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COLUMBIA RIVER: SELECT AREA FISHERY EVALUATION PROJECT 1995-96 ANNUAL REPORTS

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COLUMBIA RIVER: SELECT AREA FISHERY EVALUATION PROJECT

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EXECUTIVE SUMMARY

The Columbia River Terminal Fisheries Research Project was initiated in 1993 and retitled the Select Area Fishery Evaluation (SAFE) Project in October 1997. In referring to the project in this report the preferred title, SAFE, will be used in most cases.

Water quality monitoring was conducted from November 1994 through October 1996 at five Oregon and three Washington select area study sites in the lower Columbia River. Physicochemical monitoring and aquatic biomonitoring programs were established to profile baseline parameters at each study site and document differences between study sites. Data collected at study sites where fish rearing operations were initiated indicate a potential negative impact on the surrounding benthic invertebrate communities. Recommended actions to reduce impacts include reducing amount of feed, lowering rearing densities, and leaving questionable sites fallow for one or more rearing seasons. Monitoring will continue to delineate indices of organic pollution that will signal necessary actions to maintain the health of the ecosystems adjacent to net-pen rearing operations.

Homing and straying rates have been calculated for 1993 brood coho to evaluate each study site's capability to successfully acclimate and imprint smolts. Stray rates of 0% for Youngs Bay, 0.5% for Blind Slough, 1.3% for Deep River, and 4.8% for Tongue Point compare favorably to results for previous net-pen releases at Youngs Bay. The only strays recovered were from Big Creek and Grays River hatcheries.

Select Area Brights (SAB) fall chinook released from Big Creek Hatchery have resulted in an alarmingly high stray rate while in contrast, releases from Youngs Bay net pens have produced substantially lower rates averaging only 2% to Washington lower Columbia streams. As a result, the broodstock program has been abandoned at Big Creek Hatchery and moved to Klaskanine Hatchery in the Youngs Bay drainage.

The potential of the study sites to harvest target species while avoiding non-target species was determined by test gillnetting during spring and fall months. In the spring, Tongue Point, Deep River, Blind Slough, and Steamboat Slough have the greatest potential. Similarly, in the fall the same sites plus Clifton Channel have good potential. Consistent test fishing results have been obtained since the program's inception.

Using test fishing results the initial SAFE fall commercial seasons were established in Tongue Point Basin, Blind Slough, and Deep River. Experimental releases of 1993 brood coho produced adult returns to select area fisheries which comprised 79% of the total commercial harvest of coho in the entire Columbia River. Adult survival rates for select area net-pen coho ranged from 3.8% to 1.6%, while Columbia River hatcheries generated adult survival rates of less than 1%. Nearly 100% of net-pen released coho were accounted for as harvest while most of the coho released from hatcheries were accounted for as adult escapement in 1996. Select area fall commercial fisheries in 1996 were successful in minimizing impacts on listed salmon under the Endangered Species Act. Only 18 upriver bright fall chinook were caught in select area fisheries with less than one Snake River wild fall chinook.

The anadromous fish stocks selected for use in select area rearing sites include early stock coho, SAB fall chinook, and Willamette spring chinook. Various rearing and release strategies including time and size of release, rearing density, and seasonal feeding experiments are being implemented. Health of juveniles is routinely monitored to aid in evaluation of release strategies and resultant survival rates as adults.

INTRODUCTION

DESCRIPTION OF CURRENT IO-YEAR PROJECT

In its 1993 Strategy For Salmon, the Northwest Power Planning Council recommended that terminal fishing sites be identified and developed to harvest abundant fish stocks while minimizing the incidental harvest of weak stocks. The Council called on the Bonneville Power Administration (BPA) to: “Fund a study to evaluate potential terminal fishery sites and opportunities. This study should include: general requirements for developing those sites (e.g., construction of acclimation/release facilities for hatchery smolts so that adult salmon would return to the area for harvest); the potential number of harvesters that might be accommodated; type of gear to be used; and other relevant information needed to determine the feasibility and magnitude of the program.

Beginning in 1993, BPA initiated the Columbia River Terminal Fisheries Project, a 1 0-year comprehensive program to investigate the feasibility of terminal fisheries in Youngs Bay and other sites in Oregon and Washington (BPA 1993). Terminal fisheries are being explored as a means to increase the sport and commercial harvest of hatchery fish while providing greater protection of weak wild salmon stocks. The project will be conducted in three distinct stages: an initial 2-year research stage to investigate potential sites, salmon stocks, and methodologies; a second 3-year stage of expansion in Youngs Bay and introduction into areas of greatest potential as shown from initial stage; and a final 5-year phase of establishment of terminal fisheries at full capacity at all acceptable sites.

The goal of the project is to determine the feasibility of creating and expanding terminal, known stock fisheries in the Columbia River Basin to allow harvest of strong anadromous salmonid stocks while providing greater protection to depressed fish stocks. This goal is to be accomplished by addressing nine defined project objectives:

1. Survey and categorize potential terminal fishing sites in the Columbia River basin for basic physical characteristics (high, medium, and low).

2. Determine the capability of the medium and high terminal fishing sites for rearing and acclimating anadromous fish species in net pens or other facilities.

3. Determine the capability of the medium and high terminal fishing sites to allow manageable and economically competitive harvest of returning fish.

4. For the medium and high terminal fishing sites, determine the potential for harvest of target and non-target fish species.

5. Evaluate the suitability of various anadromous fish stocks for use in the medium and

high terminal fishing sites.

6. Determine the generic costs and logistics of a large-scale net-pen rearing program (overwinter rearing and short-term acclimation) and estimate the variables for each of the medium and high terminal fishing sites.

7. Evaluate the effects of a large-scale net-pen rearing program (over-winter rearing and short-term acclimation) for terminal fishing on hatchery production programs.

8. Determine the effects on upriver fish runs, escapements, and Zone 6 fisheries of shifting various levels of historical Zone 1 - 5 commercial fisheries to terminal sites.

9. Coordinate activities with ODFW, WDFW, CEDC, BPA, National Marine Fisheries Service (NMFS), and Salmon For All (SFA).

DESCRIPTION OF WORK FOR CURRENT YEARS (1994-96)

Under each of the above objectives a listing of tasks and activities are to be accomplished throughout the 1 O-year project period. This report summarizes the activities, tasks, and findings for the contract period of September 1, 1994 through January 4, 1997. In general, those tasks are associated with five (5) chapters of this report and include, 1) determining capability of sites for rearing and acclimating anadromous species in net pens; 2) determining potential of harvest of target and non-target fish species; 3) construction of necessary facilities to research and develop select area salmon fisheries at Tongue Point, OR; Blind Slough, OR; Youngs Bay, OR; and Deep River, WA; 4) evaluating suitability of various available anadromous fish stocks for use in select area fishing sites; and 5) coordinating activities between agencies.

CHAPTER 1. CAPABILITY OF SITES FOR REARING AND ACCLIMATING ANADROMOUS SPECIES IN NET PENS

A. Water Quality Monitoring Program for Net-Pen Rearing Areas, November 1994 through December 1995

INTRODUCTION

The Columbia River Select Area Fishery Evaluation (SAFE) Project was initiated to provide salmonid fisheries for select or offstream areas of the lower Columbia River for public use with little or no negative biological impact to mainstem Columbia River fish runs.

The net-pen rearing phase of the project involves placing hatchery reared salmonid fry or fingerings in floating net pens in select or backwater areas of the lower Columbia River. These fish are then reared to smoltification and released into the wild and allowed to migrate to the ocean naturally. Fish are typically acclimated and cared for by hatchery personnel for periods as short as two weeks or as long as several months prior to release into the wild. Fish are fed fish food as well as being allowed to consume any naturally occurring invertebrates that may be attracted to the structure or washed into the net pens by the water currents. Expansion of these net-pen rearing operations to other suitable sites required some investigation into water quality of any potential sites for use as net-pen rearing operations. Water quality studies were begun to investigate several different locations for their potential use as fish rearing operations and to monitor water quality during and after the sites are used for fish rearing.

As net-pen rearing has developed, two main goals have been identified as the central focus of monitoring quality of the water in which fish will be placed. The first of these goals is to monitor physicochemical parameters at each of the sites over time to determine if there are any obvious problems in the immediate areas of the fish rearing pens. The second of the goals is to begin a biomonitoring program which would use benthic macroinvertebrates as indicators of any adverse change in the surrounding environment as a result of fish rearing operations. The following report addresses these two main goals and sets forth a baseline data set for future comparative use in **evaluating quality of water in and around net-pen rearing sites.**

METHODS AND MATERIALS

The study sites in ascending order from the mouth of the Columbia River are:

Youngs Bav, Oregon is located approximately 1.5 miles upstream from the mouth of Youngs Bay at Ivan Larsen's dock. This location has a strong estuarine influence and is located adjacent to a busy commercial marina. There is a fresh-water influence from the Lewis and Clark, Klaskanine and Youngs rivers.

Tongue Point, Oregon is located approximately 0.2 miles inside of the channel formed by Tongue Point and Mott Island on the federal government's Job Corps dock adjacent to the boat launching ramp. This location also has an estuarine influence, but to a lesser degree than Youngs Bay. It has a fresh-water influence from John Day River. Historically, this site was used by the U.S. Navy during War II.

Deep River, Washington is located about one mile upstream of the confluence of Deep River and the Columbia River and is owned by Steven Amala. This location has been eliminated from the list of locations that are monitored because of the possibility of conflict with log boom traffic. It was previously given a high priority rating.

Deep River, Washinnton is located approximately 0.5 miles upstream of the Washington State Highway # 4 bridge at Walter Kato's dock. This location has no saltwater influence. Historically, this location has been influenced by organic enrichment due to a log dump site upstream of the net-pen rearing operation. This resulted in deposition of a large amount of woody debris on the substrate. The log dump has been abandoned and out of use for about 20 years.

Blind Slouch, Oregon is located approximately 1.25 miles upstream from the confluence of Blind Slough and Knappa Slough and about 100 yards below the removable span bridge at Stan Kahn's dock. This location is also downstream of a former log dump site. A considerable amount of woody debris has also been deposited on the substrate as a result of past logging operations. Gnat Creek flows directly into Blind Slough providing fresh-water influence.

Steamboat Slough, Washington is located approximately 200 yards upstream of the confluence of Skamokawa Creek, Steamboat Slough and the Columbia River at Dan Silverman's dock in Steamboat Slough. This location has been used as commercial fish buying station and a commercial dock in the past. It has some unique fresh-water influence from the Elochoman River upstream and from Skamokowa Creek downstream, but it has a strong mainstem Columbia influence.

Cathlamet Channel, Washinaton is located approximately 200 yards downstream of the Cathlamet-Puget Island Bridge at Fred Johnson's dock. This location has little or no unique fresh-water influence and may be considered a mainstem Columbia River location. It was chosen as a potential site because it is located near a previous net-pen rearing site and had a history of having unique catches of local origin.

Clifton Channel, Oregon, which also could be considered mainstem, is located at the dock owned by Andros Marincovich about 200 yards upstream of the former Bumble Bee fish cannery. There is a small creek (Hunt Creek) about one mile upstream that may lend a small unique fresh-water influence at this location.

Wallace Slough, Oregon is located at a marina about 0.2 miles inside of the upstream confluence of Wallace Slough and the mainstem of the Columbia River. This marina is co-owned by Gary Viuhkola and Greg Poysky and is approximately 1.5 miles downstream of two lumber mills located outside of the town of Clatskanie, Oregon. Log rafts still pass by this location but it has a much smaller influence on the substrate because of high flushing action from a strong tidal current at this location. Clatskanie River mouth is immediately downstream from the site providing it's fresh-water influence.

Phvsicochemical Monitoring

To assess waters ability to sustain life, six aquatic physicochemical parameters have been measured electrometrically using a Hydrolab Inc. TM multiparameter water testing device. For the purpose of this report the term Hydrolab refers to the above described device. This computer-automated equipment is capable of collecting data from several electrometric probes simultaneously at any pre-programmed interval within the limits of a portable battery supply. The Hydrolab was deployed at all sites once monthly for 24-hour periods and programmed to collect data at 30-minute intervals, with the electrometric sensors placed at two meters (ca. 6 feet) into the water column at each present or potential net-pen rearing location.

Mean and standard deviations of the mean have been calculated for each of the following parameters. Water temperature is given in degrees Celsius. pH, which is a measure of the ionic concentration of the water, is given in undefined relative units. Specific conductance is a measure of the water's ability to conduct electricity and is directly related to the concentration of total dissolved salts in the water. Specific conductance is reported as micro Siemens per centimeter (micro mhos/centimeter) and is a measurement that is the inverse of resistance. Dissolved oxvoen is the amount of free oxygen available for respiration found in the water and is given as milligrams per liter. Due to a technical upgrade in the Hydrolab software, Dissolved oxvoen percent saturation is also given as a relative indicator of the expected amount of dissolved oxygen for water at any given temperature. This parameter is representative of all collections made after April 1995. Water turbiditv is a measure of suspended solids found in the water and is measured by an optic sensor known as a nephelometer that detects water's ability to refract light that is projected at a wave-length of 860 nanometers at right angles to the optic sensor. Turbidity data are reported as Nephelometric Turbidity Units (NTUs).

Aquatic Biomonitoring

An aquatic biomonitoring program was undertaken to detect any adverse changes at selected sites located on the lower Columbia River due to fish rearing operations. Adverse changes in biodiversity (species richness + species abundance), are an indication of a stressed biotic community. Net-pen operations located in the marine waters of Puget Sound have been shown to cause both acute and chronic stresses to the surrounding benthic biota (Striplin Environmental Associates, 1995a; 1995b). Net-pen rearing operations located on the lower Columbia River have a radically different ecosystem with which to contend and therefore a different system of evaluating this ecosystem must be used. It is the goal of this water quality monitoring program tb detect usable endpoints which indicate degradation of the surrounding ecosystem using both chemical and biological parameters as an indication of water quality. The data presented in this report will serve as a baseline for comparative purposes as benthic collections accumulate and are analyzed throughout the life of this net-pen rearing project.

Preliminary benthic macroinvertebrate collections were conducted at all of the potential net-pen rearing locations prior to placement of fish in the net pens. These collections were used both for determination of the minimum number of replicates per sample required for an accurate representation of benthic biota and as a data set representative of net-pen rearing locations prior to the placement of fish in the pens.

During April 1995 a petite Ponar dredge (15 cm x 15 cm opening) was used to collect six replicates each at both control and impact sites at each of the net-pen rearing locations. The benthos directly adjacent to the net pens was designated as the impact site, and the benthos located near the opposite shore (far enough away to be outside of the area affected by the net-pen operations), at a similar depth, was designated as the control site for that particular location. Samples were washed through a 500 micrometer sieve and fixed in Kahle's solution, a histological fixative especially well suited for fixation of aquatic invertebrates. After 24 - 48 hours samples were transferred to 70% ethyl alcohol for preservation and storage. All organisms were sorted, identified to the lowest possible taxon and enumerated using binocular stereo microscopes. Quality control checks of 20% of sorted samples from each site were conducted to check for organisms missed in the initial sorting procedure. Any replicate that was found to have missed more than 10% of the organisms in the organic debris after the initial sorting was cause for all samples from that site to be resorted.

Although nine net-pen rearing locations were used for collection of baseline data, only four of the sites were chosen for the purpose of determination of sample size. Ascending from the mouth of the Columbia River in an upstream direction the locations analyzed were: Tongue Point, Oregon; Deep River, Washington; Clifton Channel, Oregon; and Wallace Slough, Oregon. Samples were statistically analyzed using a two tailed t-test for means and a standard test for determination of sample replicate size (APHA, 1992). The formula for the computation of determination of sample replicate size is:

$$N = \left((t \times s) / (D \times x) \right)^2$$

Where: s = standard deviation of the samples from the preliminary survey
t = tabulated t value at the 0.05 level for the degrees of freedom of the preliminary survey
x = mean density of samples of preliminary survey
D = required level of precision expressed as a decimal (0.30 to 0.35 usually yields a statistically reliable estimate)

The benthic macroinvertebrate data was statistically analyzed using several different measures of biological community structure. It has been shown that benthic macroinvertebrate communities respond to environmental stress by having a lowered community diversity. Typically, there will be a loss or lowered number of ecologically sensitive species and an increase in the numbers of more ecologically tolerant species. There are two components of biological diversity. The first is taxa richness, or the number of species in a given ecosystem. The second is species abundance or the number of individuals in a given ecosystem. There are many statistical equations that attempt to reduce the richness and abundance values to a single figure that would give an index of the health of a given ecosystem. In the majority of these equations the highest diversity would exist if each individual belonged to a different species and the lowest diversity would exist if all individuals belonged to one species. Real world ecosystems fall somewhere in between these two extremes. Each of these diversity indices have different types of inherent bias from things like sensitivity to more common species or sensitivity to sample size. There are inherent problems with the use of all indices in that a certain amount of caution needs to be used so as not to make the mistake that this single numerical value not be the sole indicator of a given ecosystem's health. A close look at species assemblages and pollution tolerances of certain species and species groups, as well as life histories of these organisms needs to be taken into consideration. The indices used to evaluate this baseline data set were: Taxa richness (the number of species), species abundance (the numbers of individuals), relative abundance (the number per unit of area, given as organisms per square meter), as well as three biological indices Shannon's Index, reciprocal of Simpson's Index, and Pielou's Evenness Index.

Shannon's Diversity Index is: $H' = --\sum_i p_i l2\ (pi)$, $(i = 1,2,3,\ldots,S)$, $0 \leq H' \leq \infty$

Reciprocal of Simpson's Index is: $N_2 = (\sum_i p^2_i)^{-1}$, $(i= 1,2,3,\ldots,S)$, $0 \leq N_2 \leq S$

Pielou's Evenness Index is: $E = H'/\ln(s)$

$= -\sum_i p_i^{\ln}(p_i) / \ln(s)$

RESULTS

Phvsicochemical Monitoring

Physicochemical data are presented graphically in Figures l-9 and in tabular form in Tables l-8. Each site has different physicochemical characteristics so the data has been organized graphically by the different parameters for a visual comparison between different net-pen rearing locations. Tabular data has been organized by site with the arithmetic mean and standard deviation of the mean shown for all physicochemical parameters. Tables are self- explanatory with some exceptions. The dissolved oxygen percent concentration is an automated feature that gives an indication of expected dissolved oxygen value for that temperature and barometric pressure. This feature was available only after April 1995 due to a software upgrade provided by the Hydrolab Corporation. Due to equipment malfunction all physicochemical data for October 1995 at Wallace Slough, Clifton Channel, Blind Slough, and Tongue Point were lost.

The Youngs Bay location had a temperature low of 5.75 degrees C during the month of December 1994 and a high of 21.86 degrees C the month of July 1995. A pH of 6.33 was lowest during February and highest during May at 8.01. Specific conductivity varies greatly with a low of 134.09 micro Siemens per centimeter during February 1995 and a high of 9407.37 micro Siemens per centimeter during October 1995. Salinity is a function of specific conductivity, so the months that had the highs and lows of specific conductivity will be the same months that contain the highs and lows in the salinity category. Dissolved oxygen concentration fluctuates with the water temperature and barometric pressure. The waters ability to retain oxygen is inversely proportional to the water temperature so it would be expected that the highest dissolved oxygen concentrations to be at the time of the lowest water temperatures. The low for dissolved oxygen was during July 1995 at 6.64 mg/L and a high of 13.79 mg/L during December 1994. Turbidity was lowest during October 1995 at 6.24 NTUs and highest during January at 69.22 NTUs.

The Tongue Point location had a temperature low of 5.07 degrees C during January 1995 and a high of 20.10 degrees C during July 1995. Mean lows and highs for pH readings were 6.73 and 7.95 during December 1995 and May 1995, respectively. Specific conductivity lows and highs were 92.53 micro Siemens per centimeter and 2494.67 micro Siemens per centimeter during December 1995 August 1995, respectively. Dissolved oxygen concentrations were lowest and highest during the months of July and January 1995 with readings of 7.82 mg/l and 15.52 mg/L. Turbidity was lowest in August at 13.27 NTUs and highest during June 1995 at 74.81 NTUs.

The Deep River location had low and high temperatures of 4.59 degrees C and 23.37 degrees C during December 1994 and July 1995, respectively. Low and high mean ph readings were 4.98 and 6.47 during March 1995 and September 1995, respectively. Specific conductivity measurements were lowest and highest at 41.89 micro Semens per centimeter and 446.18 micro Semens per centimeter during March 1995 and October 1995, respectively. Dissolved oxygen concentrations were lowest and highest at 6.04 mg/L and 13.56 mg/L during August 1995 and December 1994, respectively. Turbidity was lowest during November 1995 at 4.77 NTUs and highest during November 1994 at 89.01 NTUs.

The Blind Slough location had low and high temperatures of 4.68 and 21.40 during December 1994 and August 1995, respectively. Low and high mean ph readings were recorded at 5.38 and 7.24 during March 1995 and May 1995, respectively. Specific conductivity was lowest at 39.36 and highest at 117.22 micro Semens per centimeter during November 1995 and September 1995, respectively. Dissolved oxygen concentrations were lowest at 7.08 mg/L during September 1995 and highest during December 1994 at 13.91 mg/L. Turbidity values were lowest during March 1995 at 6.63 NTUs and highest during June 1995 at 64.11 NTUs.

At Steamboat Slough the temperature lows and highs were recorded during January and July 1995 with readings of 3.68 degrees C and 21.23 degrees C, respectively. Mean pH lows and highs were recorded during February and May 1995 with readings of 6.70 and 8.07, respectively. Specific conductivity was lowest during December 1995 at 98.96 micro Semens per centimeter and highest during October 1995 at 158.49 micro Semens per centimeter. Dissolved oxygen concentrations were lowest during September 1995 at 8.35 mg/L and highest during December 1994 at 14.60 mg/L. Turbidity was lowest during October 1995 at 7.49 NTUs and highest during the month of December 1995 at 83.24 NTUs.

Clifton Channel had temperature lows of 4.3 degrees C during February 1995 and highs of 20.95 degrees C during August 1995. The low and high mean pH was recorded during December 1995 at 6.64 pH units and May 1995 at 7.73 ph units. Specific conductivity lows and highs were recorded during December 1995 and February 1995 with a low of 87.03 micro Semens per centimeter and a high of 149.96 micro Semens per centimeter, respectively. Dissolved oxygen concentrations were lowest during August 1995 at 8.78 mg/L and highest during February 1995 at 15.15 mg/L. Turbidity was lowest during September 1995 at 9.66 NTUs and highest during June 1995 at 65.10 NTUs.

Cathlamet Channel had low and high temperatures of 3.99 and 21.23 degrees C during the months of January and July 1995, respectively. Low and high mean pH values were recorded as 6.69 and 8.02 during February and May 1995, respectively. Specific conductivity lows and highs were recorded during December 1995 and October 1995 with values of 97.08 micro Semens per centimeter and 159.92 micro Semens per centimeter, respectively. Dissolved oxygen concentrations lows and highs were recorded during July 1995 and December 1994 with values of 8.51 mg/L and 14.43 mg/L, respectively. Turbidity lows and highs were recorded during October 1995 and December 1995 with values of 3.31 NTUs and 97.15 NTUs, respectively.

Wallace Slough had temperature lows and highs during January 1995 and August 1995 with readings of 4.11 degrees C and 21.06 degrees C, respectively. Mean low and high pH values were recorded during December 1995 and May 1995 with values of 6.59 and 7.79, respectively. Specific conductivity values were lowest during December 1995 at 81 .OO micro Semens per centimeter and highest during November 1994 at 147.04 micro Semens per centimeter. Dissolved oxygen concentrations were lowest during June 1995 at 8.17 mg/L and highest during December 1994 at 14.59 mg/L. Turbidity lows occurred during November 1995 with a mean value of 14.23 NTUs and the highest recorded was during June 1995 with a mean value of 125.71 NTUs.

Aquatic Biomonitoring Data

The biomonitoring data are presented in Tables 9-l 5. Tables 9-12 give results of the statistical analysis of the preliminary survey for determination of minimum numbers of replicates required for an accurate representation of benthic biota. For the Tongue Point location, the "N_2 " values for the control and impact sites were 2.6536 and 1.2678, respectively. For Deep River, the “N2” values for control and impact sites were 0.0005 and 0.00025, respectively. For Clifton Channel the “N2” Values for control and impact sites were 0.188 and 0.2297, respectively. For Wallace Slough the “N2” values for control and impact sites were 0.0005 and 0.0000078, respectively.

Benthic Macroinvertebrate Communitv Structure

Tables 13-l 5 give results of the analysis of the benthic macroinvertebrate community structure. Tables 13 through 16 are the lists of the organisms encountered in the benthos adjacent to the net pens. These data are useful indicators of the communities in and around the net pens. The taxa richness indicate that there are between six and fifteen species collected at each location. Relative abundance values indicate that the Youngs Bay control site had the highest relative abundance with 8005 organisms per square meter and that the Wallace Slough impact site had the lowest relative abundance with 129 organisms per square meter, but it also had the highest species diversity with an H’ value of 4.24. The site with the lowest species diversity was the Blind Slough impact site.

DISCUSSION AND CONCLUSIONS

Phvsicochemical Monitoring

The physicochemical parameters indicate some fairly normal ranges for all parameters at all sites. There are no instances of any parameters reaching dangerous levels at times when fish are being reared in pens. Specific conductivity readings indicate that none of the sites upriver of Tongue Point have any salt water influence. That is not to say that the salt wedge never reaches any further upstream than Tongue Point only that it does not invade the select areas as it does the mainstem. The pH values seem to indicate that as one moves upstream and nearer to the main channel, the pH values stabilize nearer a value of 7.0, which is neutral and an ideal condition to sustain life. This is indicated by generally lower standard deviations. All other parameters fall within normal ranges for the Columbia River.

Aquatic Biomonitoring

The analysis indicated that three benthic macroinvertebrate replicates per sample was adequate. For the purposes of this report only three replicates of the original six collected at both the control and the impact sites at each net-pen rearing location were biometrically analyzed for community structure.

As this water quality monitoring project has evolved, some adjustments to both the physicochemical monitoring and the benthic macroinvertebrate collection schedules have been made to accommodate a small personnel work pool and give adequate time required for sample preparation to improve the quality of data being collected and analyzed. The changes that have been made are to collect the physicochemical data once a month at all sites during the months that there are fish in the net pens and only bimonthly during the months that there are no fish in the pens.

The biomonitoring schedule will involve benthic collections in November, March, and June. The November sampling period would allow for a collection to be made that would be representative of the net-pen sites after the maximum recovery period since the previous seasons fish were released. The March collection period would be representative of the time during which fish were being reared, and the June collection period would be representative of the maximum amount of disturbance that could be caused by net-pen rearing operations. This schedule will be evaluated over the next year. Since a base line set of data has now been collected and analyzed, benthic collections will now be made only at sites where fish are going to be reared or acclimated. If any new sites are anticipated to be used for fish rearing an additional set of benthic collections will be made prior to the placement of fish in that location.

