	Count:	167	167	292	292	129	129	588	588		
Lower	Min:	2.80	0.19	1.00	0.00	0.00	0.00	0.00	0.00	7,8	8,4
	Mean:	12.10	1.01	13.73	0.58	14.82	0.31	13.33	0.69		
	Max:	38.83	2.86	47.10	1.57	41.47	0.80	47.10	2.86		
	Std:	9.45	0.35	10.01	0.39	15.30	0.25	11.09	0.44		
	Count:	76	76	87	87	39	39	202	202		
Middle	Min:	0.80	0.00	0.80	0.00	0.70	0.00	0.70	0.00	8,2	9,7

	Mean:	6.96	0.70	9.82	1.23	6.74	0.40	8.34	0.88
	Max:	25.66	1.64	31.03	3.27	37.86	2.59	37.86	3.27
	Std:	5.77	0.53	8.20	0.96	11.56	0.76	8.92	0.90
	Count:	53	53	116	116	62	62	231	231

Table 5.2-5 Summary of depth, velocity and substrate characteristics of Rocky Reach reservoir Gee minnow trap sites by reach.

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Dominant	Subdominant
Upper	Min:	0.18	0.01	0.60	0.02	0.80	0.00	0.18	0.00	8,5	7,3
	Mean:	3.90	0.70	11.81	1.20	3.66	0.45	8.40	0.94		
	Max:	9.99	2.02	25.20	4.12	13.76	1.00	25.20	4.12		
	Std:	2.71	0.71	6.36	0.91	3.05	0.29	6.51	0.84		
	Count:	38	38	89	89	28	28	155	155		

Table 5.2-6 Analysis of substrate frequency at Rocky Reach Reservoir at all Gee minnow trap sites.

Substrate	Dominant	Subdominant1	Subdominant 2
Organic detritus - 0	1	0	0
Silt, clay - 1	56	82	5
Sand - 2	85	50	6
Small Gravel - 3	10	42	0
Medium Gravel - 4	11	52	12
Large Gravel - 5	58	29	6
Small Cobble - 6	38	31	61
Large Cobble - 7	75	112	7
Boulder - 8	214	89	6
Bedrock - 9	40	62	61

Table 5.2-7 Depth, velocity and substrate characteristics of Rocky Reach reservoir beach seine sites

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Dominant	Subdominant
Lower BS1	Min:					0.25	0.00	0.25	0.00	2	1
	Mean:					1.04	0.03	1.04	0.03		
	Max:					1.90	0.06	1.90	0.06		
	Std:					0.59	0.02	0.59	0.02		
	Count:					9	9	9	9		
Lower BS2	Min:			1.00	0.00	1.20	0.00	1.00	0.00	1,5,6	2,7
	Mean:			2.15	0.04	1.90	0.00	2.07	0.03		
	Max:			3.00	0.11	2.90	0.02	3.00	0.11		
	Std:			0.70	0.03	0.53	0.01	0.66	0.03		
	Count:			18	18	9	9	27	27		
Lower BS3	Min:	0.90	0.00	1.00	0.01	0.40	0.05	0.40	0.00	2,4	2,1
	Mean:	1.67	0.03	2.06	0.06	1.22	0.15	1.65	0.08		
	Max:	2.70	0.12	2.90	0.19	2.04	0.40	2.90	0.40		
	Std:	0.58	0.04	0.69	0.06	0.52	0.11	0.69	0.09		
	Count:	9	9	9	9	9	9	27	27		
Lower BS4	Min:	1.40	0.11	1.40	0.00	0.80	0.02	0.80	0.00	2,1,8	2,1
	Mean:	2.10	0.18	2.54	0.11	1.78	0.15	2.05	0.14		
	Max:	2.90	0.23	3.60	0.55	3.10	0.34	3.60	0.55		
	Std:	0.49	0.04	0.79	0.17	0.74	0.11	0.79	0.13		
	Count:	6	6	9	9	18	18	33	33		
Lower BS5	Min:	0.50	0.01	1.00	0.00	0.70	0.00	0.50	0.00	2,1	2,5
	Mean:	1.42	0.02	2.12	0.06	1.14	0.01	1.56	0.03		
	Max:	2.50	0.04	3.40	0.16	1.80	0.02	3.40	0.16		
	Std:	0.67	0.01	0.83	0.05	0.40	0.01	0.78	0.04		
	Count:	9	9	9	9	9	9	27	27		
Middle BS1	Min:	1.98	0.00	0.90	0.00	0.80	0.00	0.80	0.00	1,2	2,1
	Mean:	2.98	0.88	1.90	0.29	1.87	0.01	2.28	0.45		
	Max:	4.42	1.63	3.30	0.78	2.80	0.11	4.42	1.63		
	Std:	0.73	0.51	0.71	0.17	0.73	0.03	0.89	0.46		
	Count:	21	21	30	30	9	9	60	60		
Middle BS2	Min:	0.80	0.01			0.80	0.00	0.80	0.00	2,1	2,1
	Mean:	2.02	0.11			2.29	0.02	2.16	0.07		
	Max:	2.90	0.19			3.20	0.08	3.20	0.19		
	Std:	0.66	0.06			0.84	0.03	0.76	0.07		