Biological diversity indices used to evaluate the benthic macroinvertebrate data have all been criticized for their various shortcomings. These indices have no founding or basis in biological systems; however there is some intrinsic value in the fact that these indices have been thoroughly tested in a variety of different ecological settings. The reciprocal of Simpson's Index (N2) was used rather than Simpson's Index because the original index obtained values ranging from zero to one and by using the reciprocal a much wider range of values from one to infinity can be expressed. Pielou's Evenness Index (E) gives an indication of how evenly the species are spread over the range of numbers in a given set (not the ecological habitat that these organisms occupy). Pielou's Index obtains values ranging from zero to one. Shannon's Index (H') has the possibly of having a value of infinity but it is usually less than five and always greater than zero. Furthermore, values exceeding three generally are thought to be an indication of clean water and that values of between one and three are indicators of moderate pollution, and in extreme cases values less than one are an indication of heavy pollution. This may be true in smaller more pristine streams with much lower levels of biological complexity. Shannon's Index is based on information theory and does a good job of indicating different levels of information. Occurrences of given species in a given ecosystem when reduced to their numbers are only pieces of information. In a system as complicated as the lower Columbia River this has to be taken into account. For the purpose of this study no ecological significance will be attached to the seemingly low values obtained here until a comparison is completed of any change in these values from subsequent sampling of the same benthic communities after fish have been reared at these sites .

As the net-pen rearing phase of the Columbia River SAFE Project expands, a close evaluation of the various available indices, as well as other indicators of organic pollution will be explored. The comparative use of chemical tests, such as total organic carbon (TOC) data when correlated with benthic macroinvertebrate data, has shown promise in the marine net-pen operations of the Puget Sound area. It is the intent of this water quality monitoring program to use any and all available methods within the projects financial and personnel resources to discover useful endpoints that give an accurate indication of the health of the ecosystems adjacent to the net-pen rearing operations.

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LITERATURE CITED

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Table 1. Physicochemical parameters for the select area net-pen rearing location, Youngs Bay, Oregon, November 1994 through December 1995.

Month		Temp degC	PH Units	SpCond us/cm	Salin ppt	DO %Sat	DO mg/l	Turb NTU
November 1994	MEAN->	8.60	7.20	6401.41	0.00	Probe not	8.70	55.61
	S.D.->	0.35	0.23	1962.09	0.00	Equipped	0.22	9.31
December 1994	MEAN->	5.75	7.28	6176.04	3.42	Probe not	13.79	39.50
	S.D.->	0.21	0.16	1653.59	0.94	Equipped	0.22	4.70
January 1995	MEAN->	6.86	6.75	1836.37	0.98	Probe not	12.81	69.22
	S.D.->	0.90	0.26	325.64	0.19	Equipped	0.36	23.86
February 1995	MEAN->	9.56	6.33	134.09	0.04	Probe not	12.24	58.62
	S.D.->	0.55	0.34	42.91	0.05	Equipped	0.46	30.05
March 1995	MEAN->	7.15	7.20	1915.90	1.02	Probe not	12.81	39.18
	S.D.->	0.26	0.21	1074.41	0.60	Equipped	0.24	4.30
April 1995	MEAN->	10.49	7.25	4799.20	2.63	Probe not	12.08	30.79
	S.D.->	0.19	0.10	537.81	0.31	Equipped	0.21	34.40
May 1995	MEAN->	17.11	8.01	1784.73	0.95	98.18	9.53	28.81
	S.D.->	0.61	0.18	609.05	0.34	6.65	0.62	14.79
June 1995	MEAN->	15.91	7.56	1813.00	0.97	102.15	10.04	tur(err)
	S.D.->	0.22	0.14	804.98	0.44	9.67	0.96	tur(err)
July 1995	MEAN->	21.86	7.30	2955.94	1.60	75.61	6.64	41.71
	S.D.->	0.57	0.10	880.46	0.49	5.21	0.44	24.73
August 1995	MEAN->	19.37	7.80	7760.57	4.34	91.75	8.34	36.94
	S.D.->	0.33	0.12	571.44	0.34	5.75	0.49	45.16
September 1995	MEAN->	19.36	7.72	8887.82	4.99	102.83	9.32	36.89
	S.D.->	0.38	0.09	269.34	0.16	5.17	0.46	13.60
October 1995	MEAN->	17.20	7.87	9407.37	5.31	95.06	8.99	6.24
	S.D.->	0.11	0.07	446.70	0.27	3.05	0.29	5.83
November 1995	MEAN->	10.91	6.69	537.00	0.27	92.63	10.36	25.51
	S.D.->	0.20	0.34	267.28	0.15	1.98	0.22	13.78
December 1995	MEAN->	8.07	6.91	1884.78	1.01	102.64	12.11	45.58
	S.D.->	0.35	0.27	824.21	0.46	1.41	0.24	13.96

Table 2. Physicochemical parameters for the select area net-pen rearing location, Tongue Point, Oregon, November 1994 through December 1995.

		Temp degC	PH Units	Second uS/cm	Salin ppt	DO %Sat	DO mg/l	Turb NTU
November 1994	MEAN->	8.40	7.28	389.18	0.00	Probe not	7.50	52.58
	S.D.->	0.17	0.06	142.41	0.00	Equipped	0.41	8.56
December 1994	MEAN->	5.32	7.67	1,005.35	0.51	Probe not	14.75	44.62
	S.D.->	0.10	0.05	292.22	0.16	Equipped	0.15	3.97
January 1995	MEAN->	5.07	7.36	1341.31	0.70	Probe not	15.52	18.11
	S.D.->	0.10	0.05	821.88	0.46	Equipped	0.31	1.02
February 1995	MEAN->	5.36	7.02	166.16	0.10	Probe not	14.39	55.49
	S.D.->	0.10	0.04	5.93	0.00	Equipped	0.10	44.82
March 1995	MEAN->	7.93	7.33	1189.37	0.63	Probe not	13.16	35.22
	S.D.->	0.11	0.12	763.73	0.42	Equipped	0.10	6.69
April 1995	MEAN->	9.57	7.55	745.92	0.10	Probe not	12.19	19.61
	S.D.->	0.26	0.07	450.95	0.00	Equipped	0.24	2.72
May 1995	MEAN->	15.84	7.95	132.51	0.10	103.31	10.35	34.74
	S.D.->	0.35	0.07	3.18	0.00	4.70	0.47	16.71
June 1995	MEAN->	15.99	7.52	135.04	0.10	94.40	9.41	74.81
	S.D.->	0.08	0.05	12.17	0.00	3.42	0.34	20.23
July 1995	MEAN->	20.10	7.33	132.89	0.10	84.98	7.82	61.85
	S.D.->	0.32	0.02	5.10	0.00	3.33	0.31	23.78
August 1995	MEAN->	19.67	7.71	2494.67	1.34	94.78	8.68	13.27
	S.D.->	0.26	0.09	1297.48	0.72	4.43	0.40	7.84
September 1995	MEAN->	19.60	7.47	1430.47	0.76	99.73	9.25	35.25
	S.D.->	0.12	0.10	768.31	0.42	3.57	0.32	5.66
October 1995	MEAN->	Hydrolab malfunctioned: No data available for this site						
	S.D.->	during this sampling period.						
November 1995	MEAN->	10.63	7.46	117.16	0.00	92.33	10.40	27.53
	S.D.->	0.08	0.05	3.07	0.00	1.41	0.15	13.69
December 1995	MEAN->	6.30	6.73	92.53	0.00	94.01	11.77	54.19
	S.D.->	0.19	0.04	1.22	0.00	1.19	0.20	12.79

Table 3. Physicochemical parameters for the select area net-pen rearing location, Deep River, Washington, November 1994 through December 1995.

Month		Temp degC	PH Units	Second uS/cm	Salin ppt	DO %Sat	DO mg/l	Turb NTU
November 1994	MEAN->	8.39	6.11	87.84	0.00	Probe not	8.33	89.01
	S.D.->	0.38	0.36	8.09	0.00	Equipped	0.35	28.18
December 1994	MEAN->	4.59	6.39	71.42	0.00	Probe not	13.56	72.00
	S.D.->	0.32	0.33	10.59	0.00	Equipped	0.51	18.25
January 1995	MEAN->	6.91	5.35	55.56	0.00	Probe not	12.26	66.15
	S.D.->	0.19	0.33	6.82	0.00	Equipped	0.59	60.17
February 1995	MEAN->	9.44	5.35	54.51	0.00	Probe not	12.81	58.73
	S.D.->	0.31	0.69	5.92		Equipped	0.66	20.81
March 1995	MEAN->	8.37	5.29	41.89	0.00	Probe not	11.14	22.52
	S.D.->	0.18	0.06	2.12	0.00	Equipped	0.21	7.86
April 1995	MEAN->	11.51	5.48	51.49	0.00	Probe not	11.48	21.94
	S.D.->	0.12	0.10	1.96	0.00	Equipped	0.25	3.08
May 1995	MEAN->	14.85	6.42	68.96	0.00	87.47	9.05	16.71
	S.D.->	0.39	0.17	3.49	0.00	7.11	0.68	6.00
June 1995	MEAN->	18.42	6.38	82.45	0.00	77.77	7.31	33.32
	S.D.->	0.27	0.14	2.85	0.00	5.55	0.51	6.96
July 1995	MEAN->	23.37	6.43	104.91	0.00	77.54	6.66	21.59
	S.D.->	0.36	0.13	2.74	0.00	7.67	0.64	7.86
August 1995	MEAN->	20.06	6.34	116.08	0.01	66.08	6.04	19.66
	S.D.->	0.38	0.11	4.49	0.03	5.56	0.47	4.77
September 1995	MEAN->	20.18	6.47	256.94	0.00	79.15	7.27	28.05
	S.D.->	0.20	0.08	4.06	0.00	5.53	0.49	9.31
October 1995	MEAN->	15.71	6.15	446.18	0.23	63.06	6.32	7.90
	S.D.->	0.41	0.17	86.87	0.06	2.58	0.23	2.00
November 1995	MEAN->	11.15	5.38	42.78	0.00	71.88	8.01	4.77
	S.D.->	0.19	0.04	1.50	0.00	2.68	0.30	0.62
December 1995	MEAN->	8.89	4.98	42.58	0.00	85.36	9.76	25.55
	S.D.->	0.33	0.06	1.51	0.00	2.70	0.37	3.24

Table 4. Physicochemical parameters for the select area net-pen rearing location, Blind Slough, Oregon, November 1994 through December 1995.

Month		Temp degC	PH Units	Second uS/cm	Salin ppt	DO %Sat	DO mg/l	Turb NTU
November 1994	Mean ->	7.17	5.49	59.85	0.00	Probe not	8.60	29.15
	S. D. ->	0.14	0.06	3.91	0.00	Equipped	0.18	6.49
December 1994	Mean->	4.68	5.97	47.42	0.00	Probe not	13.91	16.07
	S.D.->	0.09	0.04	2.00	0.00	Equipped	0.16	2.07
January 1995	MEAN->	6.34	5.67	45.08	0.00	Probe not	13.90	15.71
	S.D.->	0.30	0.11	5.27	0.00	Equipped	0.28	1.76
February 1995	MEAN->	5.27	5.73	58.18	0.00	Probe not	10.96	19.04
	S.D.->	0.20	0.14	9.32	0.00	Equipped	0.43	2.09
March 1995	MEAN->	8.89	5.38	42.73	0.00	Probe not	12.62	6.63
	S.D.->	0.15	0.03	0.96	0.00	Equipped	0.37	1.42
April 1995	MEAN->	9.95	5.72	50.58	0.00	Probe not	12.29	30.80
	S.D.->	0.34	0.16	7.27	0.00	Equipped	0.22	7.75
May 1995	MEAN->	17.60	7.24	78.96	0.00	102.57	9.89	30.40
	S.D.->	0.19	0.18	3.39	0.00	7.32	0.70	5.72
June 1995	MEAN->	15.85	6.83	91.10	0.00	86.78	8.65	64.11
	S.D.->	0.23	0.13	7.58	0.00	6.47	0.62	14.15
July 1995	MEAN->	19.98	6.79	96.79	0.00	105.05	9.70	16.29
	S.D.->	0.18	0.11	5.39	0.00	6.41	0.57	12.64
August 1995	MEAN->	21.40	6.78	110.35	0.00	80.10	7.16	49.40
	S.D.->	0.18	0.08	3.94	0.00	5.81	0.50	28.86
September 1995	MEAN->	19.42	6.61	117.22	0.00	75.69	7.08	27.37
	S.D.->	0.25	0.10	5.65	0.00	5.01	0.44	6.29
October 1995	MEAN->	Hydrolab malfunctioned: No data available for this site during this sampling period.						
	S.D.->							
November 1995	MEAN->	10.03	5.81	39.36	0.00	79.62	9.11	26.77
	S.D.->	0.32	0.22	10.23	0.00	4.46	0.50	17.31
December 1995	MEAN->	7.63	5.57	49.17	0.00	108.89	13.25	17.54
	S.D.->	0.16	0.06	4.48	0.00	3.52	0.39	3.32

Table 5. Physicochemical parameters for the proposed select area net-pen rearing location, Steamboat Slough, Washington, November 1994 through December 1995.

Month		Temp degC	PH Units	Second uS/cm	Salin ppt	DO %Sat	DO mg/l	Turb NTU
November 1994	MEAN->	10.06	6.87	117.37	0.00	Probe not	8.75	80.69
	S.D.->	0.11	0.03	1.24	0.00	Equipped	0.13	31.48
December 1994	MEAN->	5.84	7.24	110.52	0.00	Probe not	14.60	37.24
	S.D.->	0.12	0.08	3.73	0.00	Equipped	0.22	8.08
January 1995	MEAN->	3.68	7.35	129.45	0.10	Probe not	9.60	20.42
	S.D.->	0.07	0.04	2.97	0.00	Equipped	0.07	1.49
February 1995	MEAN->	6.69	6.70	118.91	0.00	Probe not	13.00	47.58
	S.D.->	0.15	0.03	1.11	0.00	Equipped	0.25	17.36
March 1995	MEAN->	6.37	7.11	125.19	0.08	Probe not	13.82	37.25
	S.D.->	0.08	0.05	3.01	0.04	Equipped	0.27	7.00
April 1995	MEAN->	9.29	7.01	137.20	0.10	Probe not	13.53	53.66
	S.D.->	0.13	0.02	1.02	0.00	Equipped	0.16	9.53
May 1995	MEAN->	12.97	8.07	148.41	0.10	107.89	11.59	32.72
	S.D.->	0.14	0.09	0.96	0.00	3.13	0.32	4.06
June 1995	MEAN->	16.07	7.60	122.73	0.08	99.48	9.90	46.68
	S.D.->	0.25	0.06	0.60	0.04	2.66	0.25	26.83
July 1995	MEAN->	21.23	7.32	134.30	0.10	93.75	8.39	25.14
	S.D.->	0.12	0.04	0.94	0.00	5.07	0.45	11.28
August 1995	MEAN->	20.73	7.37	140.39	0.10	99.33	8.95	9.54
	S.D.->	0.12	0.05	1.43	0.00	4.02	0.36	3.48
September 1995	MEAN->	20.45	7.26	152.67	0.10	91.43	8.35	33.13
	S.D.->	0.08	0.03	0.59	0.00	3.70	0.34	5.14
October 1995	MEAN->	17.65	7.41	158.49	0.00	102.61	9.96	7.49
	S.D.->	0.21	0.04	1.14	0.00	3.42	0.32	0.95
November 1995	MEAN->	10.62	7.31	99.95	0.00	86.51	9.62	17.57
	S.D.->	0.06	0.05	1.76	0.00	1.52	0.16	8.37
December 1995	MEAN->	7.21	6.71	98.96	0.00	107.57	13.09	83.24
	S.D.->	0.08	0.03	2.43	0.00	1.09	0.13	14.08

Table 6. Physicochemical parameters for the proposed select area net-pen rearing location, Clifton Channel, Oregon, November 1994 through December 1995.

Month		Temp degC	PH Units	Second uS/cm	Salin ppt	DO %Sat	DO mg/l	Turb NTU
November 1994	MEAN->	9.46	6.98	137.30	0.00	Probe not	8.80	22.63
	S.D.->	0.32	0.22	11.10	0.00	Equipped	0.17	19.43
December 1994	MEAN->	7.02	7.16	110.63	0.00	Probe not	11.59	61.77
	S.D.->	0.19	0.09	11.23	0.00	Equipped	0.24	14.75
January 1995	MEAN->	4.49	7.08	145.35	0.10	Probe not	14.14	8.38
	S.D.->	0.16	0.04	3.11	0.00	Equipped	0.15	0.82
February 1995	MEAN->	4.30	7.06	149.96	0.10	Probe not	15.15	26.87
	S.D.->	0.10	0.04	3.37	0.00	Equipped	0.07	1.31
March 1995	MEAN->	7.41	6.97	120.80	0.06	Probe not	9.68	14.34
	S.D.->	0.16	0.10	8.47	0.05	Equipped	0.15	0.94
April 1995	MEAN->	9.38	7.25	129.90	0.10	Probe not	13.49	25.83
	S.D.->	0.24	0.05	3.54	0.00	Equipped	0.12	4.43
May 1995	MEAN->	16.78	7.73	123.29	0.10	103.10	10.10	46.99
	S.D.->	0.28	0.08	0.50	0.00	3.68	0.33	6.23
June 1995	MEAN->	16.05	7.57	113.19	0.00	100.93	10.09	65.10
	S.D.->	0.12	0.08	0.44	0.00	3.64	0.35	11.63
July 1995	MEAN->	19.40	7.46	121.67	0.05	99.71	9.31	24.09
	S.D.->	0.16	0.11	0.99	0.05	3.29	0.29	20.19
August 1995	MEAN->	20.95	7.46	134.56	0.10	97.31	8.78	21.27
	SD.->	0.25	0.06	0.75	0.00	2.99	0.25	4.22
September 1995	MEAN->	20.13	7.29	143.19	0.00	98.96	9.11	9.66
	S.D.->	0.21	0.06	1.34	0.00	3.13	0.26	3.70
October 1995	MEAN->	Hydrolab malfunctioned: No data available for this site during this sampling period.						
	S.D.->							
November 1995	MEAN->	10.34	7.51	120.60	0.00	91.97	10.44	10.80
	S.D.->	0.12	0.03	4.18	0.00	1.16	0.13	1.65
December 1995	MEAN->	6.64	6.64	87.03	0.00	115.94	14.43	49.94
	S.D.->	0.05	0.05	2.04	0.00	0.67	0.09	3.35

Table 7. Physicochemical parameters for the proposed select area net-pen rearing location, Cathlamet Channel, Washington, November 1994 through December 1995.

Month		Temp degC	PH Units	Second uS/cm	Salin ppt	DO %Sat	DO mg/l	Turb NTU
November 1994	MEAN->	10.48	6.77	104.04	0.00	Probe not	7.33	19.66
	S.D.->	0.23	0.02	2.01	0.00	Equipped	0.54	1.58
December 1994	MEAN->	6.47	7.22	109.78	0.00	Probe not	14.43	58.01
	S.D.->	0.10	0.03	1.97	0.00	Equipped	0.14	9.96
January 1995	MEAN->	3.99	7.26	127.25	0.10	Probe not	13.17	26.36
	S.D.->	0.16	0.07	2.72	0.00	Equipped	0.09	1.53
February 1995	MEAN->	6.55	6.69	121.66	0.00	Probe not	10.65	42.20
	S.D.->	0.07	0.02	1.54	0.00	Equipped	0.23	2.45
March 1995	MEAN->	6.82	6.91	119.79	0.00	Probe not	13.79	40.32
	S.D.->	0.09	0.05	1.35	0.00	Equipped	0.10	2.43
April 1995	MEAN->	8.97	7.00	138.17	0.10	Probe not	12.14	51.50
	S.D.->	0.18	0.04	1.04	0.00	Equipped	0.13	16.10
May 1995	MEAN->	13.59	8.02	132.43	0.10	Probe not	10.43	20.95
	S.D.->	0.10	0.04	1.27	0.00	Equipped	0.35	2.82
June 1995	MEAN->	15.84	7.67	124.45	0.00	102.79	10.30	23.14
	SD.->	0.17	0.04	1.42	0.00	12.98	0.30	5.13
July 1995	MEAN->	21.23	7.38	131.55	0.10	94.94	8.51	10.24
	S.D.->	0.11	0.03	0.90	0.00	3.04	0.27	1.58
August 1995	MEAN->	20.46	7.64	143.12	0.10	102.76	9.36	16.22
	S.D.->	0.20	0.08	0.93	0.00	4.22	0.37	1.88
September 1995	MEAN->	20.29	7.36	150.21	0.10	90.83	8.29	45.54
	S.D.->	0.18	0.01	3.70	0.00	3.56	0.32	6.32
October 1995	MEAN->	17.64	7.41	159.92	0.00	97.21	9.38	3.31
	S.D.->	0.07	0.02	1.93	0.00	2.48	0.24	0.48
November 1995	MEAN->	10.72	7.48	112.99	0.00	97.14	10.95	14.53
	S.D.->	0.04	0.01	0.83	0.00	1.12	0.13	1.66
December 1995	MEAN->	7.24	6.75	97.08	0.00	93.20	11.33	97.15
	S.D.->	0.04	0.02	2.07	0.00	2.88	0.36	6.50

Table 8. Physicochemical parameters for the proposed select area net-pen rearing location, Wallace Slough, Oregon, November 1994 through December 1995.

Month		Temp degC	PH Units	Second uS/cm	Salin ppt	DO %Sat	DO mg/l	Turb NTU
November 1994	MEAN->	9.25	7.19	147.04	0.00	Probe not	9.08	42.67
	S.D.->	0.12	0.03	1.46	0.00	Equipped	0.14	7.52
December 1994	MEAN->	6.43	7.29	135.62	0.00	Probe not	14.59	47.37
	S.D.->	0.07	0.05	3.00	0.00	Equipped	0.14	5.29
January 1995	MEAN->	4.11	7.33	144.22	0.10	Probe not	14.38	16.02
	S.D.->	0.09	0.07	3.42	0.00	Equipped	0.14	1.48
February 1995	MEAN->	4.54	6.87	144.76	0.10	Probe not	14.39	51.34
	S.D.->	0.35	0.08	2.63	0.00	Equipped	0.19	88.90
March 1995	MEAN->	7.79	7.04	132.12	0.10	Probe not	13.10	31.44
	S.D.->	0.20	0.07	0.98	0.00	Equipped	0.15	3.92
April 1995	MEAN->	9.78	7.11	118.43	0.00	Probe not	11.83	38.44
	S.D.->	0.17	0.03	0.88	0.00	Equipped	0.13	10.37
May 1995	MEAN->	16.90	7.79	122.31	0.10	103.92	10.17	54.32
	S.D.->	0.34	0.96	0.51	0.00	3.16	0.26	16.24
June 1995	MEAN->	16.22	7.60	114.10	0.00	82.23	8.17	125.71
	S.D.->	0.25	0.05	0.62	0.00	2.10	0.21	80.36
July 1995	MEAN->	19.65	7.61	118.83	0.00	111.87	10.36	23.94
	S.D.->	0.33	0.10	0.18	0.00	4.52	0.39	9.30
August 1995	MEAN->	21.06	7.52	133.29	0.10	92.92	8.36	69.65
	S.D.->	0.24	0.07	0.55	0.00	3.75	0.31	139.30
September 1995	MEAN->	20.27	7.36	140.87	0.10	110.47	10.09	20.23
	S.D.->	0.31	0.07	0.70	0.00	5.25	0.44	9.54
October 1995	MEAN->	Hydrolab malfunctioned: No data available for this site during this sampling period.						
	S.D.->							
November 1995	MEAN->	10.68	7.49	113.85	0.00	101.44	11.38	14.23
	S.D.->	0.23	0.02	1.25	0.00	1.47	0.17	9.32
December 1995	MEAN->	6.98	6.59	81.00	0.00	116.39	14.35	58.35
	S.D.->	0.16	0.07	1.09	0.00	0.98	0.13	2.92

Table 9. Statistical analysis of the preliminary survey of the benthic macroinvertebrates for the determination of sample replicate size at Tongue Point, Oregon, April 1995.

		CONTROL SITE			IMPACT SITE		
Date	Location	Sample #	Taxon	Number	Sample #	Taxon	Number
04/12/95	Tongue Point	1	Nematoda	6	7	Nematoda	11
04/12/95	Tongue Point	1	Oligochaeta	30	7	Oligochaeta	69
04/12/95	Tongue Point	1	Ampharitidae	12	7	Ampharitidae	60
04/12/95	Tongue Point	1	Nereidae	2	7	Nereidae	5
04/12/95	Tongue Point	1	Corophium spp.	169	7	Chironomidae	2
04/12/95	Tongue Point	2	Nematoda	2	7	Macoma balthica	2
04/12/95	Tongue Point	2	Oligochaeta	14	8	Nematoda	90
04/12/95	Tongue Point	2	Ampharitidae	6	8	Oligochaeta	102
04/12/95	Tongue Point	2	Nereidae	3	8	Ampharitidae	123
04/12/95	Tongue Point	2	Chironomidae	1	8	Nereidae	10
04/12/95	Tongue Point	2	Corophium spp.	101	8	Chironomidae	5
04/12/95	Tongue Point	3	Nematoda	12	8	Ceratopogonidae	1
04/12/95	Tongue Point	3	Oligochaeta	10	8	Corophium spp.	9
04/12/95	Tongue Point	3	Ampharitidae	10	8	Copopoda	12
04/12/95	Tongue Point	3	Nereidae	2	8	Ostracoda	8
04/12/95	Tongue Point	3	Corophium spp.	300	8	Macoma balthica	2
04/12/95	Tongue Point	3	Ostracoda	3	9	Nematoda	155
04/12/95	Tongue Point	3	Macoma balthica	10	9	Oligochaeta	142
04/12/95	Tongue Point	3	Goniobasis spp.	2	9	Ampharitidae	168
04/12/95	Tongue Point	4	Oligochaeta	22	9	Nereidae	4
04/12/95	Tongue Point	4	Ampharitidae	10	9	Chironomidae	3
04/12/95	Tongue Point	4	Nereidae	1	9	Copopoda	54
04/12/95	Tongue Point	4	Corophium spp.	115	9	Ostracoda	19
04/12/95	Tongue Point	5	Oligochaeta	46	9	Macoma balthica	4
04/12/95	Tongue Point	5	Ampharitidae	30	9	Goniobasis spp.	1
04/12/95	Tongue Point	5	Chironomidae	2	10	Nematoda	29
04/12/95	Tongue Point	5	Corophium spp.	251	10	Oligochaeta	162
04/12/95	Tongue Point	5	Ostracoda	1	10	Ampharitidae	128
04/12/95	Tongue Point	5	Macoma balthica	1	10	Nereidae	5
04/12/95	Tongue Point	5	Goniobasis spp.	1	10	Copopoda	55
04/12/95	Tongue Point	6	Nematoda	1	10	Ostracoda	11
04/12/95	Tongue Point	6	Ampharitidae	6	11	Nematoda	20
04/12/95	Tongue Point	6	Nereidae	1	11	Oligochaeta	41
04/12/95	Tongue Point	6	Corophium spp.	97	11	Ampharitidae	52
04/12/95	Tongue Point	6	Macoma balthica	1	11	Nereidae	1
04/12/95	Tongue Point				11	Chironomidae	2
04/12/95	Tongue Point				11	Copopoda	1
04/12/95	Tongue Point				11	Ostracoda	3
04/12/95	Tongue Point				12	Nematoda	179
04/12/95	Tongue Point				12	Oligochaeta	238
04/12/95	Tongue Point				12	Ampharitidae	157
04/12/95	Tongue Point				12	Nereidae	6
04/12/95	Tongue Point				12	Chironomidae	2
04/12/95	Tongue Point				12	Copopoda	34
04/12/95	Tongue Point				12	Ostracoda	41
04/12/95	Tongue Point				12	Macoma balthica	6
04/12/95	Tongue Point				12	Goniobasis spp.	1
			MEAN-------------------->	34.62		MEAN--------->	45.61
			S.D.------------------------->	70.56		S.D.------------->	64.21

t-Test: Paired Two-Sample for Means	
Mean	37.50
Variance	5211.71
Observations	34.00
Pearson Correlation	N.A.
Pooled Variance	4491.37
Hypothesized Mean Difference	65.00
df	-0.70
t -->	0.24
P(T<=t) one-tail	1.67
t Critical one-tail	0.49
P(T<=t) two-tail	2.00
t Critical two-tail	
t Critical two-tail	

$N = ((t \times s) / (D \times X))^2$

Where: s = Standard deviation of the samples from the preliminary survey.
t = Tabulated t - value at the 0.05 level for the degrees of freedom of the Preliminary survey.
X = The mean density of the samples of the preliminary survey.
D = Required level of precision expressed as a decimal (0.30 - 0.35 usually yields a statistically reliable estimate.

Control Site

$((.24 \times 70.58) / (.30 \times 34.62))^2$ N = 2.6536

Impact Site

$((.24 \times 64.21) / (.30 \times 45.61))^2$ N = 1.2678

Table 10. Statistical analysis of the preliminary survey of the benthic macroinvertebrates for determination of sample replicate size at Deep River, Washington, April 1995.

		CONTROL SITE			IMPACT SITE		
Date	Location	Sample #	Taxon	Number	Sample #	Taxon	Number
04/05/95	Deep River	1	Nematoda	58	7	Nematoda	2
04/05/95	Deep River	1	Oligochaeta	189	7	Oligochaeta	108
04/05/95	Deep River	1	Chironomidae	16	7	Chironomidae	11
04/05/95	Deep River	1	Ceratopogonidae	10	7	Ceratopogonidae	5
04/05/95	Deep River	1	Ephemera spp.	2	7	Corophium spp.	5
04/05/95	Deep River	1	Corophium spp.	83	7	Copopoda	1
04/05/95	Deep River	1	Copopoda	5	7	Ostracoda	1
04/05/95	Deep River	1	Bosmina spp.	4	7	Hydracarina	1
04/05/95	Deep River	1	Ostracoda	27	7	Macoma balthica	2
04/05/95	Deep River	1	Hydracarina spp.	5	8	Oligochaeta	32
04/05/95	Deep River	1	Macoma balthica	22	8	Hirudinea	1
04/05/95	Deep River	1	Corbicula fluminea	1	8	Chironomidae	13
04/05/95	Deep River	2	Nematoda	81	8	Gomphidae ?	1
04/05/95	Deep River	2	Oligochaeta	151	8	Corophium spp.	46
04/05/95	Deep River	2	Chironomidae	31	8	Macoma balthica	3
04/05/95	Deep River	2	Ceratopogonidae	17	8	UNID , Anodonta ?	1
04/05/95	Deep River	2	Ephemera spp.	3	9	Nematoda	4
04/05/95	Deep River	2	Corophium spp.	43	9	Oligochaeta	77
04/05/95	Deep River	2	Copopoda	5	9	Hirudinea	1
04/05/95	Deep River	2	Ostracoda	10	9	Chironomidae	46
04/05/95	Deep River	2	Hydracarina spp.	1	9	Ceratopogonidae	29
04/05/95	Deep River	2	Macoma balthica	35	9	Corophium spp.	29
04/05/95	Deep River	3	Nematoda	66	9	Copopoda	1
04/05/95	Deep River	3	Oligochaeta	189	9	Ostracoda	2
04/05/95	Deep River	3	Chironomidae	18	9	Hydracarina	1
04/05/95	Deep River	3	Ceratopogonidae	7	9	Macoma balthica	6
04/05/95	Deep River	3	Trichoptera	1	10	Nematoda	4
04/05/95	Deep River	3	Ephemera spp.	4	10	Oligochaeta	138
04/05/95	Deep River	3	Corophium spp.	97	10	Chironomidae	56
04/05/95	Deep River	3	Bosmina spp.	4	10	Ceratopogonidae	3
04/05/95	Deep River	3	Ostracoda	30	10	Ephemera spp.	3
04/05/95	Deep River	3	Hydracarina	4	10	Corophium spp.	4
04/05/95	Deep River	3	Macoma balthica	19	10	Copopoda	2
04/05/95	Deep River	3	Corbicula fluminea	1	10	Bosmina spp.	3
04/05/95	Deep River	4	Nematoda	47	10	Daphnia spp.?	1
04/05/95	Deep River	4	Oligochaeta	145	10	Ostracoda	4
04/05/95	Deep River	4	Chironomidae	20	10	Hydracarina	2
04/05/95	Deep River	4	Ceratopogonidae	14	10	Macoma balthica	1
04/05/95	Deep River	4	Ephemera spp.	2	11	Nematoda	5
04/05/95	Deep River	4	Argia spp.?	1	11	Oligochaeta	161
04/05/95	Deep River	4	Corophium spp.	32	11	Chironomidae	14
04/05/95	Deep River	4	Bosmina spp.	2	11	Ceratopogonidae	2
04/05/95	Deep River	4	Ostracoda	13	11	Ephemera spp.	1
04/05/95	Deep River	4	Macoma balthica	13	11	Corophium spp.	1
04/05/95	Deep River	5	Nematoda	89	11	Copopoda, cyclopoida	1
04/05/95	Deep River	5	Oligochaeta	124	11	Copopoda, calanoida	1
04/05/95	Deep River	5	Chironomidae	17	11	Ostracoda	6
04/05/95	Deep River	5	Ceratopogonidae	7	11	Hydracarina	2
04/05/95	Deep River	5	Trichoptera	4	11	Macoma balthica	1
04/05/95	Deep River	5	Corophium spp.	87	12	Nematoda	4
04/05/95	Deep River	5	Copopoda	2	12	Oligochaeta	132
04/05/95	Deep River	5	Bosmina spp.	5	12	Chironomidae	5
04/05/95	Deep River	5	Daphnia spp.?	2	12	Ceratopogonidae	1
04/05/95	Deep River	5	Ostracoda	23	12	UNID Coleoptera?	1
04/05/95	Deep River	5	Hydracarina	4	12	Ostracoda	3
04/05/95	Deep River	5	Macoma balthica	24	12	Macoma balthica	3
04/05/95	Deep River	6	Nematoda	42	12	Corbicula fluminea	1
04/05/95	Deep River	6	Oligochaeta	109			
04/05/95	Deep River	6	Chironomidae	17			
04/05/95	Deep River	6	Ceratopogonidae	7			
04/05/95	Deep River	6	Corophium spp.	73			
04/05/95	Deep River	6	Copopoda	16			
04/05/95	Deep River	6	Ostracoda	7			
04/05/95	Deep River	6	Hydracarina	2			
04/05/95	Deep River	6	Macoma balthica	19			
04/05/95	Deep River	6	Pissidae?	2			
			MEAN---------->	33.48		MEAN---------->	17.46
			S.D.--------------->	45.77		S.D.--------------->	36.23

t-Test: Paired Two-Sample for Means	
Mean	33.11
Variance	2118.04
Observations	65.00
Pearson Correlation	ERR
Pooled Variance	1630.88
Hypothesized Mean Difference	120.00
df	2.50
t -->	0.01
P(T<=t) one-tail	1.66
t Critical one-tail	0.01
P(T<=t) two-tail	1.98
t Critical two-tail	

$N = ((t \times s) / (D \times X))^2$

Where:
- s = Standard deviation of the samples from the preliminary survey.
- t = Tabulated t-value at the 0.05 level for the degrees of freedom of the preliminary survey.
- X = The mean density of the samples of the preliminary survey.
- D = Required level of precision expressed as a decimal (0.30 - 0.35 usually yields a statistically reliable estimate.

Control Site

$((.01 \times 33.48) / (.30 \times 45.77))^2$ N = .0005

Impact Site

$((.01 \times 17.46) / (.30 \times 36.23))^2$ N = .000025

Table 11. Statistical analysis of the preliminary survey of the benthic macroinvertebrates for determination of sample replicate size at Clifton Channel, Oregon, April 1995.

		CONTROL SITE			IMPACT SITE		
Date	Location	Sample #	Taxon	Number	Sample #	Taxon	Number
04/17/95	Clifton Channel	1	Nematoda	2	7	Nematoda	12
04/17/95	Clifton Channel	1	Chironomidae	2	7	Oligochaeta	94
04/17/95	Clifton Channel	1	UNID Gomphidae?	2	7	Chironomidae	12
04/17/95	Clifton Channel	1	Corophium spp.	511	7	Ephemera spp.	1
04/17/95	Clifton Channel	1	Macoma balthica	25	7	UNID Gomphidae?	1
04/17/95	Clifton Channel	1	Corbicula fluminea	3	7	Corophium spp.	502
04/17/95	Clifton Channel	1	Goniobasis spp.	1	7	Ostracoda	2
04/17/95	Clifton Channel	1	UNID gastropoda	18	7	Macoma balthica	6
04/17/95	Clifton Channel	2	Nematoda	2	7	UNID Pissidae?	2
04/17/95	Clifton Channel	2	Oligochaeta	52	8	UNID Gastropoda	3
04/17/95	Clifton Channel	2	Chironomidae	2	8	Nematoda	12
04/17/95	Clifton Channel	2	UNID Gomphidae?	1	8	Oligochaeta	77
04/17/95	Clifton Channel	2	Corophium spp.	932	8	Chironomidae	5
04/17/95	Clifton Channel	2	Macoma balthica	24	8	UNID Gomphidae?	1
04/17/95	Clifton Channel	2	Corbicula fluminea	2	8	Corophium spp.	601
04/17/95	Clifton Channel	2	UNID Gastropoda	35	8	Macoma balthica	15
04/17/95	Clifton Channel	3	Nematoda	2	8	UNID Gastropoda	2
04/17/95	Clifton Channel	3	Oligochaeta	23	9	Nematoda	6
04/17/95	Clifton Channel	3	Chironomidae	1	9	Oligochaeta	37
04/17/95	Clifton Channel	3	Corophium spp.	578	9	Chironomidae	8
04/17/95	Clifton Channel	3	Macoma balthica	13	9	Ceratopogonidae	1
04/17/95	Clifton Channel	3	Corbicula fluminea	1	9	Ephemera spp.	1
04/17/95	Clifton Channel	3	UNID Gastropoda	5	9	Corophium spp.	131
04/17/95	Clifton Channel	4	Oligochaeta	2	9	Macoma balthica	1
04/17/95	Clifton Channel	4	Chironomidae	1	10	Nematoda	26
04/17/95	Clifton Channel	4	Corophium spp.	462	10	Oligochaeta	166
04/17/95	Clifton Channel	4	Macoma balthica	27	10	Chironomidae	10
04/17/95	Clifton Channel	4	UNID Gastropoda	24	10	Ceratopogonidae	1
04/17/95	Clifton Channel	5	Nematoda	1	10	Ephemera spp.	1
04/17/95	Clifton Channel	5	Oligochaeta	5	10	Corophium spp.	496
04/17/95	Clifton Channel	5	Chironomidae	1	10	Macoma balthica	6
04/17/95	Clifton Channel	5	Corophium spp.	171	10	Corbicula fluminea	4
04/17/95	Clifton Channel	5	Macoma balthica	12	11	Nematoda	29
04/17/95	Clifton Channel	5	Corbicula fluminea	3	11	Oligochaeta	79
04/17/95	Clifton Channel	5	UNID Gastropoda	12	11	Chironomidae	4
04/17/95	Clifton Channel	6	Oligochaeta	17	11	Ephemera spp.	4
04/17/95	Clifton Channel	6	Corophium spp.	778	11	Corophium spp.	531
04/17/95	Clifton Channel	6	Macoma balthica	22	11	Ostracoda	2
04/17/95	Clifton Channel	6	Corbicula fluminea	3	11	Macoma balthica	8
04/17/95	Clifton Channel	6	UNID Gastropoda	36	11	UNID Gastropoda	1
04/17/95	Clifton Channel	6	Goniobasis spp.	2	12	Nematoda	18
04/17/95	Clifton Channel				12	Oligochaeta	30
04/17/95	Clifton Channel				12	Chironomidae	13
04/17/95	Clifton Channel				12	Corophium spp.	354
04/17/95	Clifton Channel				12	Macoma balthica	14
04/17/95	Clifton Channel				12	UNID Gastropoda	1
			MEAN------------>	93.07317		MEAN------------>	72.41304
			S.D.--------------->	221.7298		S.D.-------------->	156.1046

t-Test: Paired Two-Sample for Means	
Mean	95.35
Variance	50206.75
Observations	40.00
Pearson Correlation	ERR
Pooled Variance	36758.09
Hypothesized Mean Difference	69.00
df	0.51
t -->	0.31
P(T<=t) one-tail	1.67
t Critical one-tail	0.61
P(T<=t) two-tail	1.99
t Critical two-tail	

$N = ((t \times s) / (D \times X))^2$

Where: x = Standard deviation of the samples from the preliminary survey.
t = Tabulated t-value at the 0.05 level for the degrees of freedom of the Preliminary survey.
X = The mean density of the samples of the preliminary survey.
D = Required level of precision expressed as a decimal (0.30 - 0.35 Usually yields a statistically reliable estimate.

Control Site

$((.31 \times 93.07) / (.30 \times 221.73))^2$ N = .188

Impact Site

$((.31 \times 72.41) / (.30 \times 156.1))^2$ N = .2297

Table 12. Statistical analysis of the preliminary survey of the benthic macroinvertebrates for determination of sample replicate size at Wallace Slough, Oregon, April 1995.

		CONTROL SITE			IMPACT SITE		
Date	Location	Sample #	Taxon	Number	Sample #	Taxon	Number
04/17/95	Wallace Slough	1	Oligochaeta	4	7	Nematoda	40
04/17/95	Wallace Slough	1	Chironomidae	1	7	Oligochaeta	628
04/17/95	Wallace Slough	1	Corophium spp.	3	7	Hirudinea	5
04/17/95	Wallace Slough	1	UNID Bivalvia	2	7	Chironomidae	65
04/17/95	Wallace Slough	1	UNID Gastropoda	11	7	Ceratopogonidae	13
04/17/95	Wallace Slough	2	Oligochaeta	3	7	Corophium spp.	1
04/17/95	Wallace Slough	2	Chironomidae	2	7	Bosmina longrostris	1
04/17/95	Wallace Slough	2	Corophium spp.	4	7	Copopoda	1
04/17/95	Wallace Slough	2	Macoma balthica	4	7	UNID Gastropoda	6
04/17/95	Wallace Slough	2	UNID Bivalvia	1	8	Nematoda	14
04/17/95	Wallace Slough	2	UNID Gastropoda	4	8	Oligochaeta	763
04/17/95	Wallace Slough	3	Nematoda	1	8	Chironomidae	74
04/17/95	Wallace Slough	3	Oligochaeta	2	8	Ceratopogonidae	12
04/17/95	Wallace Slough	3	Chironomidae	1	8	Ephemera spp.	1
04/17/95	Wallace Slough	3	Corophium spp.	7	8	Gomphidae ?	1
04/17/95	Wallace Slough	3	Macoma balthica	2	8	Corophium spp.	2
04/17/95	Wallace Slough	3	Corbicula fluminea	1	8	Daphnia spp.	1
04/17/95	Wallace Slough	3	UNID Gastropoda	5	8	Ostracoda	1
04/17/95	Wallace Slough	4	Nematoda	1	8	UNID Gastropoda	1
04/17/95	Wallace Slough	4	Oligochaeta	3	8	Macoma balthica	7
04/17/95	Wallace Slough	4	Chironomidae	2	9	Nematoda	15
04/17/95	Wallace Slough	4	Corophium spp.	6	9	Oligochaeta	457
04/17/95	Wallace Slough	4	Macoma balthica	2	9	Chironomidae	77
04/17/95	Wallace Slough	4	UNID Gastropoda	2	9	Ceratopogonidae	5
04/17/95	Wallace Slough	5	Oligochaeta	3	9	Ostracoda	1
04/17/95	Wallace Slough	5	Chironomidae	1	9	Hydracarina	1
04/17/95	Wallace Slough	5	Corophium spp.	9	9	UNID Gastropoda	3
04/17/95	Wallace Slough	5	Macoma balthica	2	9	Macoma balthica	10
04/17/95	Wallace Slough	5	Goniobasis spp	3	10	Nematoda	36
04/17/95	Wallace Slough	5	UNID Gastropoda	4	10	Oligochaeta	715
04/17/95	Wallace Slough	6	Oligochaeta	4	10	Hirudinea	2
04/17/95	Wallace Slough	6	Corophium spp.	7	10	Chironomidae	158
04/17/95	Wallace Slough	6	Macoma balthica	1	10	Ceratopogonidae	15
04/17/95	Wallace Slough	6	Corbicula fluminea	2	10	Ephemera spp.	2
04/17/95	Wallace Slough	6	UNID Gastropoda	1	10	Collembola UNID	2
04/17/95	Wallace Slough				10	Daphnia spp.	2
04/17/95	Wallace Slough				10	Copopoda	1
04/17/95	Wallace Slough				10	Ostracoda	3
04/17/95	Wallace Slough				10	Hydracarina spp. A	1
04/17/95	Wallace Slough				10	Hydracarina spp. B	1
04/17/95	Wallace Slough				10	Hydracarina spp. C	1
04/17/95	Wallace Slough				10	UNID Gastropoda	2
04/17/95	Wallace Slough				10	Macoma balthica	14
04/17/95	Wallace Slough				11	Nematoda	11
04/17/95	Wallace Slough				11	Oligochaeta	523
04/17/95	Wallace Slough				11	Chironomidae	109
04/17/95	Wallace Slough				11	Ceratopogonidae	12
04/17/95	Wallace Slough				11	Ephemera spp.	1
04/17/95	Wallace Slough				11	Daphnia spp.	1
04/17/95	Wallace Slough				11	Copopoda	2
04/17/95	Wallace Slough				11	Macoma balthica	11
04/17/95	Wallace Slough				12	Nematoda	23
04/17/95	Wallace Slough				12	Oligochaeta	738
04/17/95	Wallace Slough				12	Hirudinea	1
04/17/95	Wallace Slough				12	Chironomidae	107
04/17/95	Wallace Slough				12	Ceratopogonidae	14
04/17/95	Wallace Slough				12	Ephemera spp.	1
04/17/95	Wallace Slough				12	Corophium spp.	2
04/17/95	Wallace Slough				12	Macoma balthica	7
			MEAN-------------------------------->	3.46		MEAN---------------------	80.07

t-Test: Paired Two-Sample for Means	
Mean	3.441
Variance	9.345
Observations	34.000
Pearson Correlation	ERR
Pooled Variance	24496.367
Hypothesized Mean Difference	57.000
df	-2.994
t -->	0.002
P(T<=t) one-tail	1.672
t Critical one-tail	0.004
P(T<=t) two-tail	2.002
t Critical two-tail	

$N = ((t \times s) / (D \times X))^2$

Where: s = Standard deviation of the samples from the preliminary survey.
t = Tabulated t-value at the 0.05 level for the degrees of freedom of the preliminary survey.
X = The mean density of the samples of the preliminary survey.
D = Required level of precision expressed as a decimal (0.30 - 0.35 usually yields a statistically reliable estimate.

Control Site

$((.002 \times 3.46) / (.30 \times 3.01))^2$ N = 0.0005

Impact Site

$((.002 \times 80.07) , (.30 \times 89 83))^2$ N = .0000078

Table 13. Species lists from Youngs Bay and Tongue Point (Oregon) and Deep River (Washington) at Amala's. All benthic collections from April, 1995.

Youngs Bay	Control	Impact
Phylum Nematoda	40	44
Class Otigochaeta	1142	0
Class Polychaeta, Ampharitidae	942	299
Class Polychaeta, Nereidae	14	15
Class Insecta, Chironomidae	32	3
Class Crustacea, 0. Amphipoda, Corophium spp.	770	4
C. Crustacea, 0. Amphipoda, Eogammerius spp.	216	2
C. Crustacea, So. Copopoda, Scottolana canadensis	294	510
Class Crustacea Order Cumacea	1	4
Class Crustacea, Order Mysidacea	1	1
Class Crustacea, 0. Isopoda,Gnorishpaeroma spp.	0	1
Class Crustacea, Order Cirripedia	294	71
Class Bivalvia, Macoma balthica	1	1
Class Bivalvia,Corbicula fluminea	11	0
Class Bivalvia, unidentified spp. A	3	0
Class Bivalvia, unidentified spp. B	8	0
Totals	3590	955

Tongue Point	Control	Impact
Phylum Nematoda	20	256
Class Oligochaeta	54	313
Class Polychaeta, Ampharitidae	28	351
Class Polychaeta, Nereidae	7	19
Class Insecta, Chironomidae	1	10
Class Insecta, Ceratopogonidae	0	1
Class Crustacea, 0. Amphipoda, Corophium spp.	570	9
Class Crustacea, Order Copopoda	0	66
Class Crustacea, Order Ostracoda	3	27
Class Bivalvia, Macoma balthica	10	8
Class Gastropoda, Juga plicifera.	2	1
Totals	695	1061

Deep River at Amala's	Control	Impact
Phylum Nematoda	246	77
Class Oligochaeta	895	1059
Class Hirudinea	0	1
Class Polychaeta, Nereidae	1	2
Class Insecta, Chironomidae	22	7
Class Insecta, Ceratopogonidae	7	11
Class Insecta, 0. Ephemeroptera, Ephemera spp.	7	9
Class Crustacea, 0. Amphipoda, Corophium spp.	40	15
C. Crustacea, So. Copopoda, Cyclopoida	6	2
Class Crustacea, 0. Cladocera, Bosmina longirostris	3	3
Class Crustacea, Order Ostracoda	7	3
Class Acarina, Hydracarina	2	0
Class Bivalvia, Macoma balthica	3	7
Class Bivalvia,Corbicula fluminea	1	0
Totals	1237	1196

Table 14. Species lists from Deep River (Washington) at Kato's, Blind Slough (Oregon), and Steamboat Slough (Washington). All benthic collections from April, 1995.

Deep River at Kato's	Control	Impact
Phylum Nematoda	205	6
Class Oligochaeta	529	217
Class Hirudinea	0	2
Class Insecta, Chironomidae	65	70
Class Insecta, Ceratopogonidae	34	5
Class Insecta,Order Trichoptera	3	0
Class Insecta, 0. Ephemeroptera, Ephemera spp.	9	0
Class Insecta, Gomphidae	0	1
Class Crustacea, 0. Amphipoda, Corophium spp.	223	80
C. Crustacea, So. Copopoda, Cyclopoida	10	2
Class Crustacea, 0. Cladocera, Bosmina longirostris	8	0
Class Crustacea, Order Ostracoda	67	3
Class Acarina, Hydracarina	10	2
Class Bivalvia, Macoma balthica	76	11
Class Bivalvia,Corbicula fluminea	2	0
Class Bivalvia, unidentified spp. A	0	1
Totals	1241	400

Blind Slough	Control	Impact
Phylum Nematoda	24	0
Class Oligochaeta	108	398
Class Polychaeta	43	0
Class Insecta, Chironomidae	12	121
Class Insecta, Ceratopogonidae	6	2
Class Insecta,Order Trichoptera	0	1
Class Insecta, 0. Ephemeroptera, Ephemera spp.	4	1
Class Crustacea, 0. Amphipoda, Corophium spp.	54	1
C. Crustacea, So. Copopoda, Cyclopoida, Halicyclops spp.	6	5
Class Crustacea, 0. Cladocera, Bosmina longirostris	7	0
Class Crustacea, Order Ostracoda	45	1
Class Acarina, Hydracarina	2	0
Class Bivalvia, Macoma balthica	4 2	8
Totals	353	539

Steamboat Slough	Control	Impact
Phylum Nematoda	11	3
Class Oligochaeta	601	13
Class Hirudinea	0	5
Class Insecta, Chironomidae	35	0
Class Insecta, Ceratopogonidae	7	0
Class Insecta, 0. Ephemeroptera, Ephemera spp.	2	0
Class Crustacea, 0. Amphipoda, Corophium spp.	387	836
Class Crustacea, Order Ostracoda	4	0
Class Acarina, Hydracarina	3	0
Class Bivalvia, Macoma balthica	45	15
Class Bivalvia, Corbicula fluminea	4	6
Class Gastropoda, Physa spp.	85	56
Class Gastropoda, Goniobasis spp.	12	0
Totals	1209	929

Table 15. Species lists from Clifton Channel (Oregon); Cathlamet Channel (Washington), and Wallace Slough (Oregon). All benthic collections from April, 1995

Clifton Channel	Control	Impact
Phylum Nematoda	6	30
Class Oligochaeta	75	208
Class Insecta, Chironomidae	5	25
Class Insecta, Ceratopogonidae	0	1
Class Insecta, 0. Ephemeroptera, Ephemera spp.	0	2
Class Insecta, Gomphidae	3	2
Class Crustacea, 0. Amphipoda, Corophium spp.	2021	1234
Class Crustacea, O.Ostracoda	0	2
Class Bivalvia, Macoma balthica	62	22
Class Bivalvia, Unidentified spp. A,	0	5
Class Bivalvia,Corbicula fluminea	6	0
Class Gastropoda, unidentified spp. A	58	5
Class Gastropoda, unidentified spp. B	1	0
Totals	2237	1533

Cathlamet Channel	Control	Impact
Phylum Nematoda	6	14
Class Oligochaeta	51	240
Class Insecta, Chironomidae	4	11
Class Insecta, Ceratopogonidae	0	4
Class Crustacea, 0. Amphipoda, Corophium spp.	569	1
Class Crustacea, O.Ostracoda	2	450
Class Bivalvia, Macoma balthica	32	15
Class Bivalvia,Corbicula fluminea	1	8
Class Bivalvia, Unidentified spp. A,	6	10
Class Gastropoda, Goniobasis spp.	1	3
Class Gastropoda, Physa spp.	10	5 2
Totals	717	862

Wallace Slough	Control	Impact
Phylum Nematoda	69	1
Class Oligochaeta	1848	9
Class Hirudinea	5	0
Class Insecta, Chironomidae	216	4
Class Insecta, Ceratopogonidae	30	0
Class Insecta,O. Ephemeroptera, Ephemera spp.	1	0
Class Odonata, Gomphidae	1	0
Class Crustacea, 0. Amphipoda, Corophium spp.	3	14
C. Crustacea, So. Copopoda, Cyclopoida	1	0
Class Crustacea, 0. Cladocera, Bosmina longirostris	1	0
Class Crustacea, 0. Cladocera, Daphnia spp.	1	0
Class Crustacea, Order Ostracoda	2	0
Class Acarina, Hydracarina	1	0
Class Bivalvia, Macoma balthica	17	6
Class Bivalvia,Corbicula fluminea	0	4
Class Gastropoda unidentified spp. A	10	20
Totals	2206	58

Table 16. Statistical analysis of the benthic macroinvertebrate assemblages of the nine select area net-pen rearing locations, April 1995.