	Count:	9	9			9	9	18	18		

Table 5.2-7 Depth, velocity and substrate characteristics of Rocky Reach reservoir beach seine sites

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		**Depth (ft)**	**Velocity (ft/sec)**	**Depth (ft)**	**Velocity (ft/sec)**	**Depth (ft)**	**Velocity (ft/sec)**	**Depth (ft)**	**Velocity (ft/sec)**	**Dominant**	**Subdominant**
Middle	Min:	1.20	0.00			0.80	0.00	0.80	0.00	2,4,6	2,4
BS3	Mean:	1.80	0.01			1.59	0.08	1.68	0.05		
	Max:	2.50	0.02			2.10	0.18	2.50	0.18		
	Std:	0.50	0.01			0.42	0.07	0.47	0.06		
	Count:	6	6			9	9	15	15		
Middle	Min:	1.20	0.95					1.20	0.95	7	8
BS4	Mean:	1.57	1.18					1.57	1.18		
	Max:	1.80	1.37					1.80	1.37		
	Std:	0.26	0.17					0.26	0.17		
	Count:	3	3					3	3		
Middle	Min:	1.00	0.00			0.90	0.00	0.90	0.00	1,6	1,6,7
BS5	Mean:	1.50	0.12			1.63	0.06	1.56	0.09		
	Max:	2.10	0.30			2.10	0.19	2.10	0.30		
	Std:	0.42	0.11			0.44	0.06	0.44	0.09		
	Count:	9	9			9	9	18	18		
Upper	Min:	1.80	0.00	0.50	0.00	1.20	0.00	0.50	0.00	2,1	2,1
BS1	Mean:	2.44	0.09	1.21	0.00	2.53	0.01	2.06	0.03		
	Max:	3.00	0.53	2.80	0.00	3.50	0.08	3.50	0.53		
	Std:	0.44	0.16	0.63	0.00	0.75	0.03	0.86	0.10		
	Count:	9	9	9	9	9	9	27	27		
Upper	Min:	0.65	0.28	0.80	0.00	0.80	0.00	0.65	0.00	4,3	4,5
BS2	Mean:	1.49	0.70	2.02	0.47	2.09	0.24	1.96	0.39		
	Max:	2.30	1.40	3.20	1.19	3.40	0.85	3.40	1.40		
	Std:	0.56	0.36	0.85	0.49	0.83	0.27	0.82	0.40		
	Count:	6	6	9	9	18	18	33	33		
Upper	Min:	3.58	0.19	1.10	0.00	1.00	0.00	1.00	0.00	2,8	2,1
BS3	Mean:	3.99	1.39	2.13	0.00	2.13	0.05	2.96	0.64		
	Max:	4.48	2.95	3.20	0.03	3.00	0.16	4.48	2.95		
	Std:	0.26	0.59	0.80	0.01	0.74	0.06	1.10	0.79		
	Count:	17	17	9	9	12	12	38	38		
Upper	Min:	1.70	0.24	1.30	0.03	1.10	0.00	1.10	0.00	2	2,3
BS4											

	Mean:	2.58	0.27	2.36	0.15	2.32	0.57	2.42	0.33
	Max:	3.40	0.31	3.20	0.44	3.30	0.88	3.40	0.88
	Std:	0.60	0.02	0.66	0.14	0.76	0.28	0.69	0.25
	Count:	9	9	9	9	9	9	27	27

Table 5.2-7 Depth, velocity and substrate characteristics of Rocky Reach reservoir beach seine sites

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Dominant	Subdominant
Upper	Min:	1.20	0.01	1.10	0.03	1.00	0.00	1.00	0.00	1	1,4
BS5	Mean:	2.17	0.02	2.10	0.12	1.88	0.30	2.01	0.18		
	Max:	3.30	0.03	3.20	0.22	2.60	0.63	3.30	0.63		
	Std:	0.70	0.01	0.76	0.05	0.63	0.20	0.69	0.19		
	Count:	9	9	9	9	18	18	36	36		

Table 5.2-8 Summary of depth, velocity and substrate characteristics of Rocky Reach reservoir beach seine sites by area.

		Sample Period 1		Sample Period 2		Sample Period 3		Total		Substrate	
Site		Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)	Dominant	Subdominant
All	Min:	0.50	0.00	0.50	0.00	0.25	0.00	0.25	0.00	2,1	2,1
	Mean:	2.39	0.47	2.04	0.15	1.84	0.14	2.07	0.24		
	Max:	4.48	2.95	3.60	1.19	3.50	0.88	4.48	2.95		
	Std:	1.00	0.60	0.79	0.22	0.78	0.20	0.89	0.40		
	Count:	122	122	120	120	156	156	398	398		
Lower	Min:	0.50	0.00	1.00	0.00	0.25	0.00	0.25	0.00	2,1	2,1
	Mean:	1.68	0.07	2.20	0.06	1.48	0.08	1.78	0.07		
	Max:	2.90	0.23	3.60	0.55	3.10	0.40	3.60	0.55		
	Std:	0.65	0.08	0.76	0.09	0.69	0.11	0.78	0.10		
	Count:	24	24	45	45	54	54	123	123		
Middle	Min:	0.80	0.00	0.90	0.00	0.80	0.00	0.80	0.00	1,2	2,1
	Mean:	2.29	0.50	1.90	0.29	1.85	0.04	2.05	0.30		
	Max:	4.42	1.63	3.30	0.78	3.20	0.19	4.42	1.63		
	Std:	0.89	0.54	0.71	0.17	0.69	0.06	0.81	0.41		
	Count:	48	48	30	30	36	36	114	114		
Upper	Min:	0.65	0.00	0.50	0.00	0.50	0.00	0.50	0.00	2,1	2,1,4
	Mean:	2.83	0.62	1.96	0.15	1.96	0.15	2.30	0.33		
	Max:	4.48	2.95	3.20	1.19	3.20	1.19	4.48	2.95		
	Std:	1.02	0.69	0.84	0.29	0.84	0.29	0.95	0.49		

Count:	50	50	45	45	45	45	161	161	

Table 5.2-9 Analysis of substrate frequency at Rocky Reach Reservoir beach seine sites.

Substrate	Dominant	Subdominant 1	Subdominant 2	Subdominant 3
Organic detritus - 0	0	0	0	0
Silt, clay - 1	103	77	6	0
Sand - 2	160	174	6	0
Small Gravel - 3	20	11	15	0
Medium Gravel - 4	33	45	21	0
Large Gravel - 5	23	38	13	0
Small Cobble - 6	21	29	1	0
Large Cobble - 7	12	14	10	3
Boulder - 8	26	7	3	0
Bedrock - 9	0	0	3	0

Table 5.3-1 Areas surveyed for habitat use.

TRANSECT*	RIVER MILE	RIVER BANK	SUBSTRATE	COMMENTS
Below Rocky Reach Dam	473.0 – 473.3	East	Gravel, cobble and bedrock	High velocity
T-8	481.6	West	Gravel and cobble	Low velocity & unsuitable substrate
T-12	485.3	West	Gravel and cobble	Low velocity & unsuitable substrate
T-13	487.1	West	Cobble and silt	Low velocity & unsuitable substrate
T-25	500.0	West	Cobble and silt	Low velocity & unsuitable substrate
T-29	504.9	East and west	Boulders and gravel	Low velocity & unsuitable substrate
T-30	505.3	West and East	Gravel and cobble	Low velocity & unsuitable substrate
T-31	506.2	West and East	Gravel and cobble	Low velocity & unsuitable substrate
Below Wells Dam	514.0 – 515.4	West and East	Gravel and cobble	Redds observed on west bank

Table 5.3-2 Location, Substrate, Water Depth, mean column velocity, Nose Depth and Nose velocity measured at fall chinook redds.