	Taxa richness	Abundance	Number per square meter	Shannon's Index H'	Reciprocal of Simpson's Index N2	Pielou's Eveness E
Youngs Bay						
Control	14	3590	8005	1.75	4.13	0.65
Impact	12	955	2120	1.20	2.56	0.48
Tongue Point						
Control	9	695	1543	0.75	1.47	0.34
Impact	10	1061	4711	1.54	3.85	0.64
Deep River at Amala's						
Control	12	1237	2747	1.77	0.89	0.36
Impact	12	1196	2656	1.27	0.54	0.22
Deep River at Kato's						
Control	13	1241	2755	1.72	3.97	0.25
Impact	12	400	888	1.32	2.73	0.37
Blind Slough						
Control	12	353	784	2.02	5.91	0.81
Impact	10	539	1196	0.74	1.68	0.32
Steamboat Slough						
Control	12	1209	2684	2.80	1.34	0.54
Impact	7	929	2063	1.24	0.47	0.24
Clifton Channel						
Control	9	2237	4967	1.14	0.32	0.15
Impact	11	1533	3404	1.50	0.71	0.30
Cathlamet Channel						
Control	10	717	1592	1.56	0.83	0.36
Impact	11	862	1914	2.73	1.30	0.54
Wallace Slough						
Control	15	2206	4898	1.40	0.66	0.24
Impact	6	58	129	4.24	1.56	0.87

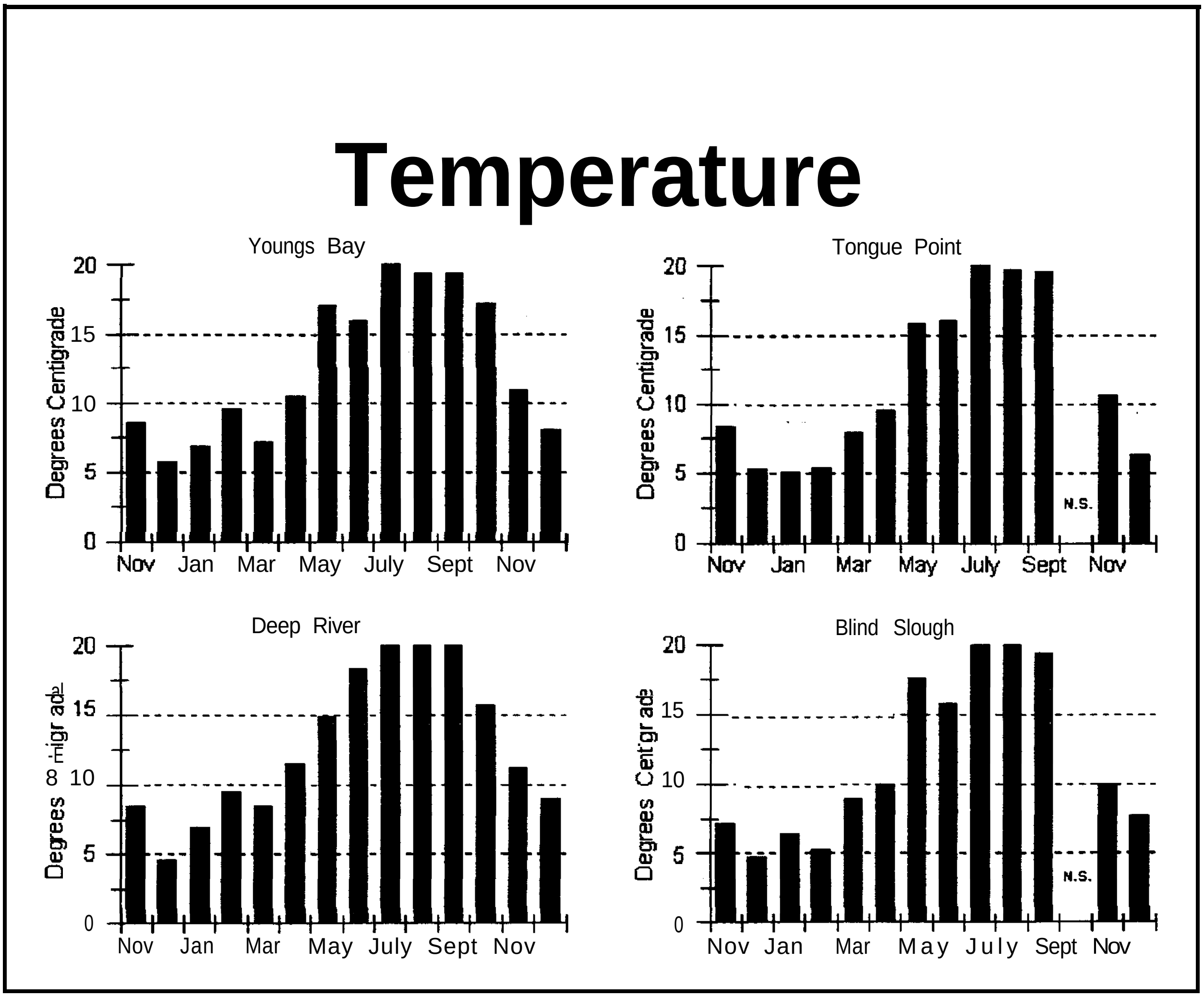

Figure I. Temperature profiles of the four lower river net-pen rearing sites, November, 1994 through December, 1995. Note: N.S. signifies data not sampled.

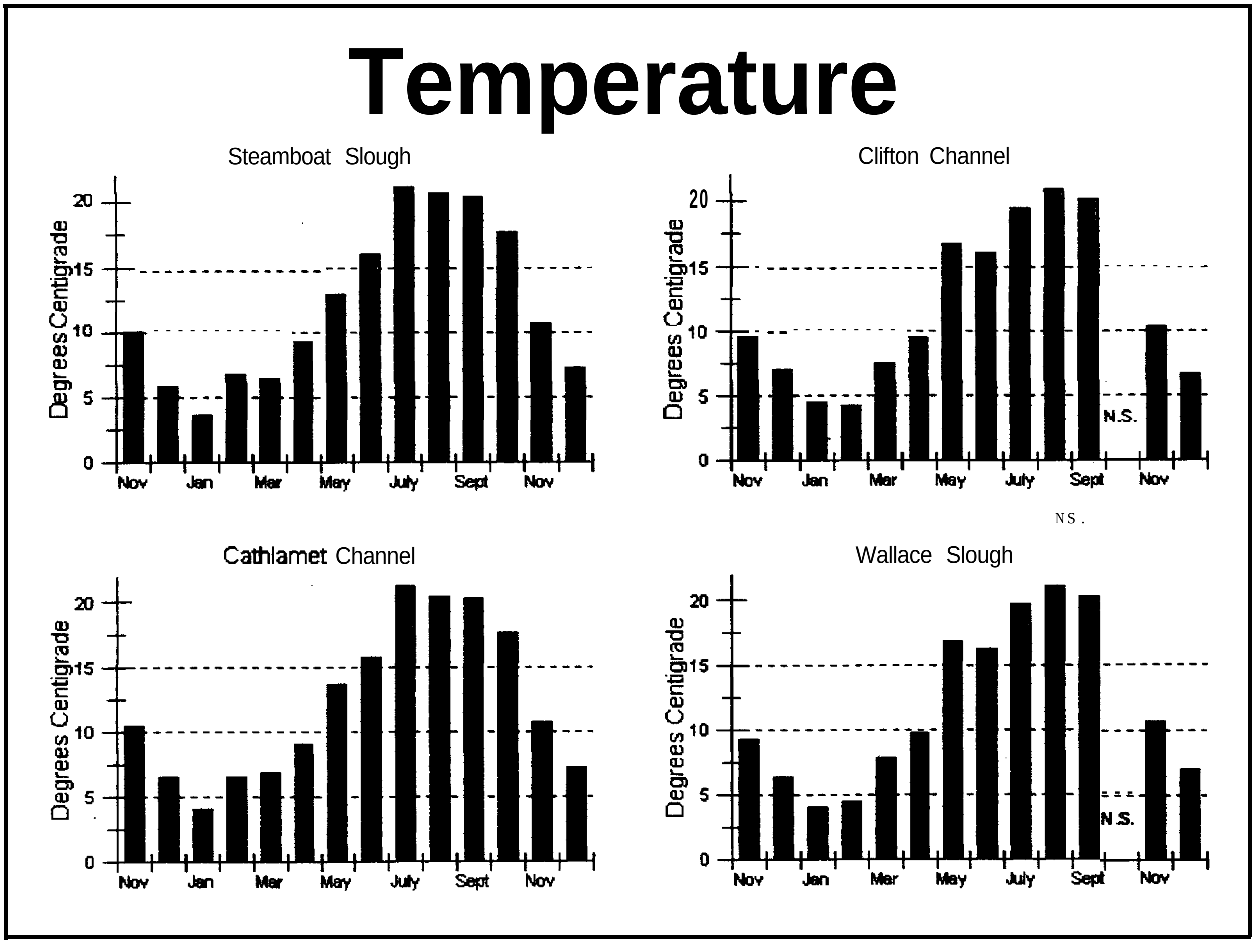

Figure 2. Temperature profiles of the four potential net-pen rearing sites, November, 1994 through December, 1995. Note: N.S. signifies data not sampled.

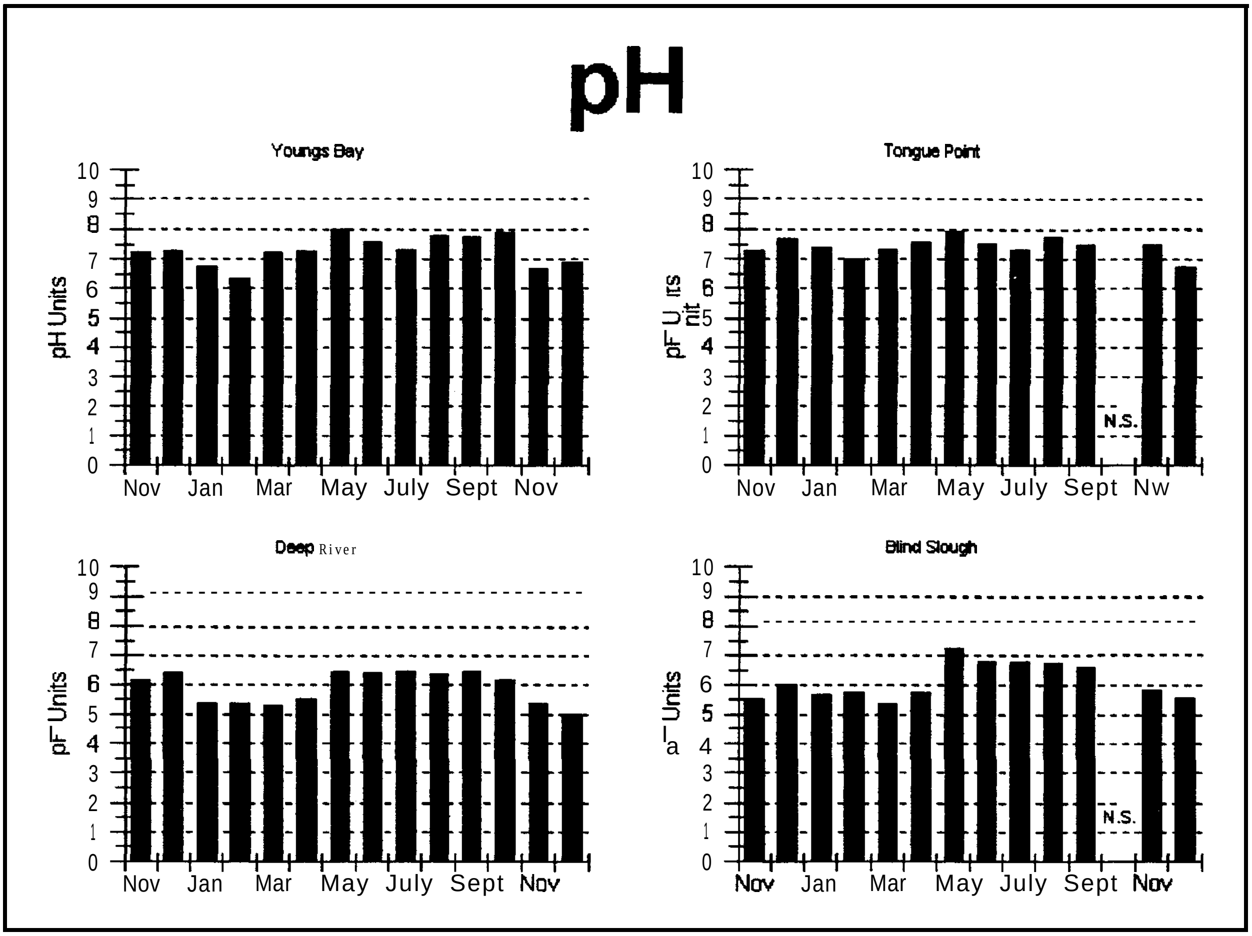

Figure 3. The pH profiles of the four lower river net-pen rearing sites, November, 1994 through December, 1995. Note: N.S. signifies data not sampled.

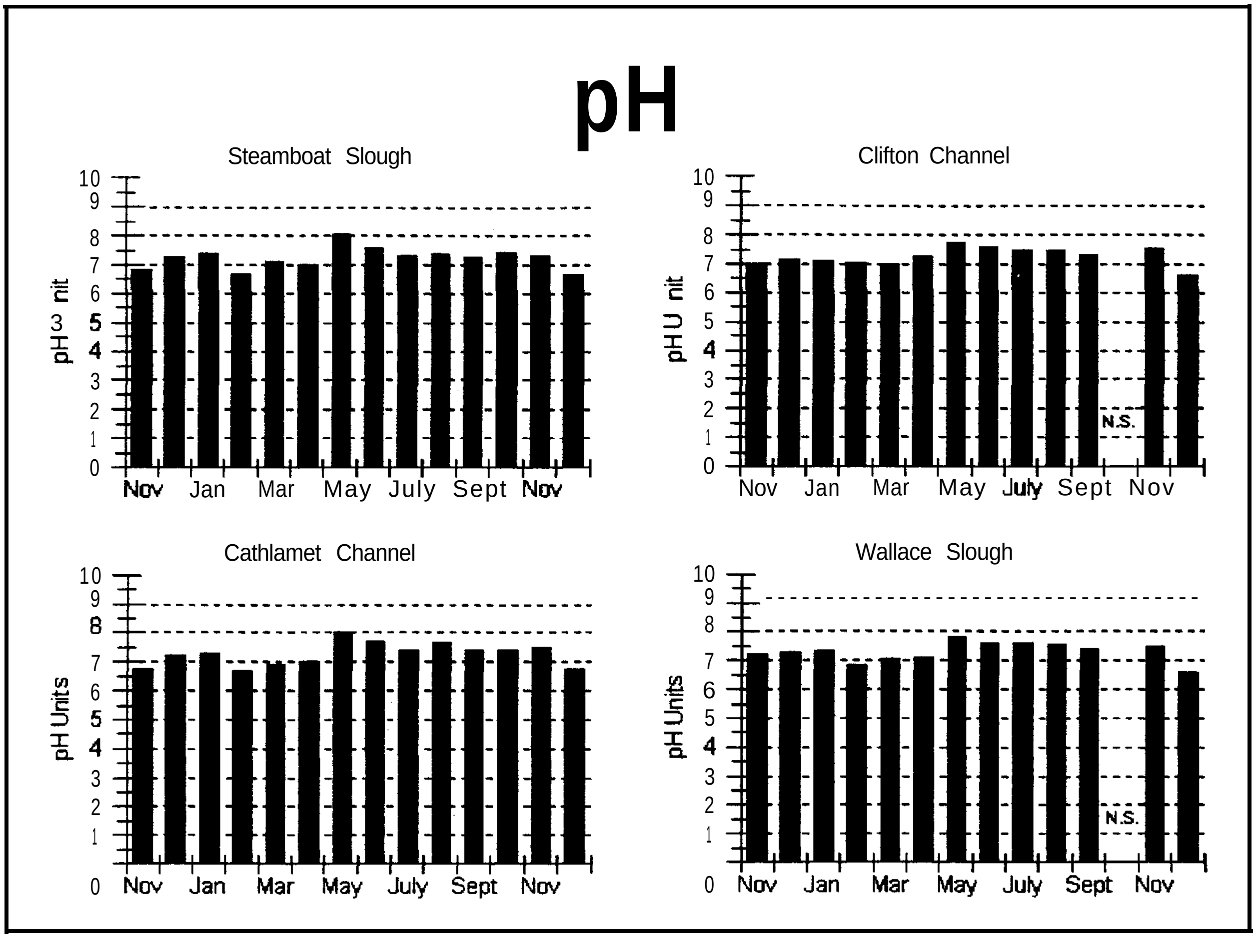

Figure 4. The pH profiles of the four potential net-pen rearing sites, November, 1994 through December, 1995. Note: N.S. signifies data not sampled.

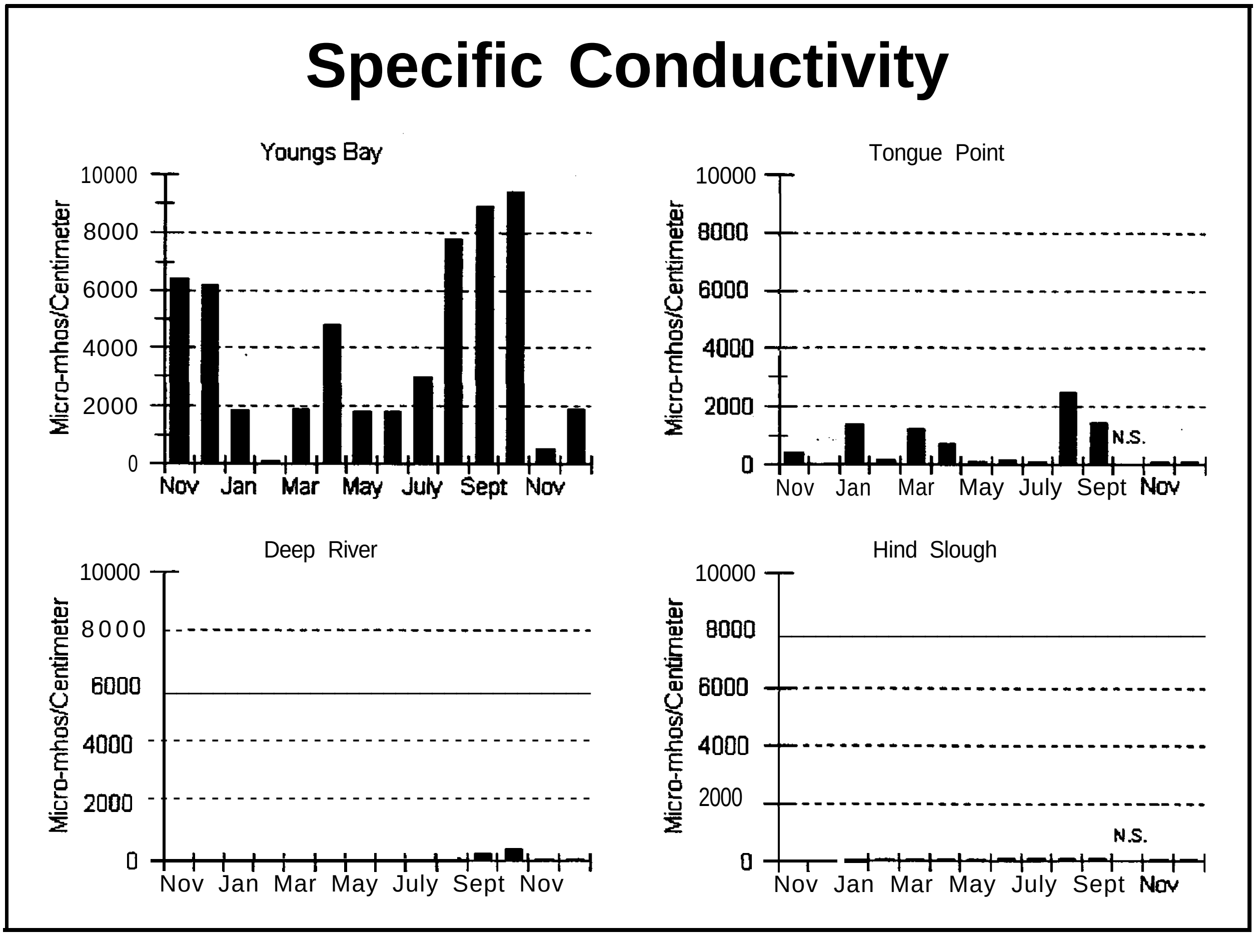

Figure 5. Specific conductivity profiles for the four lower river net-pen rearing sites, November, 1994 through December, 1995. Note: N.S. signifies data not sampled.

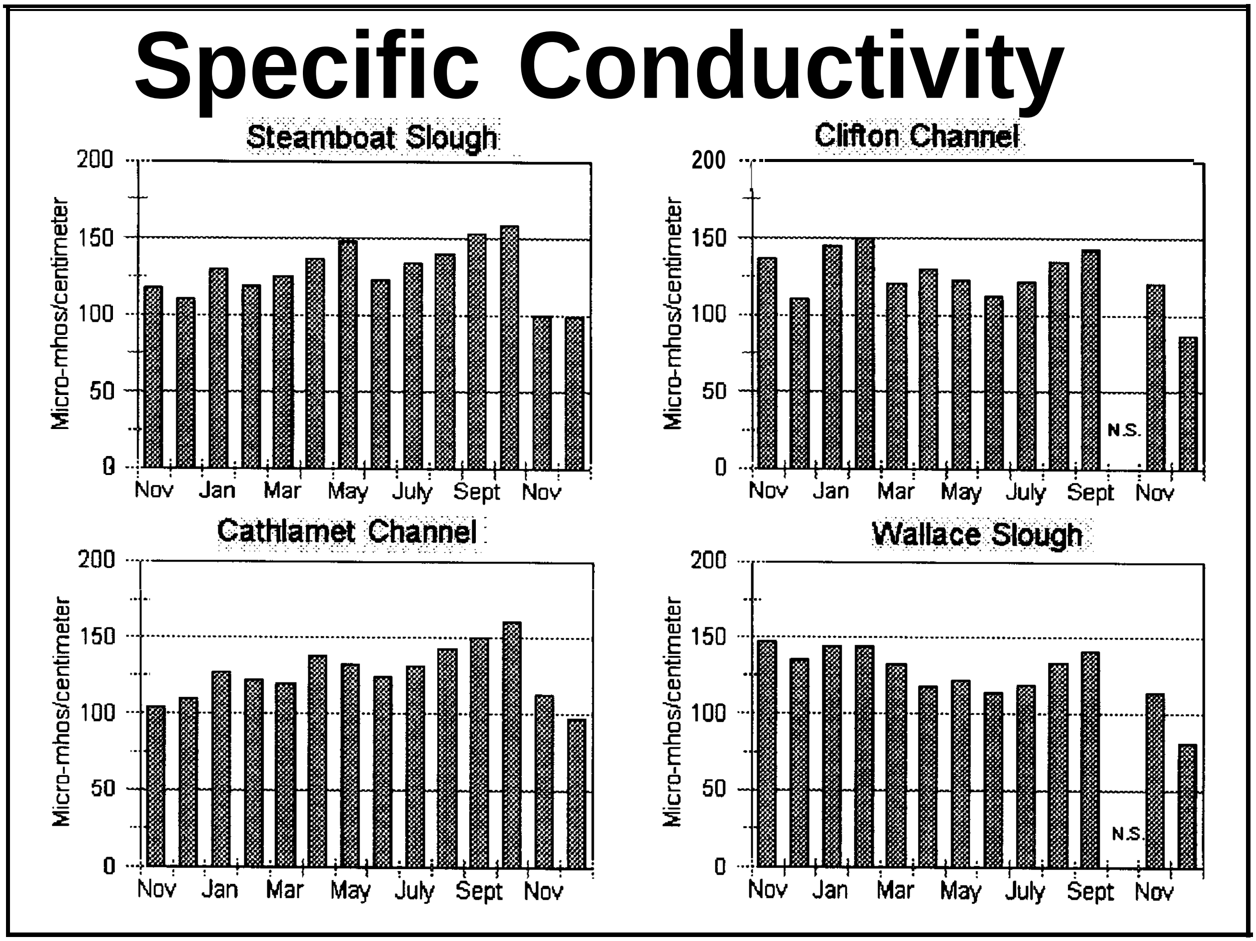

Figure 6. Specific conductivity profiles for the four potential net-pen rearing sites, November, 1994 through December, 1995. Note. N.S. signifies data not sampled.

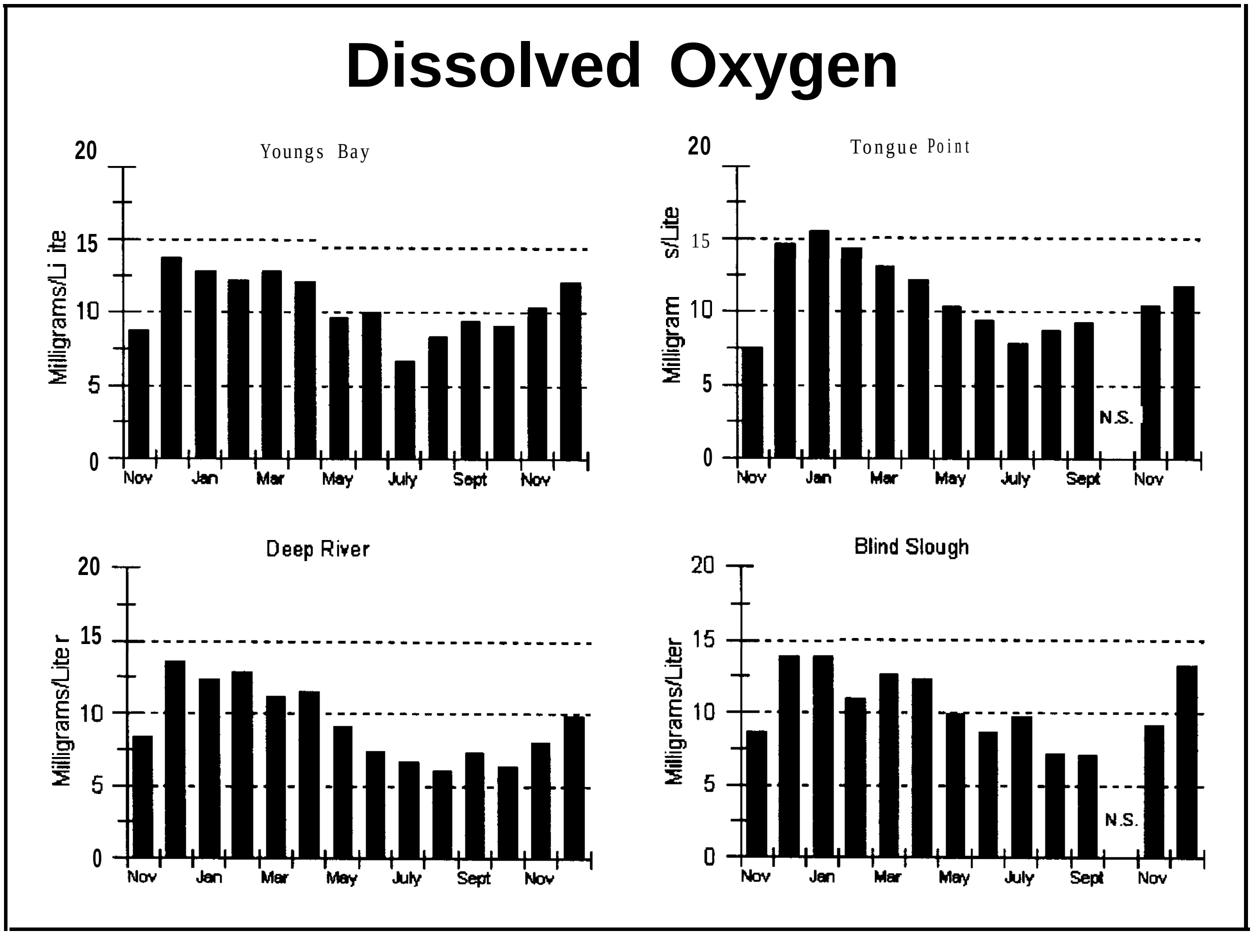

Figure 7. Dissolved oxygen profiles of the four lower river net-pen rearing sites, November, 1994 through December, 1995. Note: N.S. signifies data not sampled.