REDD	DATE	LATITUDE 47°55.xxxx'	LONGITUDE 119°52.xxxx'	SUBSTRATE	DEPTH	MEAN COLUMN VELOCITY	NOSE DEPTH	NOSE VELOCITY
1	11/9[1]	9934	1758	54.7	8.78	4.37	7.81	3.17
2	11/9	9906	1824	56.7	9.21	4.64	8.46	3.76
3	11/9	9896	1851	54.7	9.60	4.57	8.79	3.19
4	11/9	9586	2430	45.7	13.56	3.71	12.73	4.98
5	11/9	9908	1356	56.8	11.92	6.80	11.09	5.31
6	11/9	9783	1761	54.7	11.77	5.75	11.09	2.78
7	11/9	9755	1831	54.7	11.92	5.68	11.42	2.76
8	11/9	9737	1877	54.6	12.18	5.54	11.42	2.55
9	11/9	9663	2052	54.7	12.92	6.09	12.40	2.80
10	11/9	9609	2363	45.6	13.91	3.83	13.06	1.58
11	11/9	9602	2424	56.6	13.78	3.91	12.73	4.03
12	11/16[2]	47°56.0133'	1534	45.6	6.40	2.86	5.84	1.46
13	11/16	9937	1824	65.6	8.83	3.47	8.14	2.61
14	11/16	47°56.0004	1524	56.6	8.28	4.51	7.81	2.81
15	11/16	9925	1589	45.6	9.82	4.88	9.12	3.04
16	11/16	9937	1647	65.6	9.53	4.32	8.79	4.74
17	11/16	9926	1645	54.8	9.11	3.78	8.46	1.81
18	11/16	9879	1642	56.6	9.66	4.12	9.12	3.43
19	11/16	9878	1685	65.6	10.34	4.61	9.78	3.23
20	11/16	9880	1754	54.7	9.42	4.27	8.79	0.32
21	11/16	9768	1909	54.7	10.98	4.08	10.43	4.40
22	11/16	9787	2050	54.7	10.45	4.05	9.45	3.08
23	11/16	9740	2316	45.6	9.56	2.34	8.79	2.66
24	11/16	9627	2366	45.7	12.08	3.08	11.42	2.15
25	11/16	9702	1884	56.7	12.01	4.43	11.09	3.29
26	11/16	9689	1963	56.8	12.22	4.96	11.09	4.60

1. Water discharge from Wells Dam ranged from 155 kcfs at the start of the survey to 114 kcfs at the end.
2. Water discharge from Wells Dam ranged from 90 kcfs at the start of the survey to 125 kcfs at the end.

Table 5.3-2 Location, Substrate, Water Depth, mean column velocity, Nose Depth and Nose velocity measured at fall chinook redds.

REDD	DATE	LATITUDE 47°55.xxxx'	LONGITUDE 119°52.xxxx'	SUBSTRATE	DEPTH	MEAN COLUMN VELOCITY	NOSE DEPTH	NOSE VELOCITY
27	11/16	9678	2078	54.7	11.96	4.81	10.76	5.74
28	11/16	9665	2223	45.6	12.91	4.48	11.75	3.13
29	11/16	9622	2400	46.6	12.20	3.71	11.42	2.61
30	11/16	9498	2722	54.8	15.35	5.50	14.70	2.94
31	11/16	9482	2225	54.6	15.37	6.30	14.70	1.77
32	11/16	9489	2474	54.7	15.60	5.44	15.03	1.35
33	11/16				19.21	5.17	18.64	3.80
34	11/16	9323	2696	45.6	15.55	4.60	13.71	1.52
35	11/16	9287	2718	54.7	19.68	5.20	19.29	1.84
36	11/16	9242	2823	54.8	19.72	4.69	18.86	4.66
37	11/16	9195	2906	54.8	19.90	4.67	18.96	3.31
38	11/16	9081	2992	54.6	20.07	4.88	19.29	2.84
39	11/16	9009	2992	54.8	20.64	5.56	20.28	0.71
40	11/16	8927	3076	54.8	21.28	6.62	20.60	1.23
41	11/16	8857	3291	65.6	21.29	5.67	20.60	1.55
42	11/16				21.40	5.32	20.28	4.00
				AVERAGE:	13.34	4.70	12.57	2.94
				STANDARD DEVIATION:	4.20	0.95	4.19	1.23

1. Water discharge from Wells Dam ranged from 155 kcfs at the start of the survey to 114 kcfs at the end.
2. Water discharge from Wells Dam ranged from 90 kcfs at the start of the survey to 125 kcfs at the end.