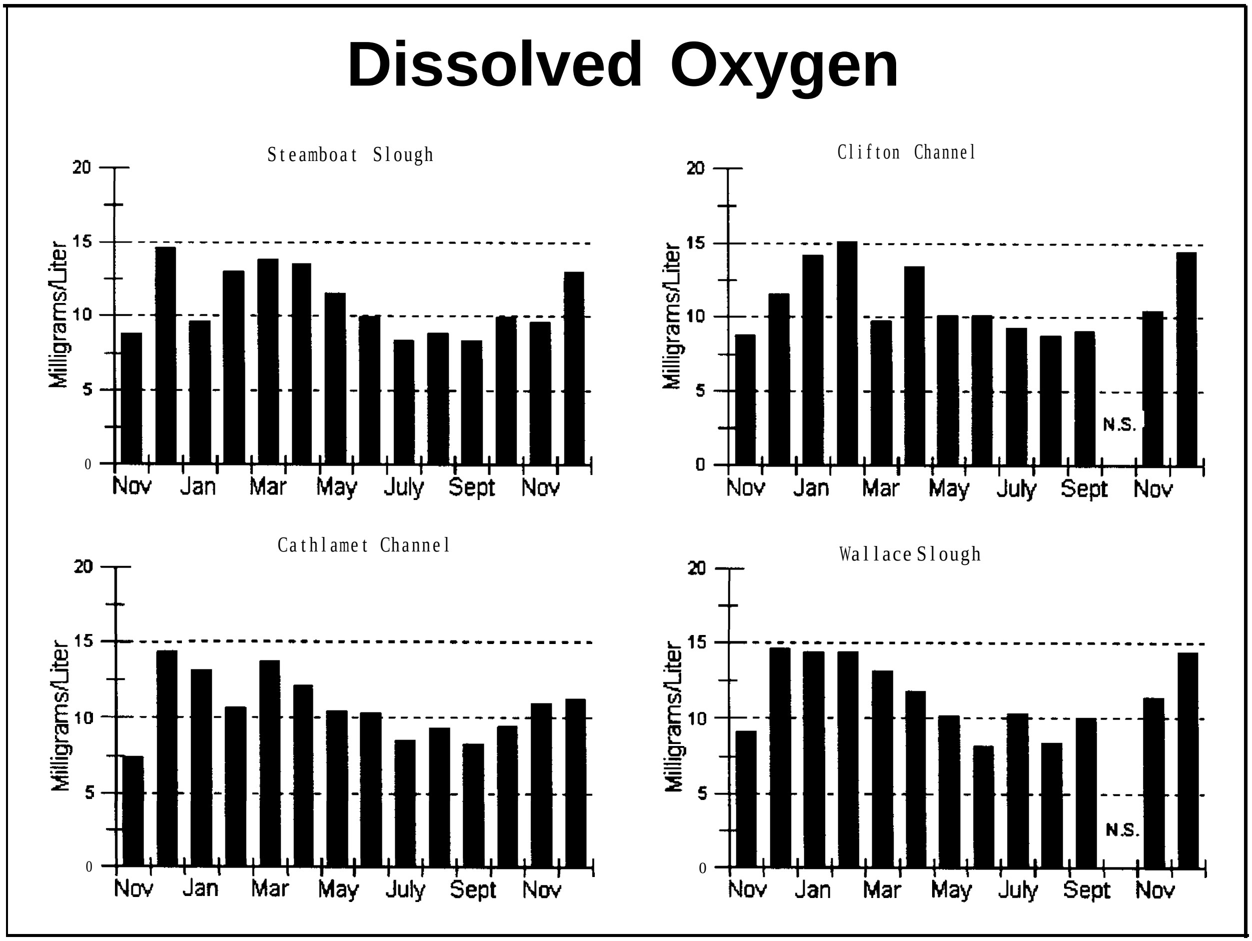

Figure 8. Dissolved oxygen profiles of the four potential net-pen rearing sites, November, 1994 through December, 1995. Note: N.S. signifies data not sampled.

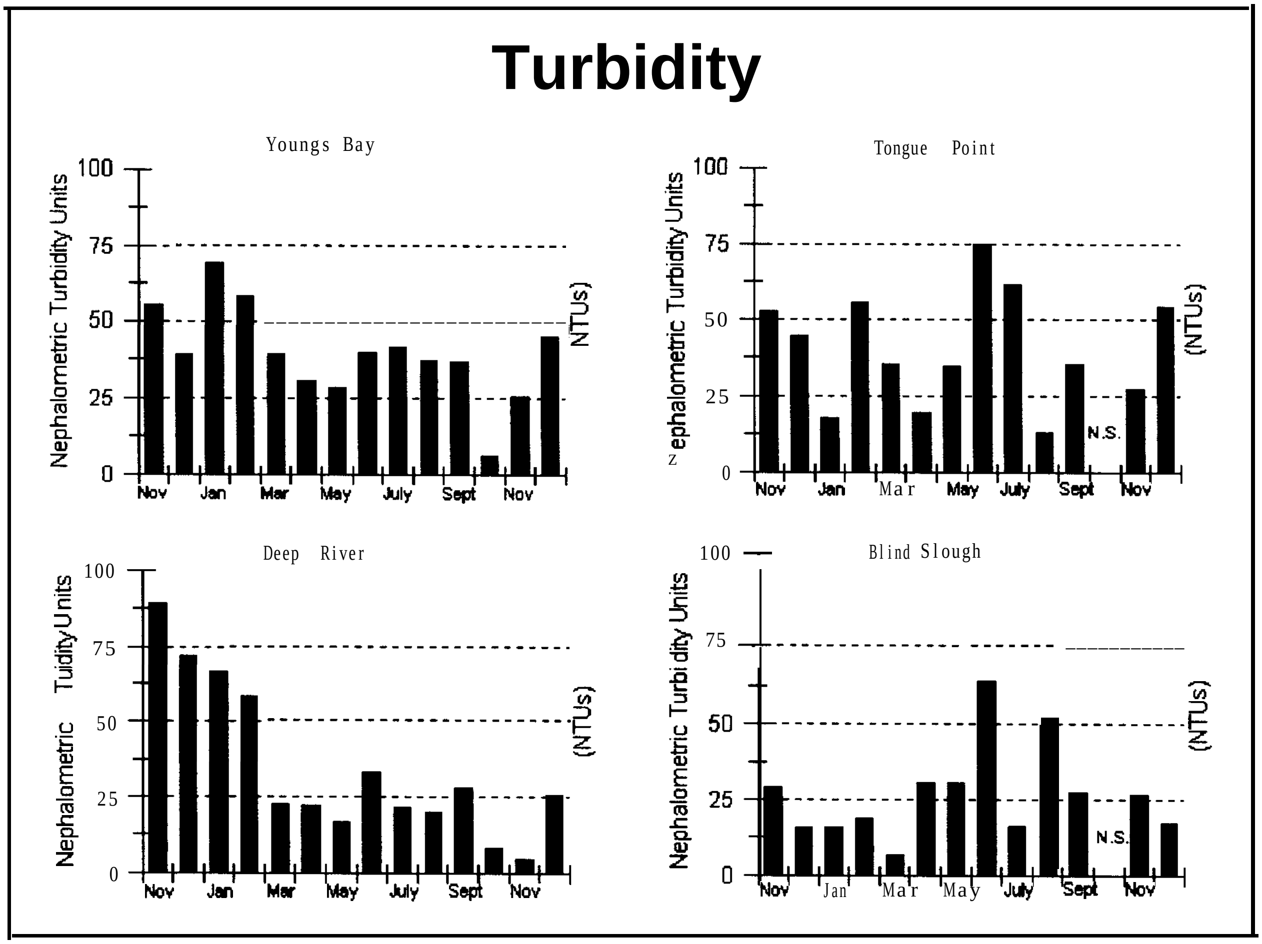

Figure 9. Water turbidity profiles for the four lower river net-pen rearing sites, November, 1994 through December, 1995. Note: N.S. signifies data not sampled.

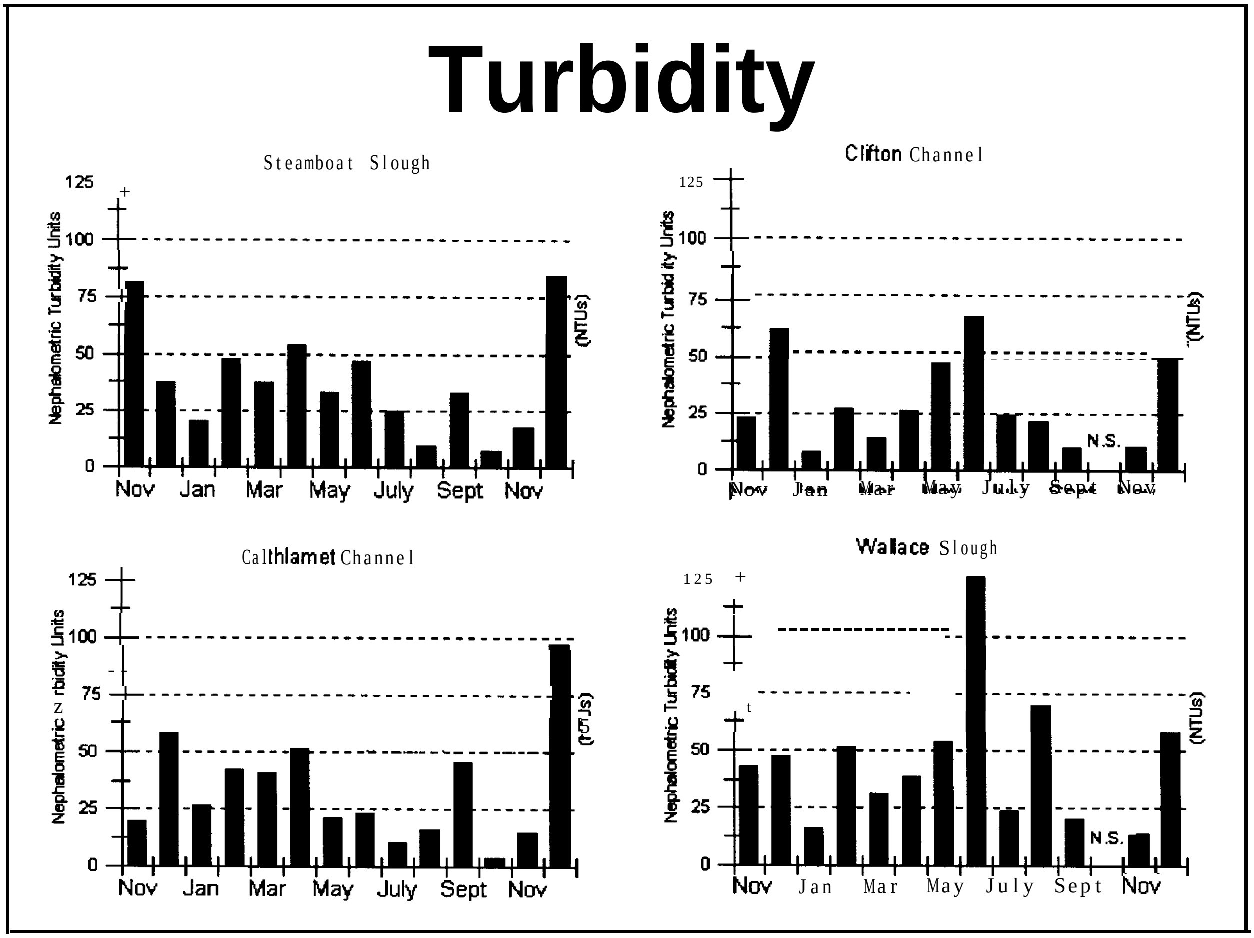

Figure 10. Water turbidity profiles for the four potential net-pen rearing sites, November, 1994 through December, 1995. Note: N.S. signifies data not sampled.

B. Water Quality Monitoring Program for Net-Pen Rearing Areas, November 1995 through October 1996

INTRODUCTION

The Columbia River Select Area Fishery Evaluation (SAFE) Project was initiated to provide salmonid fisheries for select or offstream areas of the lower Columbia River for public use with little or no negative biological impact to mainstem Columbia River fish runs.

The net-pen rearing phase of the project involves placing hatchery reared salmonid fry or fingerings in floating net pens in select or backwater areas of the lower Columbia River. These fish are then reared to smoltification and released into the wild and allowed to migrate to the ocean naturally. Fish are typically acclimated and cared for by hatchery personnel for periods as short as two weeks or as long as several months prior to release into the wild. Fish are fed fish food as well as being allowed to consume any naturally occurring invertebrates that may be attracted to the structure or washed into the net pens by the water currents. Expansion of these net-pen rearing operations to other suitable sites required some investigation into water quality of any potential sites for use as net-pen rearing operations. Water quality studies were begun to investigate several different locations for their potential use as fish rearing operations and to monitor water quality during and after the sites are used for fish rearing.

As net-pen rearing has developed, two main goals have been identified as the central focus of monitoring quality of the water in which fish will be placed. The first of these goals is to monitor physicochemical parameters at each of the sites over time to determine if there are any obvious problems in the immediate areas of the fish rearing pens. The second of the goals was to begin a biomonitoring program which would use benthic macroinvertebrates as indicators of any adverse change in the surrounding environment as a result of fish rearing operations. The following report addresses these two main goals and compares the benthic baseline data collected in April 1995 with the benthic data collected prior to placement of fish in the net pens, during the midpoint of the rearing process, and after the fish were released. Comparisons are also made of each sites change in the benthic community structure during the rearing period.

METHODS AND MATERIALS

The study sites in ascending order from the mouth of the Columbia River are:

Youngs Bay. Oregon is located approximately 1.5 miles upstream from the mouth of Youngs Bay at Ivan Larsen's dock. This location has a strong estuarine influence and is located adjacent to a busy commercial marina. There is fresh-water influence from the Lewis and Clark, Klaskanine, and Youngs rivers.

Tongue Point, Oregon is located approximately 0.2 miles inside of the channel formed by Tongue Point and Mott Island on the federal government's Job Corps dock adjacent to the boat launching ramp. This location also has an estuarine influence, but to a lesser degree than Youngs Bay. It has a fresh-water influence from John Day River. Historically, this site was used by the U.S. Navy during War II.

Deep River, Washington is located approximately 0.5 miles upstream of the Washington State Highway # 4 bridge at Walter Kato's dock. This location has no saltwater influence. Historically, this location has been influenced by organic enrichment due to a log dump site upstream of the net-pen rearing operation. This resulted in deposition of a large amount of woody debris on the substrate. The log dump has been abandoned and out of use for about 20 years.

Blind Slough, Oregon is located approximately 1.25 miles upstream from the confluence of Blind Slough and Knappa Slough and about 100 yards below the removable span bridge at Stan Kahn's dock. This location is also downstream of a former log dump site. A considerable amount of woody debris has also been deposited on the substrate as a result of past logging operations. Gnat Creek flows directly into Blind Slough providing fresh-water influence.

Steamboat Slough, Washington is located approximately 200 yards upstream of the confluence of Skamokawa Creek, Steamboat Slough and the Columbia River at Dan Silverman's dock in Steamboat Slough. This location has been used as commercial fish buying station and a commercial dock in the past. It has some unique fresh-water influence from the Elochoman River upstream and from Skamokowa Creek downstream, but it has a strong mainstem Columbia influence.

Cathlamet Channel, Washington is located approximately 200 yards downstream of the Cathlamet-Puget Island Bridge at Fred Johnson's dock. This location has little or no unique fresh-water influence and may be considered a mainstem Columbia River location. It was chosen as a potential site because it is located near a previous net-pen rearing site and had a history of having unique catches of local origin.

Clifton Channel, Oregon which also could be considered a mainstem location is located at the dock owned by Andros Marincovich about 200 yards upstream of the former Bumble Bee fish cannery. There is a small creek (Hunt Creek) about one mile upstream that may lend a small unique fresh-water influence at this location.

Wallace Slough, Oregon is located at a marina about 0.2 miles inside of the upstream confluence of Wallace Slough and the mainstem of the Columbia River. This marina is co-owned by Gary Viuhkola and Greg Poysky and is approximately 1.5 miles downstream of two lumber mills located outside of the town of Clatskanie, Oregon. Log rafts still pass by this location but it has a much smaller influence on the substrate because of high flushing action from a strong tidal current at this location. The Clatskanie River mouth is immediately downstream of this site providing its fresh-water influence.

Aquatic Biomonitoring

An aquatic biomonitoring program was undertaken to detect any adverse changes at selected sites located on the lower Columbia River due to fish rearing operations. Adverse changes in biodiversity (species richness + species abundance), are an indication of a stressed biotic community. Net-pen operations located in the marine waters of Puget Sound have been shown to cause both acute and chronic stresses to the surrounding benthic biota (Striplin Environmental Associates, 1995a; 1995b). Net-pen rearing operations located on the lower Columbia River have a radically different ecosystem with which to contend and therefore a different system of evaluating this ecosystem must be used. It is the goal of this water quality monitoring program to detect usable endpoints which indicate degradation of the surrounding ecosystem using both chemical and biological parameters as an indication of water quality. The data presented in this report is compared to benthic collections made in April, 1995.

Benthic macroinvertebrate collections were conducted at all of the net-pen rearing locations in November, 1995, prior to placement of fish in the net pens, in early March, 1996, at the mid-point of the fish rearing operation, and in early June, 1996, after the fish were released. A petite Ponar dredge (15 cm x 15 cm opening) was used to collect benthos at both control and impact sites at each of the net-pen rearing locations. The benthos directly adjacent to the net pens was designated as the impact site, and the benthos located near the opposite shore (far enough away to be outside of the area affected by the net-pen operations), at a similar depth, was designated as the control site for each particular location. Samples were washed through a 500 micrometer sieve and fixed in Kahle's solution, a histological fixative especially well suited for fixation of aquatic invertebrates. After 24-48 hours samples were transferred to 70% ethyl alcohol for preservation and storage. All organisms were sorted, identified to the lowest possible taxon and enumerated using binocular stereo microscopes. Quality control checks of 20% of sorted samples from each site were conducted to check for organisms missed in the initial sorting procedure. Any replicate that was found to have missed more than 10% of the organisms in the organic debris after the initial sorting was cause for all samples from that site to be resorted.

The benthic macroinvertebrate data was statistically analyzed using several different measures of biological community structure. It has been shown that benthic macroinvertebrate communities respond to environmental stress by having a lowered community diversity. Typically, there will be a loss or lowered number of ecologically sensitive species and an increase in the numbers of more ecologically tolerant species.

There are two components of biological diversity. The first is taxa richness, or the number of species in a given ecosystem. The second is species abundance (evenness) or the number of individuals in a given ecosystem. There are many statistical equations that attempt to reduce the richness and abundance values to a single figure that would give an index of the health of a given ecosystem. In the majority of these equations the highest diversity would exist if each individual belonged to a different species and the lowest diversity would exist if all individuals belonged to one species. Real world ecosystems fall somewhere in between these two extremes. Each of these diversity indices have different types of inherent bias from things like sensitivity to more common species or sensitivity to sample size. There are inherent problems with the use of all indices in that a certain amount of caution needs to be used so as not to make the mistake that this single numerical value not be the sole indicator of a given ecosystem's health. A close look at species assemblages and pollution tolerances of certain species and species groups, as well as life histories of these organisms needs to be taken into consideration. The indices used to evaluate this baseline data set were: Taxa richness (the number of species), species abundance (the numbers of individuals), relative abundance (the number per unit of area, given as organisms per square meter), as well as three biological indices Shannon's Index, reciprocal of Simpson's Index, and Pielou's Evenness Index.

Shannon's Diversity Index is: $H' = -\sum_i p_i l2\ (pi)$, $(i = 1,2,3,\ldots,S)$, $0 \leq H' \leq \infty$

Reciprocal of Simpson's Index is: $N_2 = (\sum_i p^2_i)^{-1}$, $(i = 1,2,3,\ldots,S)$, $0 \leq N_2 \leq S$

Pielou's Evenness Index is: $E = H' / \ln(s)$

$= -\sum_i p_i^{\ln}(p_i) / \ln(s)$

Phvsicochemical Monitoring

To assess waters ability to sustain life, six aquatic physicochemical parameters have been measured electrometrically using a Hydrolab Inc. ™ multiparameter water testing device. For the purpose of this report the term Hydrolab refers to the above described device. This computer-automated equipment is capable of collecting data from several electrometric probes simultaneously at any pre-programmed interval within the limits of a portable battery supply. The Hydrolab was deployed at all sites once monthly for 24-hour periods and programmed to collect data at 30-minute intervals, with the electrometric sensors placed at two meters (ca. 6 feet) into the water column at each present or potential net-pen rearing location.

Mean and standard deviations of the mean have been calculated for each of the following parameters. Water temperature is given in degrees Celsius. pH, which is a measure of the ionic concentration of the water, is given in undefined relative units.

Specific conductance is a measure of the water's ability to conduct electricity and is directly related to the concentration of total dissolved salts in the water. Specific conductance is reported as micro-mhos/ centimeter (micro-Semens/ centimeter) and is a measurement that is the inverse of resistance. Dissolved oxygen is the amount of free oxygen available for respiration found in the water and is given as milligrams per liter. Dissolved oxygen percent saturation is also given as a relative indicator of the expected amount of dissolved oxygen for water at a given temperature. Water turbidity is a measure of suspended solids found in the water and is measured by an optic sensor known as a nephelometer that detects water's ability to refract light that is projected at a wave-length of 860 nanometers at right angles to the optic sensor. Turbidity data are reported as Nephelometric Turbidity Units (NTUs).

RESULTS

Benthic Macroinvertebrate Community Structure

Tables 17 through 24 give results of the analysis of the benthic macroinvertebrate community structure. Tables 17 through 20 are lists of the organisms encountered in the benthos adjacent to the net pens and tables 21 through 24 are the species diversity indices with the calculations being based on the numbers from tables 17 through 20. These data will be discussed by site beginning with the site located closest to the Pacific Ocean and proceeding upriver.

Youngs Bay

The species lists and species diversity indices for Youngs Bay are presented in Tables 17 and 21. Taxa richness for November indicate 13 species at the impact site and nine species at the control site. Total abundance for the November collection was 1839 individuals for the impact site and 386 individuals for the control site. The two dominant species for November at the impact site were the amphipod Corophium salmonis with 640 individuals and the polychaete annelid Hobsonia florida with 415 individuals. This represents 34 percent and 23 percent, respectively, of the total community structure. The two dominant species for November at the control site were H. florida with 169 individuals and the oligochaete annelids with 100 individuals. This represents 44 percent and 26 percent, respectively, of the total community structure. The Shannon's Index was calculated at 1.73 at the impact site and 1.53 at the control site for November. The reciprocal of Simpson's Index was 4.42 for the impact site and 3.53 for the control site for November. Pielou's Evenness Index was .674 for the impact site and .698 for the control site for November.

Taxa richness for the March collection was 14 species for the impact site and 12 species for the control site. Total abundance for the March collection was 1710 individuals at the impact site and 256 individuals at the control site. The two dominant species for March at the impact site were the oligochaetes with 1278 individuals and H.

florida with 162 individuals. This represents 75 percent and 10 percent, respectively, of the total community structure. The two dominant species for March at the control site were H. florida with 76 individuals and the harpacticoid copopod Coullana canadensis with 62 individuals. This represents 30 percent and 24 percent, respectively, of the total community structure. The Shannon's Index was calculated at 1.07 at the impact site and 1.86 at the control site for March. The reciprocal of Simpson's index was 1.75 for the impact site and 5.01 for the control site for March. Pielou's Evenness Index was .405 for the impact site and .748 for the control site for March.

Taxa richness for the June collection was 15 species at the impact site and 10 species at the control site. Total abundance for the June collection was 1923 individuals at the impact site and 257 individuals at the control site. The two dominant species for June at the impact site were the oligochaetes with 1577 individuals and C. salmonis with 174 individuals. This represents 82 percent and 9 percent, respectively, of the total community structure. The two dominant species for June at the control site were oligochaetes with 59 individuals and the bivalved mollusc Macoma balthica with 51 individuals. This represents 23 percent each of the total community structure.
The Shannon's Index was calculated at .784 at the impact site and 1.97 at the control site for June. The reciprocal of Simpson's Index was 1.47 for the impact site and 6.47 for the control site for June. Pielou's Evenness Index was .289 for the impact site and .856 for the control site for June.

Tongue Point

The species lists and species diversity indices for Tongue Point are presented in Tables 18 and 22. Taxa richness for November indicate 11 species at both the impact and control site. Total abundance for the November collection was 1536 individuals for the impact site and 297 individuals for the control site. The two dominant species for November at the impact site were the oligochaetes with 786 individuals and S. canadensis with 590 individuals. This represents 51 percent and 38 percent, respectively, of the total community structure. The two dominant species for November at the control site were the oligochaetes with 112 individuals and C. salmonis with 92 individuals. This represents 38 percent and 31 percent, respectively, of the total community structure.
The Shannon's Index was calculated at 1.08 at the impact site and 1.66 at the control site for November. The reciprocal of Simpson's Index was 2.42 for the impact site and 3.82 for the control site for November. Pielou's Evenness Index was .449 for the impact site and .692 for the control site for November.

Taxa richness for the March collection was 8 species for the impact site and 10 species for the control site. Total abundance for the March collection was 820 individuals at the impact site and 902 individuals at the control site. The two dominant species for March at the impact site were the oligochaetes with 501 individuals and the crustacean Order Ostracoda (seed shrimp) with 217 individuals. This represents 61 percent and 26 percent, respectively, of the total community structure. The two dominant species for March at the control site were C. salmonis with 571 individuals and the oligochaetes with 175 individuals. This represents 63 percent and 19 percent, respectively of the total community structure. The Shannon's Index was calculated at .989 at the impact site and 1 .1 1 at the control site for March. The reciprocal of Simpson's Index was 2.2 for the impact site and 2.21 for the control site for March. Pielou's Evenness Index was .476 for the impact site and .482 for the control site for March.

Taxa richness for the June collection was 13 species at both the impact site and control site. Total abundance for the June collection was 2769 individuals at the impact site and 1452 individuals at the control site. The two dominant species for June at the impact site were the oligochaetes with 2316 individuals and the Phylum Nematoda with 243 individuals. This represents 84 percent and 9 percent, respectively, of the total community structure. The two dominant species for June at the control site were the oligochaetes with 915 individuals and the Phylum Nematoda with 397 individuals. This represents 63 percent and 28 percent, respectively, of the total community structure. The Shannon's Index was calculated at .658 at the impact site and 1.04 at the control site for June. The reciprocal of Simpson's Index was 1.41 for the impact site and 2.11 for the control site for June. Pielou's Evenness Index was .257 for the impact site and .404 for the control site for June.

Deep River

The species lists and species diversity indices for Deep River are presented in Tables 19 and 23. Taxa richness for November indicate 23 species at the impact site and 11 species at the control site. Total abundance for the November collection was 831 individuals at the impact site and 1006 individuals for the control site. The two dominant species for November at the impact site were the insect Family Chironomidae with 507 individuals and the oligochaetes with 214 individuals. This represents 61 percent and 26 percent, respectively, of the total community structure. The two dominant species for November at the control site were the oligochaetes with 869 individuals and the chironomids with 53 individuals. This represents 86 percent and 5 percent, respectively of the total community structure. The Shannon's Index was calculated at 1.26 at the impact site and .603 at the control site for November. The reciprocal of Simpson's Index was 2.27 for the impact site and 1.33 for the control site for November. Pielou's Evenness Index was .4 for the impact site and .252 for the control site for November.

Taxa richness for the March collection was 13 species for the impact site and 17 species for the control site. Total abundance for the March collection was 219 individuals at the impact site and 252 individuals at the control site. The two dominant species for March at the impact site were the chironomids with 94 individuals and the oligochaetes with 86 individuals. This represents 43 percent and 39 percent, respectively, of the total community structure. The two dominant species for March at the control site were the oligochaetes with 98 individuals and the chironomids with 44 individuals. This represents 39 percent and 17 percent, respectively, of the total community structure. The Shannon's Index was calculated at 1.42 at the impact site and 1.99 at the control site for March. The reciprocal of Simpson's Index was 2.92 for the impact site and 4.74 for the control site for March. Pielou's Evenness Index was .555 for the impact site and .703 for the control site for March.

Taxa richness for the June collection was 9 species at the impact site and 22 species at the control site. Total abundance for the June collection was 302 individuals at the impact site and 360 individuals at the control site. The two dominant species for June at the impact site were the oligochaetes with 154 individuals and the chironomids with 85 individuals. This represents 51 percent and 28 percent, respectively, of the total community structure. The two dominant species for June at the control site were the oligochaetes with 79 individuals and M. balthica with 72 individuals. This represents 22 percent and 20 percent, respectively, of the total community structure. The Shannon's Index was calculated at 1.31 at the impact site and 2.26 at the control site for June. The reciprocal of Simpson's Index was 2.83 for the impact site and 6.93 for the control site for June. Pielou's Evenness Index was .595 for the impact site and .732 for the control site for June.

Blind Slough

The species lists and species diversity indices for Blind Slough are presented in Tables 20 and 24. Taxa richness for November indicate nine species at both the impact site and the control site. Total abundance for the November collection was 447 individuals at the impact site and 155 individuals for the control site. The two dominant species for November at the impact site were the oligochaetes with 263 individuals and the chironomids with 118 individuals. This represents 59 percent and 26 percent, respectively, of the total community structure. The two dominant species for November at the control site were C. salmonis with 41 individuals and the oligochaetes with 51 individuals. This represents 33 percent and 26 percent, respectively, of the total community structure. The Shannon's Index was calculated at 1 .I3 at the impact site and 1.62 at the control site for November. The reciprocal of Simpson's Index was 2.36 for the impact site and 4.23 for the control site for November. Pielou's Evenness Index was .545 for the impact site and .739 for the control site for November.

Taxa richness for the March collection was seven species for the impact site and 13 species for the control site. Total abundance for the March collection was 974 individuals at the impact site and 362 individuals at the control site. The two dominant species for March at the impact site were the oligochaetes with 837 and the chironomids with 123 individuals. This represents 86 percent and 13 percent, respectively, of the total community structure. The two dominant species for March at the control site were C. salmonis with 193 individuals and the oligochaetes with 56 individuals. This represents 53 percent and 15 percent, respectively, of the total community structure. The Shannon's Index was calculated at .479 at the impact site and 1.48 at the control site for March. The reciprocal of Simpson's Index was 1.33 for the impact site and 2.94 for the control site for March. Pielou's Evenness Index was .218 for the impact site and 577 for the control site for March.

Taxa richness for the June collection was ten species at the impact site and 12 species at the control site. Total abundance for the June collection was 977 individuals at the impact site and 222 individuals at the control site. The two dominant species for June at the impact site were the oligochaetes with 820 individuals and the chironomids with 113 individuals. This represents 84 percent and 12 percent, respectively, of the total community structure. The two dominant species for June at the control site were oligochaetes with 76 individuals and C. salmonis with 47 individuals. This represents 34 percent and 21 percent, respectively, of the total community structure. The Shannon's Index was calculated at .617 at the impact site and 1.81 at the control site for June. The reciprocal of Simpson's Index was 1.39 for the impact site and 4.76 for the control site for June. Pielou's Evenness Index was .257 for the impact site and .729 for the control site for June.

Physicochemical Monitoring

The Hydrolab data reported here is presented in Tables 25 through 32 and graphic profiles of selected physicochemical parameters are presented in Figures 11 through 20. Discussed are the highs and lows for each parameter at each of the four net-pen locations and the four other sites being considered for future expansion as net-pen rearing locations. These data will be discussed by site beginning with the site located closest to the Pacific Ocean and proceeding upriver.

Youngs Bay

The Youngs Bay data are presented in Table 25. The temperature low of 5.94 degrees occurred in March, and the high of 20.82 occurred in August. The pH low occurred in January at 6.54 relative units and the high of 7.97 relative units occurred in September. Specific conductivity low of 79.8 micro-mhos/ centimeter occurred in May, and the high of 5585.24 micro-mhos/ centimeter occurred in October. The dissolved oxygen low of 7.11 milligrams/ liter occurred in August, and the high of 14.25 milligrams/ liter occurred in March. The turbidity low of 18.85 nephelometric turbidity units (NTUs) occurred in June, and the high of 103.8 (NTUs) occurred in May.

Tongue Point

The Tongue Point physicochemical data are presented in Table 26. The temperature low of 6.3 degrees occurred in December, and the high of 20.58 degrees occurred in August. The pH low of 6.73 relative units occurred in December, and the high of 8.4 relative units occurred in September. Specific conductivity low of 92.53 micro-mhos/ centimeter occurred in December, and the high of 2023.08 micro-mhos/ centimeter occurred in October. The dissolved oxygen low of 8.51 milligrams/ liter occurred in July and the high of 13.36 milligrams/ liter occurred in March. The turbidity low of 7.58 (NTUs) occurred in September and the high of 54.19 (NTUs) occurred in December.

Deep River

The Deep River physicochemical data are presented in Table 27. The temperature low of 8.77 degrees occurred in February, and the high of 21.78 degrees occurred in July. The pH low of 3.61 relative units occurred in February, and the high of 6.59 relative units occurred in September. The specific conductivity low of 31.16 micro-mhos/ centimeter occurred in February, and the high of 174.96 micro-mhos/ centimeter occurred in October. The dissolved oxygen low of 5.74 milligrams/ liter occurred in July and the high of 12.14 milligrams/ liter occurred in February. The turbidity low of 4.09 (NTUs) occurred in January and the high of 53.97 (NTUs) occurred in December.

Blind Slough

The Blind Slough physicochemical data are presented in Table 28. The temperature low of 5.55 degrees occurred in January, and the high of 20.63 degrees occurred in August. The pH low of 5.57 relative units occurred in December, and the high of 7.24 relative units occurred in June. The specific conductivity low of 39.36 micro-mhos/ centimeter occurred in November, and the high of 115.48 micro-mhos/ centimeter occurred in September. The dissolved oxygen low of 7.13 milligrams/ liter occurred in August and the high of 13.21 milligrams/ liter occurred in January. The turbidity low of 5.83 (NTUs) occurred in September and the high of 34.09 (NTUs) occurred in October.

Steamboat Slough

The Steamboat Slough physicochemical data are presented in Table 29. The temperature low of 4.21 degrees occurred in February, and the high of 20.50 degrees occurred in July. The pH low of 6.46 relative units occurred in February, and the high of 7.77 relative units occurred in May. The specific conductivity low of 92.16 micro-mho/ centimeter occurred in February, and the high of 139.01 micro-mho/ centimeter occurred in September. The dissolved oxygen low of 8.67 milligrams/ liter occurred in August and the high of 16.52 milligrams/ liter occurred in January. The turbidity low of 2.17 (NTUs) occurred in August and the high of 103.53 (NTUs) occurred in October.

Clifton Channel

The Clifton Channel physicochemical data are presented in Table 30. The temperature low of 5.33 degrees occurred in January, and the high of 20.01 degrees occurred in August. The pH low of 6.64 relative units occurred in December, and the high of 7.94 relative units occurred in July. The specific conductivity low of 87.03 micro-mhos/ centimeter occurred in December, and the high of 141.69 micro-mhos/ centimeter occurred in May. The dissolved oxygen low of 9.44 milligrams/ liter occurred in October and the high of 15.48 milligrams/ liter occurred in January. The turbidity low of 10.80 (NTUs) occurred in November and the high of 49.94 (NTUs) occurred in December.

Cathlamet Channel
The Cathlamet Channel physicochemical data are presented in Table 31. The temperature low of 3.80 degrees occurred in February, and the high of 20.77 degrees occurred in July. The pH low of 6.63 relative units occurred in February, and the high of 7.80 relative units occurred in May. The specific conductivity low of 97.08 micro-mhos/ centimeter occurred in December, and the high of 139.30 micro-mhos/ centimeter occurred in September. The dissolved oxygen low of 8.76 milligrams/ liter occurred in September and the high of 16.15 milligrams/ liter occurred in February. The turbidity low of 3.08 (NTUs) occurred in October and the high of 97.15 (NTUs) occurred in December.

Wallace Slounh
The Wallace Slough physicochemical data are presented in Table 32. The temperature low of 5.54 degrees occurred in January, and the high of 20.30 degrees occurred in July. The pH low of 6.59 relative units occurred in December, and the high of 8.15 relative units occurred in July. The specific conductivity low of 81 .OO micro-mhos/ centimeter occurred in December, and the high of 138.62 micro-mhos/ centimeter occurred in May. The dissolved oxygen low of 8.85 milligrams/ liter occurred in July and the high of 14.35 milligrams/ liter occurred in December. The turbidity low of 14.23 (NTUs) occurred in November and the high of 58.35 (NTUs) occurred in December.

DISCUSSION AND CONCLUSIONS

The use of benthic community structure as an indication of water quality involves analysis of species diversity data from several different measures of community health. The two components of species diversity are species richness (the number of species) and species abundance (the number of individuals). To try to define trends, a close evaluation of the dominant species in different, but related, communities over time is required. Another aspect of this process is to make use of current knowledge about each species’ life history and pollution tolerance information. For many species and species groups this information has not been researched, and often basic natural history information is not available. Natural changes that occur in community composition throughout the year due to the change in seasons (i.e. warming and cooling of the water, as well as other parameters) should also be taken into consideration. To help define trends, the use of three widely-used species diversity indices has been incorporated into the study. The indices used are: Shannon’s Diversity Index, reciprocal of Simpson’s Diversity Index, and Pielou’s Evenness Index. These diversity indices help describe different characteristics of the community structure of benthic collections. These indices have no basis in biological theory, but rather in communication and information theory. They have, however, been widely used in the evaluation of ecological systems, and more specifically in defining benthic communities. Their use has been well documented. The rationale behind Simpson’s Index shows how many species will be present in a hypothetical collection composed of equally abundant

species if it would have the same diversity as the collection under question. (Baev and Penev, 1995) The possibilities of values for the reciprocal of Simpson's are between 0 and infinity, but usually are between zero and ten. Shannon's Index generally yields values between three and five for moderately polluted environments and values between one and three for heavily impacted environments and between zero and one for severely impacted environments.
Pielou's Evenness Index can be expressed as "the ratio of the observed diversity index to the maximum value the diversity index could have in a community with the same number of species as the collection in question." That is, if we compared our collection to a collection of the same number of species, but with an equal number of individuals in each species (the highest diversity). What would the percentage or ratio be? Pielou's Evenness Index can be read as a percentage.

These diversity indices have been used only as a secondary indicator of the trends shown by the natural successional increases or decreases in species abundance in response to environmental disturbance. Environmental disturbance can occur naturally and anthropogenically. An attempt has been made to take natural, seasonal, and cyclic change into consideration. Some of the trends that need to be watched for include the loss or lowered number of pollution intolerant species and the subsequent natural ecological succession or replacement of the ecological niche occupation by more pollution tolerant species. Some of the ecologically sensitive or pollution intolerant organisms include many members of the arthropod class, Crustacea, such as the amphipods Corophium salmonis or Eooammarus confervicolus, as well as the harpacticoid copopod, Caullana canadensis. Others include the members of the annelid class, Polychaeta, such as Hobsonia florida or Nereis limnicola, or members of the molluscan class, Bivalvia, such as Macoma balthica or Corbicula fluminea. Some of the more pollution tolerant species include members of the annelid class, Oligochaeta (aquatic earthworms), and the insect family, Chironomidae (midges). These are generalizations, of course, and it has been well documented that in all of these cases, whether or not you are considering pollution tolerant or pollution intolerant organisms, there are known examples of species in all groups that can tolerate higher or lower levels of pollution than the majority of the organisms belonging to a given group. Still the generalizations do serve as an indication of the health of a given ecosystem.

The Washington Department of Ecology has adopted new regulations regarding the management of sediments beneath net-pen rearing operations. These include a change in management practice if there is a greater than 50 percent loss of species or significantly lowered number of the members of the taxonomic classes Crustacea, Polychaeta or Mollusca.

Youngs Bay

The Youngs Bay data indicate that there was a substantial rise in pollution tolerant species and a loss of pollution intolerant species over the time period encompassed by the three collections. The November data indicate that the impact site's community is dominated by H. florida and C. salmonis, 34 percent and 23 percent respectively, both are considered intolerant of pollution. The control site changed considerably after the placement of fish in the pens. Community composition changed with the domination of the oligochaetes, making up 75 percent of the community structure at the impact site, and the noticeable decline in C. salmonis from 640 individuals to 17 individuals, at a time of the year when the water is warming and a rise in numbers would normally be expected. The control site had a dominance of H. florida and Caullana canadensis, both considered pollution intolerant organisms. An explanation for the absence of C. salmonis at the control site may be the lack of structure on which these clinging organisms can colonize out in the open water compared to the presence of physical structures near the net-pen rearing areas.

This trend continues into the June collection with the oligochaetes making up 82 percent of the total community structure at the impact site and the control site tracking fairly normally for this particular season. Note the total number of individuals is 1923 at the impact site. Of this 1923, 1577 are pollution tolerant oligochaetes. At the control site, only 257 individuals were found and the organisms that make up this control site collection are more evenly spread among the various taxa. The species diversity indices indicate similar responses by the benthic communities to stress. The trends to follow where the diversity indices are concerned are how close in diversity both impact and control sites are for the November collection, even though there is a vast difference in species composition. Secondly, note the normal rise in all of the diversity indices at the control site associated with normal seasonal warming and the drop of these indices values at the impact site. This change is primarily caused by the substantial rise of the oligochaetes in response to the fish rearing operations. When compared with the baseline data, the impact site has lost diversity with the lower numbers of H. florida down from 942 individuals, and C. salmonis, E. confervicolus and C. canadensis down from 770, 216, and 294 individuals, respectively. This baseline data was collected one year earlier during the rearing season that had already begun at the Youngs Bay site. This indicates a substantial lowering of the numbers of pollution tolerant organisms which were not found in comparable numbers even at the November collection period which was meant to be representative of the maximum ecological recovery time from the previous year's fish rearing operations.

Tongue Point

The data from Tongue Point indicate 11 species at both impact and control sites; but, the species abundance are quite different with 1536 individuals at the impact site and 297 individuals at the control site. The species composition indicated the oligochaetes dominated both the impact and control sites with 51 percent and 38 percent, respectively. The second most dominant species at the impact site was the copepod, C. canadensis with 38 percent of the total community structure. This pollution tolerant crustacean was not to be collected again at the impact site during the March and June collections. Also of note was the dominance of the March control site by C. salmonis with 571 individuals representing 63 percent of the total community structure. Evaluation of the June collections indicated that the oligochaetes dominated the community with 2316 individuals representing 84 percent of the total community structure. The second most dominant group was the Phylum Nematoda with 9 percent of the total community structure. This means 93 percent of the community composed of 2769 individuals is represented by two species groups, both of which are considered pollution tolerant. The same holds true, however, for the control site. Also of note is the substantially lowered numbers of the amphipods and copepods at both the impact and control sites. These data are confusing in that no trends can be found when considering the pollution intolerant organisms. A comparison of the baseline data from the April 1995 collection indicates a loss of the polychaetes H. florida and N. linmicola from these collections.

The species diversity indices seemingly offer no help in diagnosing the health of the Tongue Point rearing site. All three indices show loss of species diversity at both the impact and control sites when there is an expected rise at least at the control site associated with normal seasonal warming.

Deep River r

The November collection yielded data that was the opposite of what is expected, with the impact site having a higher species richness and lower species abundance than the control site. Even the species composition of the less dominant groups include members of pollution tolerant groups like the insect order, Trichoptera, albeit in small numbers. The dominant groups were the chironomids and oligochaetes, with 61 percent and 53 percent, respectively, of the total community structure. The November control collection yielded a lower diversity with the oligochaetes and chironomids also being the dominant species, with 86 percent and 53 percent, respectively, of the total community structure. A comparative look at the species abundance values from the November collections seems to give an indication of the loss of diversity at both the control and impact sites to what would be expected after a recovery period of six months. The high species diversity at the impact site is enigmatic. The March collection; however, seems to follow the expected changes associated with impacts of fish rearing operations. There was a lower species abundance and lower species richness at the impact site, and a higher species richness but lower species abundance at the control site. The lowered species abundance seems odd, but this may be the fault of the sampling design. The control site data from the March and June collections look so very similar in all aspects to the impact site data. This seems to indicate that the control site is not located far enough away from the impact site so as not to be effected by the effluents from the net-pen rearing operations. Although the data from the impact site seems to indicate that there is a higher diversity at this impact site than at the other fish rearing operations.

BlindSlough

All data point to a degradation of the impact site while a normal seasonal rise in diversity occurred at the control site. Taxa richness was nine species at both the impact and control sites for the November collections. The March collections show a loss of one species, while the control site gained four species associated with the normal seasonal rise in water temperature. The species abundance and dominant group data show an increase in the oligochaetes and chironomid numbers at the impact site causing the abundance values to rise at that site. The control site had only modest rises in oligochaete numbers and the dominant group at the control site for the November and March collections was C. salmonis, a pollution intolerant species. The June collection continues to show degradation at the impact site with the pollution tolerant oligochaetes and chironomids making up 96 percent of the total community structure. This is contrasted with the control site data which shows the dominance being spread among four groups. When compared to the April, 1995, baseline data set, the impact site yields a similar pattern with the two dominant groups being the oligochaetes and chironomids. While the control site has the species abundance more evenly spread among the various groups both tolerant and intolerant of pollution. The species diversity indices show a similar trend with the November impact values yielding a lower diversity in all three of the diversity indices than at the control site. This pattern is magnified at the March collection, with an even lower value for all three measures of diversity. By the June collection, values had dropped substantially at the impact site.

Phvsicochemical Monitoring

The physicochemical parameters indicate some fairly normal ranges for all parameters at all sites. The pH reading of 3.61 in February is the only instance of any parameter reaching a dangerous level at times when fish are being reared in pens and this event happened during the height of the flooding conditions associated with the flood of 1996. Specific conductivity readings indicate that none of the sites upriver of Tongue Point have any salt water influence. That is not to say that the salt wedge never reaches any further upstream than Tongue Point only that it does not invade the select areas as it does the mainstem. pH values seem to indicate that as one moves upstream and nearer to the main channel, the pH values stabilize nearer a value of 7.0, which is neutral and an ideal condition to sustain life. All other parameters fall within normal ranges for the Columbia River.

Overview

From a water quality stand point these net-pen rearing operations have the potential to impact the surrounding benthic macroinvertebrate communities. These net-pen rearing operations however show promise as a mitigation tool, allowing for fishing opportunities without negatively impacting the threatened or endangered wild fish stocks that have to pass through the lower Columbia River on their way to the spawning grounds. Since this is a government supported program it is our responsibility to ensure that impacts to the environment are minimized by our fish rearing operations. Below are some possible recommendations for lowering the impact if fish rearing operations cause degradation.

Recommendations for Minimizing Impacts of Net-Pen Rearing Operations

For the net-pen operations to operate with a lowered impact on the surrounding environment there has to be less organic sedimentation from fish food and fish wastes. There are many solutions to minimize impacts. Following are some suggestions for reducing organic sedimentation below and near the net pens.
(1) Reduce the amount of feed.
(2) Lower the density of fish in the pens.
(3) Spread the pen units out over a larger area.
(4) Leave a site unused for one or two rearing seasons, and rear the fish nearby in the same drainage while the previously impacted site goes through natural recovery.
(5) Use a nonpolluting net-pen design. Models are commercially available, but are likely quite expensive.

As the net-pen rearing phase of the SAFE project expands, continued evaluation of the various available indices, as well as other indicators of organic pollution will be explored. The comparative use of chemical tests, such as total organic carbon (TOC) data when correlated with benthic macroinvertebrate data, has shown promise in the marine net-pen operations of the Puget Sound area. It is the intent of this water quality monitoring program to use any and all available methods within the projects financial and personnel resources to discover useful endpoints that give an accurate indication of the health of the ecosystems adjacent to the net-pen rearing operations.

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Table 17. List of species from benthic collections taken from Youngs Bay, Oregon. Collections were made in early November, 1995, before fish were placed in the net pens; early March, 1996, during the midpoint of the fish rearing period; and early June, 1996, after the fish were released.

Species names	Novem. Impact	Novem. Control	March Impact	March Control	June impact	June Control
Phylum Nematoda	2	7	15	19	14	43
Phylum Annelida						
Class Oligochaeta	380	100	1278	22	1577	34
Class Polychaeta						
Hobsonia florida	415	169	162	76	24	23
Nereis limnicola	19	9	25	3	24	23
Phylum Arthropoda						
Class Insecta						
Chironomidae	0	0	37	4	5	5
Ceratopogonidae	0	0	1	0	12	0
Class Crustacea						
Order Amphipoda						
Corophiidae						
Corophium salmonis	640	0	17	7	174	41
Gammaridae						
Eogammarus confervicolus	24	0	0	0	3	0
Order Isopoda						
Gnorimosphaeroma spp.	0	0	2	1	2	1
Order Copopoda	13	21	49	62	11	48
Coulana canadensis						
Order Cladocera						
Bosmina longirostris	0	0	0	0	3	7
Order Cumacea	2	3	0	0	0	0
Order Cirripedia	141	0	6	0	3	0
Order Decapoda	0	1	0	0	0	0
Phylum Mollusca						
Class Bivalvia						
Macoma balthica	61	48	13	5	38	51
Corbicula fluminea	15	0	19	3	4	0
Sphaeriidae	0	0	17	4	0	0
Class Gastropoda						
Unidentified spp.: A	121	28	69	50	47	4
Unidentified spp.: B	6	0	0	0	0	0
Total: Number of individuals in sample	1839	386	1710	256	1923	257
Relative Abundance: No./square meter	26390	5539	24539	3674	27595	3688

Table 18. List of species from benthic collections taken from Tongue Point, Oregon. Collections were made in early November, 1995, before fish were placed in the net pens; early March, 1996, during the midpoint of the fish rearing period; and early June, 1996, after the fish were released.

Species names	Novem. Impact	Novem. Control	March Impact	March Control	June Impact	June Control
Phylum Nematoda spp.: A	37	4	86	3	243	397
Phylum Nematoda spp.: B	0	0	0	0	1	0
Phylum Annelida						
Class Oligochaeta	786	112	501	175	2316	915
Phylum Arthropoda						
Class Insecta						
Order Ephemeroptera						
Ephemeridae						
Ephemera spp.	0	0	0	1	1	0
Order Hemiptera						
Larval Hemiptera (unidentified, damaged)	0	1	0	0	0	0
Chironomidae	1	8	10	21	11	5
Ceratopogonidae	0	0	0	0	2	6
Class Crustacea						
Order Amphipoda						
Corophiidae						
Corophium salmonis	4	92	1	571	8	12
Gammaridae						
Eogammarus confervicolus	0	0	0	9	0	1
Order Copopoda						
Coullana canadensis	590	27	0	0	0	2
Order Cladocera						
Bosminidae						
Bosmina longirostris	0	0	2	0	132	68
Daphniidae						
Daphnia spp.	0	0	0	0	3	2
Order Ostracoda	2	2	217	106	31	21
Phylum Mollusca						
Class Bivalvia						
Tellinidae						
Macoma *baithica*	4	14	1	8	14	13
Corbiculidae						
Cofbicula fluminea	4	0	0	0	0	0
Class Gastropoda						
Juga *plicifera*	4	4	0	5	0	0
Total: Number of individuals in sample	1536	297	820	902	2769	1452
Total Abundance: #/square meter	22042	4262	11767	12944	39735	20836

Table 19. List of species from benthic collections taken from Deep River, Washington. Collections were made in early November, 1995, before fish were placed in the net pens; early March, 1996, during the midpoint of the fish rearing period; and early June, 1996, after the fish were released.

Species names	Novem. Impact	Novem. Control	March Impact	March Control	June Impact	June Control
Phylum Nematoda	1	1	2	7	0	11
Phylum Platyhelminthes	1	0	0	6	0	0
Phylum Annelida						
Class Oligochaeta	214	869	86	98	154	79
Phylum Arthropoda						
Class Insecta						
Order Ephemeroptera						
Ephemeridae						
Ephemera *spp.*	3	0	6	12	0	6
Caenidae						
Caenis *spp.*	1	0	0	0	0	1
Order Zygoptera						
Coenagnonidae						
Coenagrion *spp.*	6	0	0	1	0	0
Order Tnchoptera						
Limnephilidae						
Unidentified specimen: A	1	0	0	0	0	4
Unidentified specimen: B	1	0	0	0	0	5
Unidentified specimen: C	1	0	0	0	0	1
Order Megaloptera						
Sialis *rotunda*	3	0	3	1	0	0
Order Diptera						
Chironomidae	507	53	94	44	85	55
Ceratopogonidae	2	3	3	6	29	4
Class Crustacea						
Order Amphipoda						
Corophiidae						
Corophium salmonis	7	37	6	33	0	22
Gammaridae						
Eogammarus confervicolus	5	3	0	0	0	9
Order Isopoda						
Lirceus spp.	6	2	0	0	0	8
Order Ostracoda	0	0	4	0	0	0
Order Copopoda						
Coullana *canadensis*	5	0	0	3	0	2
Unidentified specimen: B	0	0	0	0	0	1
Order Cladocera						
Bosminidae						
Bosmina longirostris	1	0	2	2	20	6
Class Arachnida						
Hydracarina	0	0	4	0	0	0
Phylum Mollusca						
Class Bivalvia						
Tellinidae						
Macoma balthica	4	32	1	18	5	72
Corbiculidae						
Corbicula ***fluminea***	0	0	0	3	1	1
Sphaeriidae						
Unidentified specimen: A	0	1	1	12	0	0
Class Gastropoda						
Unidentified specimen: A	21	3	0	1	0	1
Unidentified specimen: B	5	0	0	1	0	0
Unidentified specimen: C (Pulmonata)	2	0	0	0	0	0
Total: Number of individuals in sample	831	1006	219	252	302	360
Relative Abundance: No./square meter	11925	14436	3143	3616	4334	5166

Table 20. List of species from benthic collections taken at Blind Slough, Oregon. Collections were made in early November, 1995, before fish were placed in the net pens; early March, 1996, during the midpoint of the fish rearing period; and earlv June. 1996. after the fish were released.