SECTION 6: DISCUSSION

6.1 Fish Assemblages in Rocky Reach Reservoir

6.1.1 Fish Distribution and Species Composition

The fish assemblage of Rocky Reach Reservoir was dominated by non-sportfish species, which contributed more than 99% to the total number of fish recorded during the 1999-2000 studies. The major non-sportfish species included, in order of decreasing abundance, threespine stickleback, northern pikeminnow, redside shiner, sucker spp. (primarily largescale sucker), chiselmouth, and peamouth. The most abundant sportfish species recorded was chinook salmon, followed by rainbow trout, mountain whitefish, and smallmouth bass. Mountain whitefish and smallmouth bass were relatively minor constituents of the sportfish population; only 10 mountain whitefish and 7 smallmouth bass were recorded, compared to 549 chinook salmon and 62 rainbow trout.

Distinct spatial distribution patterns were observed for the major fish species recorded in the reservoir, and these patterns were due primarily to the different physical characteristics in different sections of the reservoir. The lower section of the reservoir is more lacustrine in character and supports primarily species that prefer low velocity habitats. The upper section of the reservoir has more riverine characteristics, with higher velocities, and supports larger numbers of chinook salmon and rainbow trout than do the lower sections of the reservoir.

Chinook salmon and rainbow trout were recorded in all three sections of Rocky Reach Reservoir. However, the numbers of these two species were highest in the upper section of the reservoir, and declined with increasing distance downstream. Mountain whitefish and smallmouth bass were recorded only from the middle section of the reservoir.

Northern pikeminnow, redside shiner, and chiselmouth were distributed throughout the reservoir, but all of these species were most abundant in the lower section of the reservoir. The numbers of these species recorded declined with increasing distance upstream. Peamouth was also most abundant in the lower portion of the reservoir, and occurred in low numbers in both the middle and upper sections of the reservoir. The abundance of threespine stickleback was greatest in the middle section of the reservoir and very low in the upper section. Suckers were distributed throughout the reservoir, but were most abundant in the upper section. There was no apparent difference in the abundance of suckers between the lower and middle sections of the reservoir.

The composition of the fish assemblage in Rocky Reach Reservoir and the spatial distributions of the various species present are similar to those reported for other similar run-of-the-river reservoirs in the upper Columbia River drainage. The fish assemblage in Waneta Reservoir on the Pend d'Oreille River is also dominated by non-sportfish (primarily redside shiner, northern pikeminnow, and sucker species) and supports low populations of sportfish (R.L.&L. and Acres 1996). The spatial distribution of fish species reported for Waneta Reservoir was also similar to that observed in Rocky Reach Reservoir. In Waneta Reservoir, sportfish (primarily mountain whitefish) were common in the upper reaches of the reservoir and infrequent in the lower sections, while the lower sections were used primarily by coarse and forage fish species.

Similar fish species composition and distribution have also been reported in Brilliant Reservoir, a run-of the-river reservoir on the Kootenay River (R.L.&L. 1998). In that reservoir, largescale sucker, redside shiner, northern pikeminnow, and peamouth dominated the species assemblage in the middle and lower reaches of the reservoir. Sportfish species (mountain whitefish, rainbow trout, bull trout, and kokanee) in Brilliant Reservoir were mainly restricted to the uppermost reaches.

6.1.2 Limitations of Fish Sampling Methods

The ability to inventory fish populations and to describe habitat associations during the 1999-2000 investigations was limited, to some extent, by the sampling techniques that could be employed. The primary limitation, shared by all methods used, was that sampling was limited to relatively shallow water. Gillnets and electroshocking were not allowed under the federal and state permit. The full range of available habitats could not be effectively sampled with the methods used and the range of habitat associations described by the data is, therefore, similarly limited. In addition, the limitations of the sampling methods likely resulted in some species or life stages being over-represented in the catch and others being under-represented. The emphasis on shallow water sampling probably resulted in a higher proportion of juveniles and fry in the total catch than would have been the case if a broader range of habitats were effectively sampled.