Species names	Novem. Impact	Novem. Control	March Impact	March Control	June Impact	June Control
Phylum Nematoda	0	2	2	10	0	0
Phylum Platyhelminthes	1	0	0	0	0	0
Phylum Annelida						
Class Hirudinea	0	1	0	0	1	0
Class Oligochaeta	263	41	837	56	820	76
Class Polychaeta						
Hobsonia florida	39	0	0	0	0	0
Phylum Arthropoda						
Class Insecta						
Order Ephemeroptera						
Ephemeridae						
Ephemera spp.	0	3	0	2	0	0
Order Odonata						
Suborder Zygoptera						
Coenagrion *spp.*	0	0	0	0	0	1
Suborder Anisoptera (Damaged specimen)	0	0	0	0	0	1
Order Trichoptera						
Unidentified specimen: A	0	0	0	0	0	1
Order Megaloptera						
Sialis *rotunda*	4	0	0	1	0	0
Order Diptera						
Chironomidae	118	8	123	8	113	16
Ceratopogonidae	0	0	0	12	4	3
Chaoboridae						
Chaoborus spp.	0	0	0	1	0	0
Order Collembola						
Sminthuridae	0	0	2	0	0	0
Class Crustacea						
Order Am hipoda						
Corophii8ae						
Corophium salmonis	3	51	3	193	2	47
Gammaridae						
Eogammarus confervicolus	0	0	3	0	1	0
Order Copopoda						
Coullana canadensis	4	1	1	3	4	7
Order Cladocera						
Bosmina *longirosttis*	0	0	0	1	18	3
Oder Ostracoda	12	15	0	12	8	36
Class Arachnida						
Hydracarina	0	0	1	2	3	3
Phylum Mollusca						
Class Bivalvia---						
Macoma balthica	4	33	2	61	3	27
Total: Number of individuals in sample	447	155	974	362	977	222
Relative Abundance: No./square meter	6414	2224	13977	5195	14020	3186

Table 21. Youngs Bay species diversity indices.

	Novem . Impact	Novem . Control	March Imoact	March Control	June Impact	June Control
Number of species (Richness)	13	9	14	12	15	10
Number of indviduals (Evenness)	1839	386	1710	256	1923	257
Shannon's Index	1.73	1.53	1.07	1.86	0.784	1.97
Reciprocal of Simpson's Index	4.42	3.53	1.75	5.01	1.47	6.47
Pielou's Evenness Index	0.674	0.698	0.405	0.748	0.289	0.856

Note: Species diversity indices calculations based on data from Table 17.

Table 22. Tongue Point species diversity indices.

	Novem. Impact	Novem. Control	March Impact	March Control	June Impact	June Control
Number of species (Richness)	11	11	8	10	13	13
Number of individuals (Evenness)	1536	297	820	902	2769	1452
Shannon's Index	1.08	1.66	0.989	1.11	0.658	1.04
Reciprocal of Simpson's Index	2.42	3.82	2.2	2.21	1.41	2.11
Pielou's Evenness Index	0.449	0.692	0.476	0.482	0.257	0.404

Note: Species diversity indices calculations based on data from Table 18.

Table 23. Deep River, Washington species diversity indices.

	Novem. Impact	Novem. Control	March Imoact	March Control	June Impact	June Control
Number of species (Richness)	23	11	13	17	9	22
Number of individuals (Evenness)	831	1006	219	252	302	360
Shannon's Index	1.26	0.603	1.42	1.99	1.31	2.26
Reciprocal of Simpson's Index	2.27	1.33	2.92	4.74	2.83	6.93
Pielou's Evenness Index	0.4	0.252	0.555	0.703	0.595	0.732

Note: Species diversity indices calculations based on data from Table 19.

Table 24. Blind Slough, Oregon species diversity indices.

	Novem. Impact	Novem. Control	March Impact	March Control	June Impact	June Control
Number of species (Richness)	9	9	8	13	10	12
Number of Individuals (Evenness)	447	155	974	362	977	222
Shannon's Index	1.13	1.62	0.479	1.48	0.617	1.81
Reciprocal of Simpson's Index	2.36	4.23	1.33	2.94	1.39	4.76
Pielou's Evenness Index	0.545	0.739	0.218	0.577	0.257	0.729

Note: Species diversity indices calculations based on data from Table 20.

Table 25. Youngs Bay, Oregon physicochemical parameters, November, 1995 through October, 1996. Values shown are the means and standard deviations of the means for all parameters for all sample dates.

			Temp degC	pH units	SpCond uS/cm	DO %Sat	DO mg/l	Turb NTU
Youngs Bay, Oregon	Nov 95	MEAN->	10.91	6.69	537.00	92.63	10.36	25.51
River mile 12	Nov 95	S.D.->	0.20	0.34	267.28	1.98	0.22	13.78
Youngs Bay, Oregon	Dec95	MEAN->	8.07	6.91	1884.78	102.64	12.11	45.58
River mile 12	Dec95	S.D.->	0.35	0.27	824.21	1.41	0.24	13.96
Youngs Bay, Oregon	Jan96	MEAN->	9.03	6.54	216.04	100.26	11.77	21.79
River mile 12	Jan96	S.D.->	0.47	0.39	105.01	2.13	0.32	16.73
Youngs Bay, Oregon	Feb96	MEAN->	6.80	6.59	1504.24	113.43	13.90	71.75
River mile 12	Feb96	S.D.->	1.13	0.61	1263.57	3.63	0.76	49.98
Youngs Bay, Oregon	Mar96	MEAN->	5.94	7.38	622.56	114.52	14.25	67.72
River mile 12	Mat96	S.D.->	0.49	0.24	167.96	4.53	0.73	12.52
Youngs Bay, Oregon	Apr96	MEAN->	9.21	6.93	2407.88	110.38	12.76	41.84
River mile 12	Apr96	S.D.->	0.36	0.10	550.42	1.86	0.22	47.33
Youngs Bay, Oregon	May96	MEAN->	12.22	6.56	79.80	106.58	11.68	103.88
River mile 12	May96	S.D.->	0.47	0.16	11.87	3.55	0.45	127.97
Youngs Bay, Oregon	Jun96	MEAN->	18.00	7.65	290.65	94.81	9.44	18.85
River mile 12	Jun96	S.D.->	0.63	0.19	55.52	6.25	0.64	15.78
Youngs Bay, Oregon	July96	MEAN->	20.59	7.55	4122.55	80.77	7.27	22.76
River mile 12	July96	S.D.->	0.44	0.12	340.51	5.94	0.50	17.10
Youngs Bay, Oregon	Aug96	MEAN->	20.82	7.28	5022.57	79.64	7.11	28.38
River mile 12	Aug96	S.D.->	0.48	0.12	677.94	7.17	0.60	41.55
Youngs Bay, Oregon	Sept96	MEAN->	18.96	7.97	5260.92	82.01	7.54	44.25
River mile 12	Sept96	S.D.->	0.34	0.10	891.25	4.55	0.40	20.91
Youngs Bay, Oregon	Oct96	MEAN->	16.23	7.89	5585.24	88.22	8.60	52.74
River mile 12	Oct96	S.D.->	0.20	0.14	281.10	5.55	0.54	108.26

Table 26. Tongue Point, Oregon physicochemical parameters, November, 1995 through October, 1996. Values shown are the means and standard deviations of the means for all parameters for all sample dates.

			Temp degC	pH units	SpCond uS/cm	DO %Sat	DO mg/l	Turb NTU
Tongue Point, Oregon	Nov95	MEAN->	10.63	7.46	117.16	92.33	10.40	27.53
River mile 18	Nov95	S.D.->	0.08	0.05	3.07	1.41	0.15	13.69
Tongue Point, Oregon	Dec95	MEAN->	6.30	6.73	92.53	94.01	11.77	54.19
River mile 18	Dec95	S.D.->	0.19	0.04	1.22	1.19	0.20	12.79
Tongue Point, Oregon	Jan96	MEAN->	Equipment malfunctioned; no data available for this site.					
River mile 18	Jan96	S.D.->	Equipment malfunctioned; no data available for this site.					
Tongue Point, Oregon	Feb96	MEAN->	Equipment malfunctioned; no data available for this site.					
River mile 18	Feb96	S.D.->	Equipment malfunctioned; no data available for this site.					
Tongue Point, Oregon	Mar96	MEAN->	6.59	7.41	118.50	106.74	13.36	32.08
River mile 18	Mar96	S.D.->	0.18	0.05	0.55	1.62	0.25	4.75
Tongue Point, Oregon	Apr.96	MEAN->	9.55	6.90	178.20	104.41	12.03	42.22
River mile 18	Apr.96	S.D.->	0.17	0.05	49.87	2.35	0.26	8.57
Tongue Point, Oregon	May96	MEAN->	13.20	7.14	107.67	112.98	12.02	27.11
River mile 18	May96	S.D.->	0.32	0.14	7.21	3.31	0.37	18.43
Tongue Point, Oregon	Jun96	MEAN->	Equipment malfunctioned; no data available for this site.					
River mile 18	Jun96	S.D.->	Equipment malfunctioned; no data available for this site.					
Tongue Point, Oregon	July96	MEAN->	19.03	7.85	293.14	90.55	8.51	21.88
River mile 18	July96	S.D.->	0.11	0.12	188.54	5.27	0.49	4.68
Tongue Point, Oregon	Aug96	MEAN->	20.58	7.85	650.20	99.82	9.07	15.88
River mile 18	Aug96	S.D.->	0.16	0.10	342.26	5.05	0.45	5.28
Tongue Point, Oregon	Sept96	MEAN->	18.82	8.40	1832.53	102.28	9.89	18.52
River mile 18	Sept96	S.D.->	0.15	0.09	941.57	3.95	0.37	3.83
Tongue Point, Oregon	Oct96	MEAN->	16.59	7.66	2023.08	103.97	10.22	7.58
River mile 18	Oct96	S.D.->	0.14	0.08	946.73	4.53	0.45	1.91

Table 27. Deep River, Washington physicochemical parameters, November, 1995 through October, 1996. Values shown are the means and standard deviations of the means for all parameters for all sample dates.

			Temp degC	pH units	SpCond uS/cm	DO %Sat	DO mg/l	Turb NTU
Deep River, Washington	Nov95	MEAN->	11.15	5.38	42.78	71.88	8.01	4.77
River mile 22	Nov95	S.D.->	0.19	0.04	1.50	2.68	0.30	0.62
Deep River, Washington	Dec95	MEAN->	8.89	4.98	42.58	85.36	9.76	25.55
River mile 22	Dec95	S.D.->	0.33	0.06	1.51	2.70	0.37	3.24
Deep River, Washington	Jan96	MEAN->	8.94	5.25	35.44	83.53	9.81	4.09
River mile 22	Jan96	S.D.->	0.24	0.05	0.74	1.99	0.21	0.85
Deep River, Washington	Feb96	MEAN->	8.77	3.61	31.16	103.41	12.14	19.75
River mile 22	Feb96	S.D.->	0.29	1.56	0.90	2.65	0.27	7.33
Deep River, Washington	Mar96	MEAN->	7.19	5.75	40.71	88.10	10.74	9.13
River mile 22	Mar96	S.D.->	0.20	0.09	0.77	2.42	0.33	1.41
Deep River, Washington	Apt96	MEAN->	9.74	5.21	53.87	90.08	10.31	10.36
River mile 22	Apr.96	S.D.->	0.20	0.13	3.03	3.30	0.36	1.62
Deep River, Washington	May96	MEAN->	12.26	5.67	42.03	93.35	10.23	53.97
River mile 22	May96	S.D.->	0.24	0.05	0.57	7.12	0.81	7.54
Deep River, Washington	Jun96	MEAN->	18.08	6.33	68.86	84.33	8.11	4.13
River mile 22	Jun96	S.D.->	0.38	0.11	3.39	5.24	0.45	2.78
Deep River, Washington	July96	MEAN->	21.78	6.23	94.11	64.50	5.74	6.47
River mile 22	July96	S.D.->	0.38	0.08	3.31	4.50	0.39	4.34
Deep River, Washington	Aug96	MEAN->	20.25	6.20	97.83	64.72	5.95	7.66
River mile 22	Aug96	S.D.->	2.45	0.47	13.66	10.10	0.64	5.97
Deep River, Washington	Sept96	MEAN->	19.21	6.59	116.31	65.69	6.13	19.54
River mile 22	Sept96	S.D.->	0.31	0.06	2.79	5.27	0.46	9.73
Deep River, Washington	Oct96	MEAN->	15.58	6.49	174.96	66.30	6.68	13.59
River mile 22	Oct96	S.D.->	0.28	0.06	1.55	3.25	0.31	4.27

Table 28. Blind Slough, Oregon physicochemical parameters, November, 1995 through October, 1996. Values shown are the means and standard deviations of the means for all parameters for all sample dates.

			Temp degC	pH units	SpCond uS/cm	DO %Sat	DO mg/l	Turb NTU
Blind Slough, Oregon	Nov 95	MEAN->	10.03	5.81	39.36	79.62	9.11	26.77
River mile 28	Nov 95	S.D.->	0.32	0.22	10.23	4.46	0.50	17.31
Blind Slough, Oregon	Dec95	MEAN->	7.63	5.57	49.17	108.89	13.25	17.54
River mile 28	Dec95	S.D.->	0.16	0.06	4.48	3.52	0.39	3.32
Blind Slough, Oregon	Jan96	MEAN->	5.55	6.21	39.89	103.84	13.21	6.00
River mile 28	Jan96	SD.->	0.09	0.06	2.00	1.43	0.18	0.77
Blind Slough, Oregon	Feb96	MEAN->	Equipment malfunctioned; no data available for this site.					
River mile 28	Feb96	S.D.->	Equipment malfunctioned; no data available for this site.					
Blind Slough, Oregon	Mar96	MEAN->	9.27	6.17	47.78	99.82	11.61	15.70
River mile 28	Mar96	S.D.->	0.17	0.09	4.17	2.16	0.27	6.35
Blind Slough, Oregon	Apr.96	MEAN->	12.39	5.74	69.58	98.95	10.74	21.16
River mile 28	Apt96	S.D.->	0.44	0.20	13.91	4.82	0.61	2.89
Blind Slough, Oregon	May96	MEAN->	13.83	6.17	57.56	106.05	11.14	9.20
River mile 28	May96	S.D.->	0.46	0.17	8.90	3.93	0.38	2.45
Blind Slough, Oregon	Jun96	MEAN->	17.39	7.24	78.68	94.64	9.20	18.79
River mile 28	Jun96	S.D.->	0.44	0.31	4.71	7.03	0.64	3.67
Blind Slough, Oregon	July96	MEAN->	20.28	6.97	96.06	86.49	7.91	7.65
River mile 28	July96	S.D.->	0.33	0.13	5.63	7.38	0.64	4.51
Blind Slough, Oregon	Aug96	MEAN->	20.63	7.19	105.04	78.10	7.13	9.36
River mile 28	Aug96	S.D.->	0.36	0.13	5.71	7.46	0.64	10.12
Blind Slough, Oregon	Sept96	MEAN->	19.06	7.23	115.48	91.71	8.57	34.09
River mile 28	Sept96	S.D.->	0.19	0.09	5.59	5.19	0.47	5.22
Blind Slough, Oregon	Oct96	MEAN->	16.57	6.96	111.25	98.76	9.73	5.83
River mile 28	Oct96	S.D.->	0.10	0.09	5.21	6.43	0.62	1.87

Table 29. Steamboat Slough, Washington physicochemical parameters, November, 1995 through October, 1996. Values shown are the means and standard deviations of the means for all parameters for all sample dates.

		Temp degC	pH units	SpCond uS/cm	DO %Sat	DO mg/l	Turb NTU
Steamboat Slough, Washington	Nov95 MEAN->	10.62	7.31	99.95	86.51	9.62	17.57
River mile 34	Nov95 S.D.->	0.06	0.05	1.76	1.52	0.16	8.37
Steamboat Slough, Washington	Dec95 MEAN->	7.21	6.71	98.96	107.57	13.09	83.24
River mile 34	Dec95 S.D.->	0.08	0.03	2.43	1.09	0.13	14.08
Steamboat Slough, Washington	Jan96 MEAN->	6.17	7.35	101.34	100.54	12.77	9.32
River mile 34	Jan96 S.D.->	0.09	0.03	1.83	1.95	0.26	2.38
Steamboat Slough, Washington	Feb96 MEAN->	4.21	6.46	92.16	124.16	16.52	103.53
River mile 34	Feb96 S.D.->	0.20	0.07	2.80	3.00	0.43	15.35
Steamboat Slough, Washington	Mar96 MEAN->	4.34	7.51	114.84	114.00	15.11	40.71
River mile 34	Mar96 S.D.->	0.09	0.09	0.79	1.12	0.15	9.07
Steamboat Slough, Washington	Apr.96 MEAN->	7.18	6.66	135.32	113.63	13.78	38.54
River mile 34	Apr.96 S.D.->	0.15	0.05	1.46	2.38	0.28	3.52
Steamboat Slough, Washington	May96 MEAN->	10.49	7.77	132.65	123.58	14.05	50.13
River mile 34	May96 SD.->	0.20	0.05	1.33	2.34	0.25	11.92
Steamboat Slough, Washington	Jun96 MEAN->	15.42	7.66	125.32	102.54	10.39	10.99
River mile 34	Jun96 S.D.->	0.31	0.08	0.31	1.84	0.13	3.96
Steamboat Slough, Washington	July96 MEAN->	20.50	7.43	131.97	96.84	8.84	4.91
River mile 34	July96 S.D.->	0.16	0.09	2.46	6.24	0.57	1.76
Steamboat Slough, Washington	Aug96 MEAN->	20.06	7.29	127.99	93.88	8.67	2.17
River mile 34	Aug96 S.D.->	0.21	0.07	0.76	5.88	0.53	1.70
Steamboat Slough, Washington	Sept96 MEAN->	19.54	7.50	139.01	96.25	8.96	12.94
River mile 34	Sept96 S.D.->	0.16	0.05	0.72	3.98	0.36	4.79
Steamboat Slough, Washington	Oct96 MEAN->	16.88	7.54	133.12	90.69	8.90	16.43
River mile 34	Oct96 S.D.->	0.09	0.05	0.74	3.82	0.37	2.33

Table 30. Clifton Channel, Oregon physicochemical parameters, November, 1995 through October, 1996. Values shown are the means and standard deviations of the means for all parameters for all sample dates.

			Temp degC	pH units	SpCond uS/cm	DO %Sat	DO mg/l	Turb NTU
Clifton Channel, Oregon	Nov95	MEAN->	10.34	7.51	120.60	91.97	10.44	10.80
River mile36	Nov95	S.D.->	0.12	0.03	4.18	1.16	0.13	1.65
Clifton Channel, Oregon	Dec95	MEAN->	6.64	6.64	87.03	115.94	14.43	49.94
River mile36	Dec95	S.D.>	0.05	0.05	2.04	0.67	0.09	3.35
Clifton Channel, Oregon	Jan96	MEAN->	5.33	7.48	100.42	120.92	15.48	14.82
River mile36	Jan96	SD.->	0.07	0.04	3.40	0.83	0.12	1.96
Clifton Channel, Oregon	Feb96	MEAN->	Equipment malfunctioned; no data available for this site.					
River mile36	Feb96	S.D.->	Equipment malfunctioned; no data available for this site.					
Clifton Channel, Oregon	Mar96	MEAN->	5.88	7.43	116.76	115.45	14.65	42.88
River mile36	Mar96	S.D.->	0.22	0.11	1.67	2.01	0.29	4.95
Clifton Channel, Oregon	Apr96	MEAN->	9.47	6.89	133.24	105.34	12.21	34.30
River mile36	Apr.96	S.D.->	0.22	0.07	0.71	2.31	0.29	5.27
Clifton Channel, Oregon	May96	MEAN->	11.25	7.01	141.69	102.70	11.45	29.27
River mile36	May96	S.D.->	0.23	0.06	1.99	1.51	0.17	16.98
Clifton Channel, Oregon	Jun96	MEAN->	Equipment malfunctioned; no data available for this site.					
River mile36	Jun96	S.D.->	Equipment malfunctioned; no data available for this site.					
Clifton Channel, Oregon	July96	MEAN->	19.89	7.94	128.94	104.36	9.63	20.15
River mile36	July96	S.D.->	0.21	0.15	0.46	3.51	0.30	7.65
Clifton Channel, Oregon	Aug96	MEAN->	20.01	7.75	132.14	93.07	8.59	15.78
River mile36	Aug96	S.D.->	0.30	0.08	1.00	3.76	0.32	3.75
Clifton Channel, Oregon	Sept96	MEAN->	19.51	7.42	140.30	105.27	9.78	27.22
River mile36	Sept96	S.D.->	0.27	0.09	1.50	3.79	0.32	4.16
Clifton Channel, Oregon	Oct96	MEAN->	16.65	7.52	131.88	95.62	9.44	20.86
River mile36	Oct96	S.D.->	0.23	0.06	0.78	2.78	0.26	5.74

Table 31. Cathiamet Channel, Washington physicochemical parameters, November, 1995 through October, 1996. Values shown are the means and standard deviations of the means for all parameters for all sample dates.

			Temp degC	pH units	SpCond uS/cm	DO %Sat	DO mg/l	Turb NTU
Cathlamet Channel, Washington	Nov95	MEAN->	10.72	7.48	112.99	97.14	10.95	14.53
River mile 40	Nov95	S.D.->	0.04	0.01	0.83	1.12	0.13	1.66
Cathlamet Channel, Washington	Dec95	MEAN->	7.24	6.75	97.08	93.20	11.33	97.15
River mile 40	Dec95	SD.->	0.04	0.02	2.07	2.88	0.36	6.50
Cathlamet Channel, Washington	Jan96	MEAN->	6.02	7.47	109.32	106.69	13.58	9.80
River mile 40	Jan96	S.D.->	0.08	0.02	3.94	0.94	0.12	0.44
Cathlamet Channel, Washington	Feb96	MEAN->	3.80	6.63	105.55	120.71	16.15	56.60
River mile 40	Feb96	S.D.->	0.09	0.03	2.34	0.66	0.11	6.76
Cathlamet Channel, Washington	Mar96	MEAN->	4.48	7.56	117.64	105.03	13.85	36.53
River mile 40	Mar96	S.D.->	0.05	0.03	1.42	1.08	0.14	1.38
Cathlamet Channel, Washington	Apr96	MEAN->	7.31	6.70	134.48	109.83	13.43	25.89
River mile 40	Apr96	S.D.->	0.10	0.02	1.17	1.11	0.13	4.52
Cathlamet Channel, Washington	May96	MEAN->	10.41	7.80	141.36	112.39	12.77	65.19
River mile 40	May96	S.D.->	0.15	0.02	1.80	3.14	0.33	19.69
Cathlamet Channel, Washington	Jun96	MEAN->	15.44	7.44	124.74	107.10	10.88	6.65
River mile 40	Jun96	S.D.->	0.12	0.08	0.44	1.24	0.12	5.48
Cathlamet Channel, Washington	July96	MEAN->	20.77	7.46	134.45	98.35	8.93	9.37
River mile 40	July96	S.D.->	0.23	0.05	1.51	4.28	0.38	3.33
Cathlamet Channel, Washington	Aug96	MEAN->	19.78	7.34	126.85	96.44	8.92	10.26
River mile 40	Aug96	S.D.->	0.06	0.06	0.92	4.11	0.38	4.95
Cathlamet Channel, Washington	Sept96	MEAN->	19.39	7.61	139.30	93.94	8.76	18.72
River mile 40	Sept96	S.D.->	0.13	0.03	1.80	2.92	0.26	2.43
Cathlamet Channel, Washington	Oct96	MEAN->	16.86	7.55	131.95	90.84	8.92	3.08
River mile 40	Oct96	S.D.->	0.05	0.04	0.41	3.01	0.29	0.84

Table 32. Wallace Slough, Oregon physicochemical parameters, November, 1995 through October, 1996. Values shown are the means and standard deviations of the means for all parameters for all sample dates.