A major limitation of the two primary sampling methods (fyke nets and Gee minnow traps) is due to the fact that they are passive capture techniques. They rely on fish moving into the traps, and therefore do not necessarily document actual habitat use very well. Fyke nets do have the advantage of capturing a relatively broad range of species and size classes. However, fish captured in these nets are those that

were travelling along the shoreline (probably mostly at night) rather than holding in a particular type of habitat. Gee minnow traps capture only small size classes of fish and appear to be effective at capturing only a few species.

One of the active sampling methods used was beach seining. While this technique is highly effective at capturing fish in shallow, gently sloping shoreline areas, it is effective only for sampling young age-classes or smaller fish species. Beach seining also cannot be employed efficiently where the slope of the bank is steep, where the substrate material is large or irregular, or where there are obstructions due to the presence of debris. The only other active sampling method used during the 1999-2000 studies was the snorkel survey. Snorkel surveys can be usefully employed along a variety of different shoreline types when visibility is suitable, to observe fish that may not be captured by passive sampling methods. During the 1999-2000 investigations, 65% of all chinook salmon and 79% of all rainbow trout recorded were fish observed during the snorkel surveys. The primary limitation of the snorkel survey method is that it is effective in relatively shallow water, along shorelines.

6.2 Habitat Assessment

Generally, depths increased in a downstream direction in Rocky Reach reservoir, with maximum depths associated with the dam itself. Velocities were swiftest in the Wells Dam tailrace at the head of the reservoir.

We were limited in the types of habitats that we could sample due to consideration for fish species listed under the Endangered Species Act (ESA). As a result, our permits greatly restricted sampling gear, and limited the numbers and variety of species that we could observe and map. Habitat types are, therefore, underestimated.

Per our agreement with Chelan PUD, we are developing habitat utilization curves for use in the Aquatic Habitat Mapping Survey. These curves are currently being developed in consultation with Chelan PUD. There is an important distinction between species utilization curves and preference curves. Utilization curves identify those depths, velocities, and substrate/cover with which the target species is associated without any consideration for "selection" of preferred habitats. (i.e. the abundance or availability of the habitat which is being measured). Preference curves take into account not only which habitat is being utilized, but also scales the use of a particular habitat variable based upon the relative abundance (or scarcity) of that habitat. For example, if fish use a habitat more frequently than they would be expected to, based on its abundance, it will have a higher preference for use than if the particular habitat is used less frequently than it is available.

6.3 Salmonid Spawning Surveys

Spawning habitat for salmon is limited in the Rocky Reach reservoir. Suitable substrate is found only in a few areas where water velocity is sufficient to remove fine sediment. Observations of spawning found fall chinook only, no other species of fish were observed spawning in this study. Below the Rocky Reach Dam the velocity is generally too high for salmonid spawning and the appropriate-sized gravel appeared to be perched on bedrock. Spawning redds constructed by fall chinook were observed only in the Chelan River and below Wells Dam along the west bank. Location, water depth and velocity measurements recorded during this survey are similar to those reported by Giorgi (1991) who conducted studies in the same location. Dauble et al. (1999) conducted studies in tailraces of dams in the Snake River and reported similar depth and velocities. Table 6.3-1 lists the range of velocities and depths reported by these authors and others. The range of velocities in the present study is wider than reported by others. This may be explained by the instruments used to measure velocity. The ADCP averages velocity measurements over a three-second interval, which is a relatively short period. This instrument likely captures a wider variation of velocities than if a longer interval is averaged. Also, these measurements were "point in time" measurements and not necessarily recorded during actual spawning.

Table 6.3-1. Spawning velocity and depth ranges for fall chinook reported by various authors.

STUDY	SPAWNING VELOCITY (ft/sec)	SPAWNING DEPTH (ft)
Current study	0.32 – 5.74	6.39 – 21.40
Dauble et al. 1999	1.0 – 2.3	13.1 – 26.6
Giorgi 1991	1.5 – 4.0	5.0 – 32.0
Vogel 1982	0.8 – 4.4	0.4 – 2.1
Bovee 1978	0.90 – 4.25	0.3 – 4.0

SECTION 7: LITERATURE CITED

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SECTION 8: APPENDICES