		Temp degC	pH units	SpCond uS/cm	DO %Sat	DO mg/l	Turb NTU
Wallace Slough, Oregon	Nov95 MEAN->	10.68	7.49	113.85	101.44	11.38	14.23
River mile 49	Nov95 S.D.->	0.23	0.02	1.25	1.47	0.17	9.32
Wallace Slough, Oregon	Dec95 MEAN->	6.98	6.59	81.00	116.39	14.35	58.35
River mile 49	Dec95 S.D.->	0.16	0.07	1.09	0.98	0.13	2.92
Wallace Slough, Oregon	Jan96 MEAN->	5.54	7.44	96.11	100.12	12.83	24.12
River mile 49	Jan96 S.D.->	0.03	0.07	1.90	1.24	0.15	36.23
Wallace Slough, Oregon	Feb96 MEAN->	Site inaccessible due to the flood of 1996.					
River mile 49	Feb96 S.D.->	Site inaccessible due to the flood of 1996.					
Wallace Slough, Oregon	Mar96 MEAN->	Site inaccessible due to the flood of 1996.					
River mile 49	Mar96 S.D.->	Site inaccessible due to the flood of 1996.					
Wallace Slough, Oregon	Apr.96 MEAN->	9.47	6.92	130.33	111.80	12.91	39.49
River mile 49	Apr96 S.D.->	0.40	0.08	1.52	2.61	0.36	61 .00
Wallace Slough, Oregon	May96 MEAN->	11.37	6.97	138.62	110.19	12.28	35.09
River mile 49	May96 S.D.->	0.23	0.08	1.31	2.50	0.26	4.64
Wallace Slough, Oregon	Jun96 MEAN->	15.53	7.44	113.32	124.12	12.57	16.64
River mile 49	Jun96 S.D.->	0.23	0.08	0.24	2.15	0.21	2.25
Wallace Slough, Oregon	July96 MEAN->	20.30	8.15	128.55	96.79	8.85	23.47
River mile 49	July96 S.D.->	0.43	0.15	0.09	6.30	0.52	7.65
Wallace Slough, Oregon	Aug96 MEAN->	20.13	7.94	130.21	116.13	10.68	41.52
River mile 49	Aug96 S.D.->	0.21	0.13	0.18	5.90	0.53	53.29
Wallace Slough, Oregon	Sept96 MEAN->	19.43	7.55	137.07	107.30	10.00	29.96
River mile 49	Sept96 SD.->	0.33	0.13	0.55	5.79	0.50	7.02
Wallace Slough, Oregon	Oct96 MEAN->	16.60	7.64	130.44	119.03	11.81	21.94
River mile 49	Oct96 S.D.->	0.28	0.11	0.43	7.95	0.75	9.76

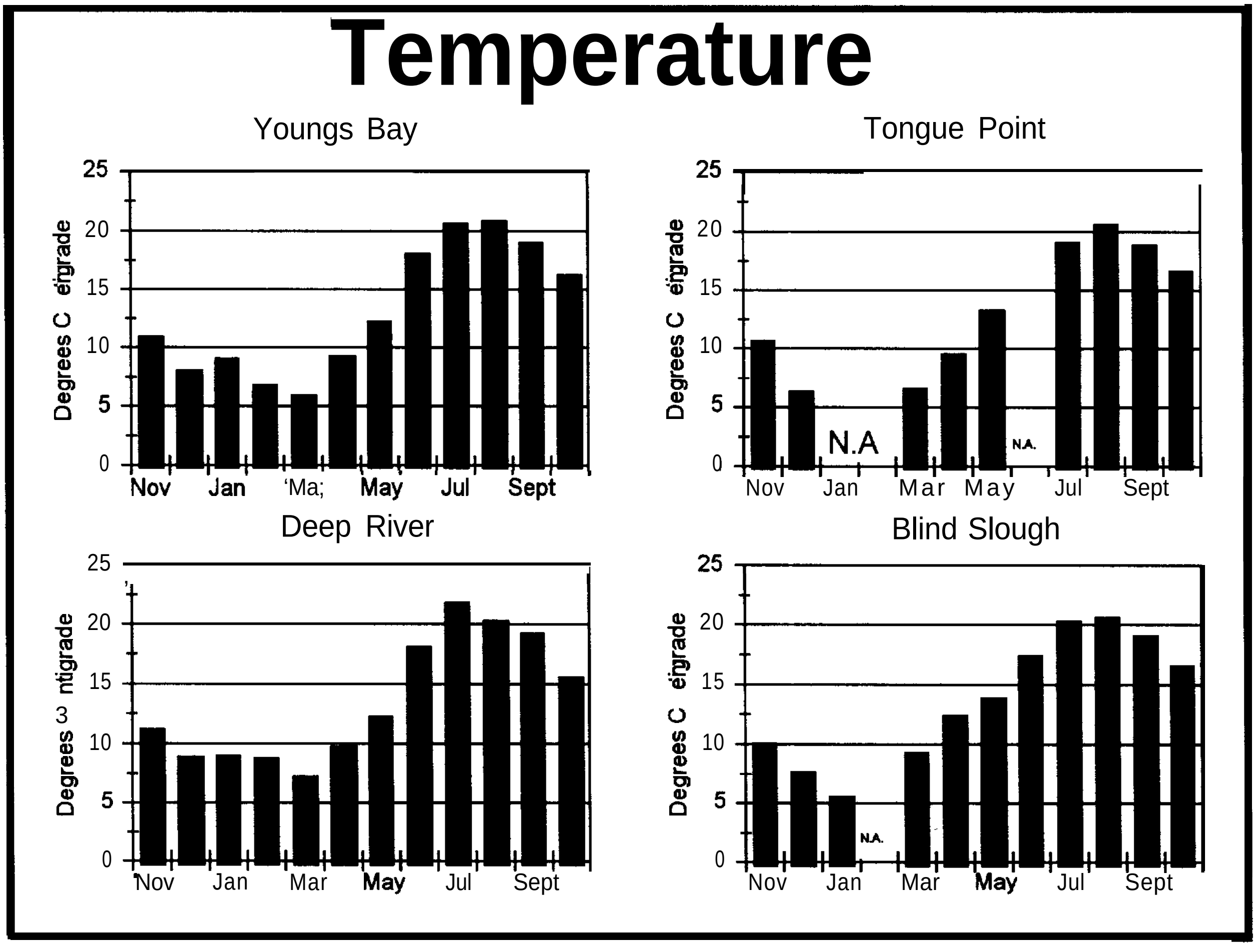

Figure 11. Temperature profiles of the four lower river net-pen rearing sites, November, 1995 through October, 1996. Note: N.A. signifies data not available.

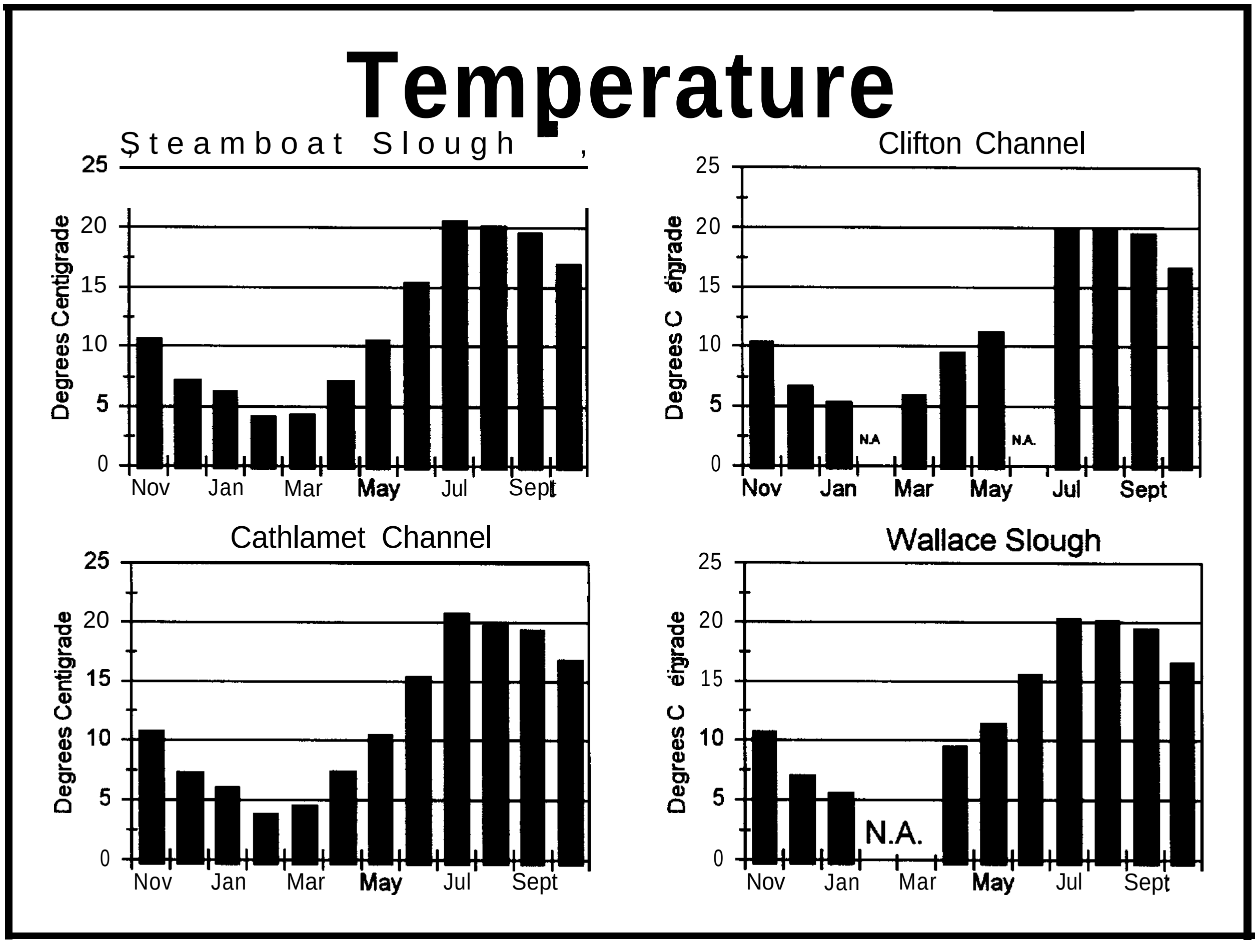

Figure 12. Temperature profiles of the four potential net-pen rearing sites, November, 1995 through October, 1996. Note: N.A. signifies data not available.

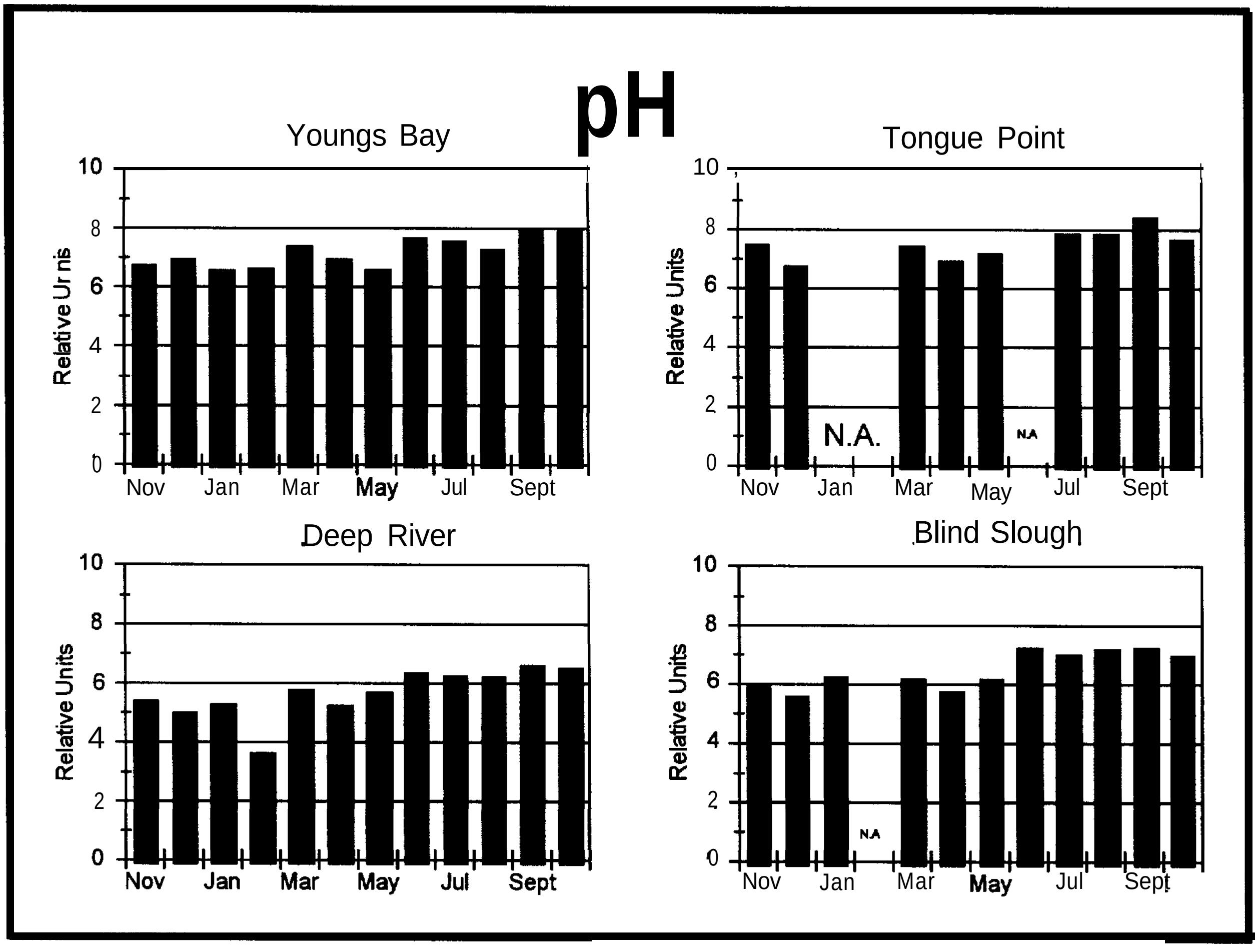

Figure 13. The pH profiles of the four lower river net-pen rearing sites, November, 1995 through October, 1996. Note: N.A. signifies data not available.

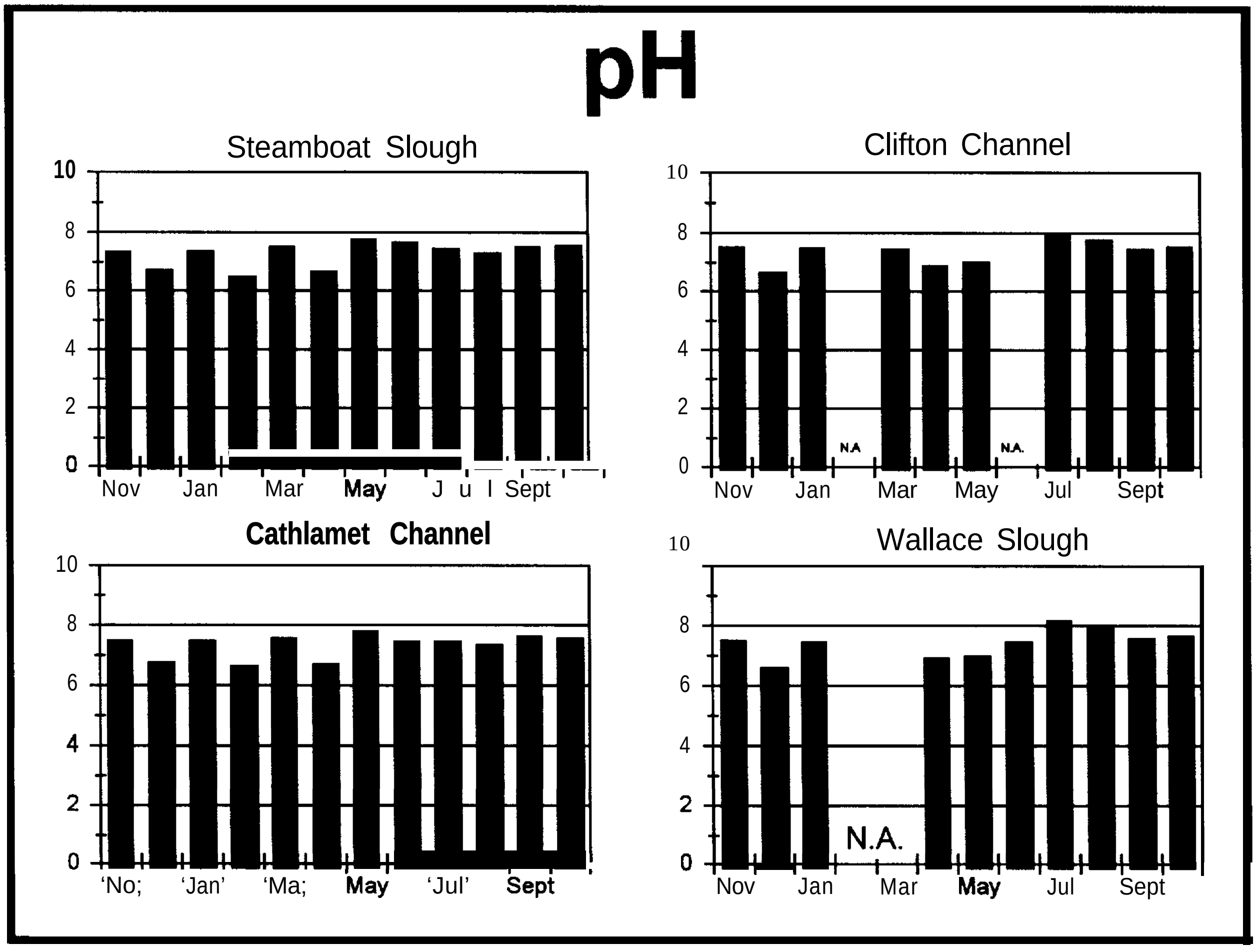

Figure 14. The **pH** profiles of the four potential net-pen rearing sites, November, 1995 through October, 1996. Note: N.A. signifies data not available.

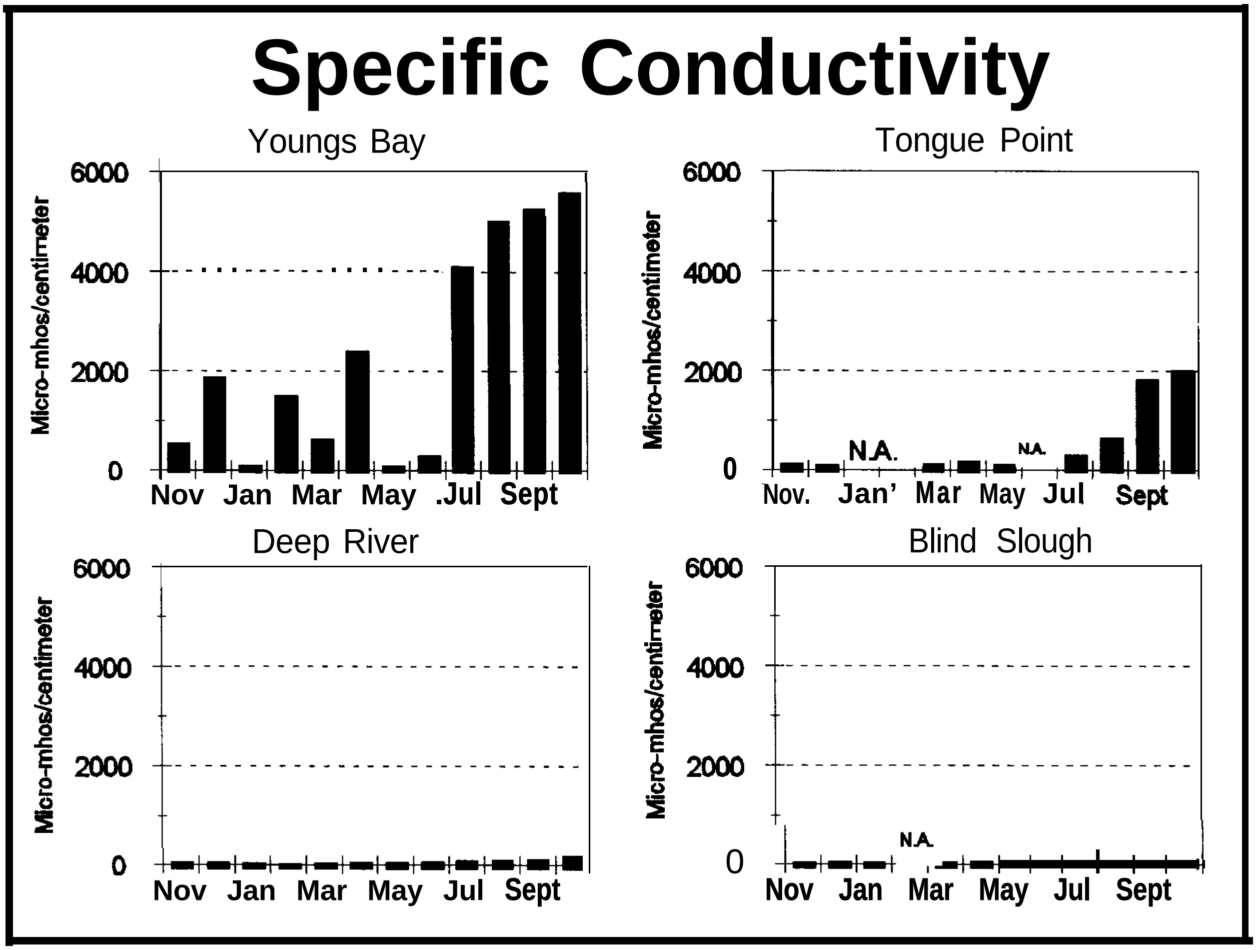

Figure 15. Specific conductivity profiles for the four lower river net-pen rearing sites, November, 1995 through October, 1996. Note: N.A. signifies data not available.

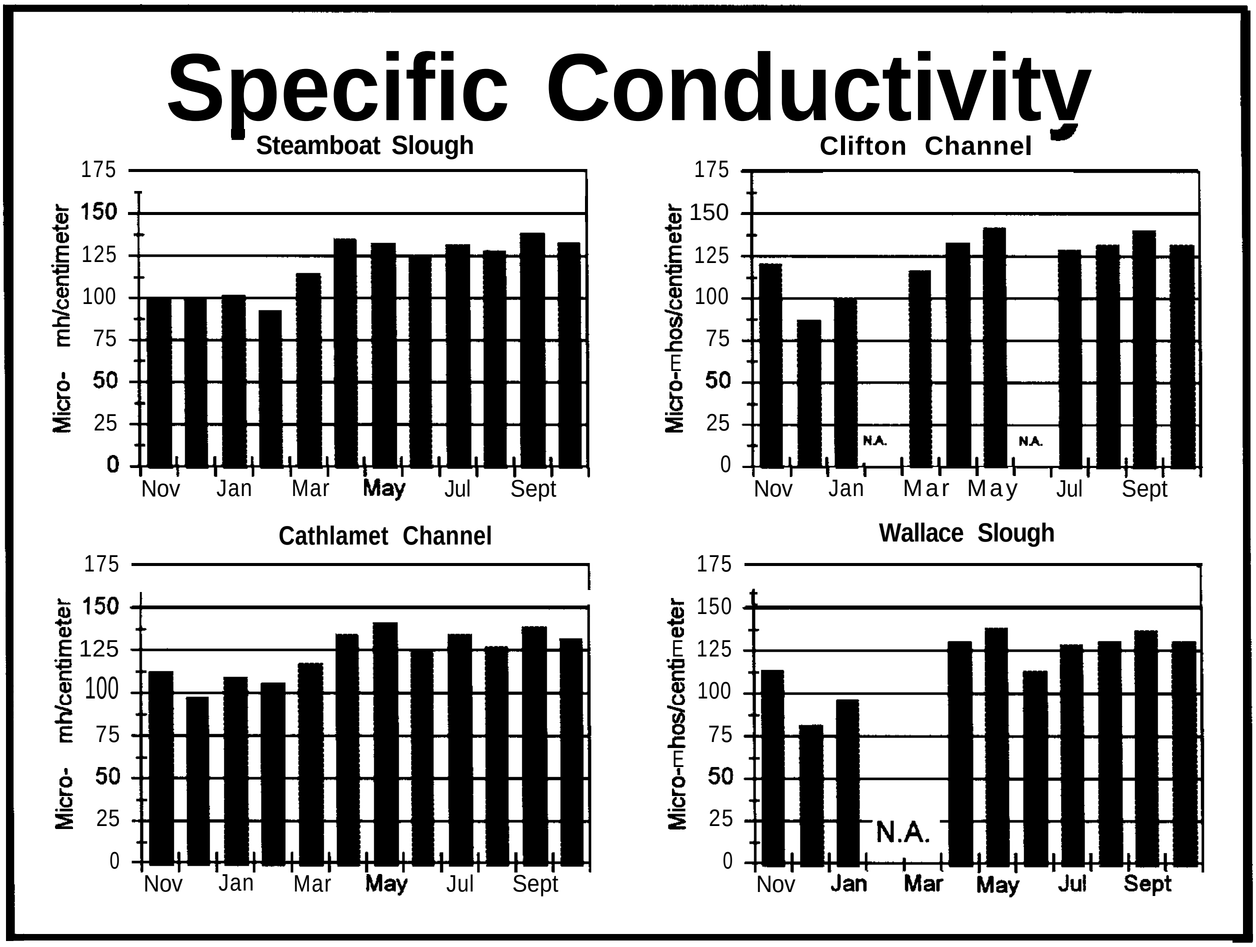

Figure 16. Specific conductivity profiles for the four potential net-pen rearing sites, November, 1995 through October, 1996. Note: N.A. signifies data not available.

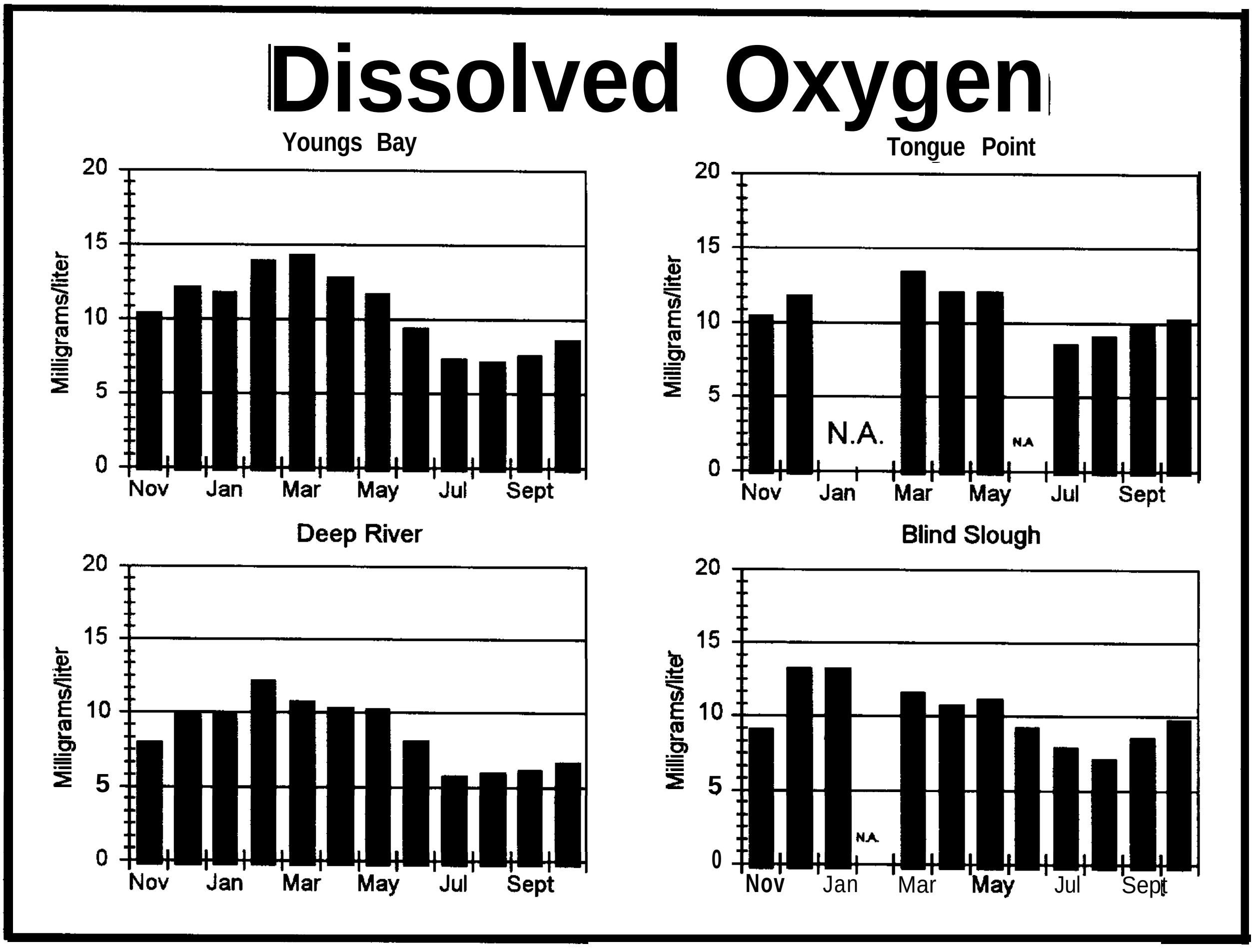

Figure 17. Dissolved oxygen profiles of the four lower river net-pen rearing sites, November, 1995 through October, 1996. Note: N.A. signifies data not available.

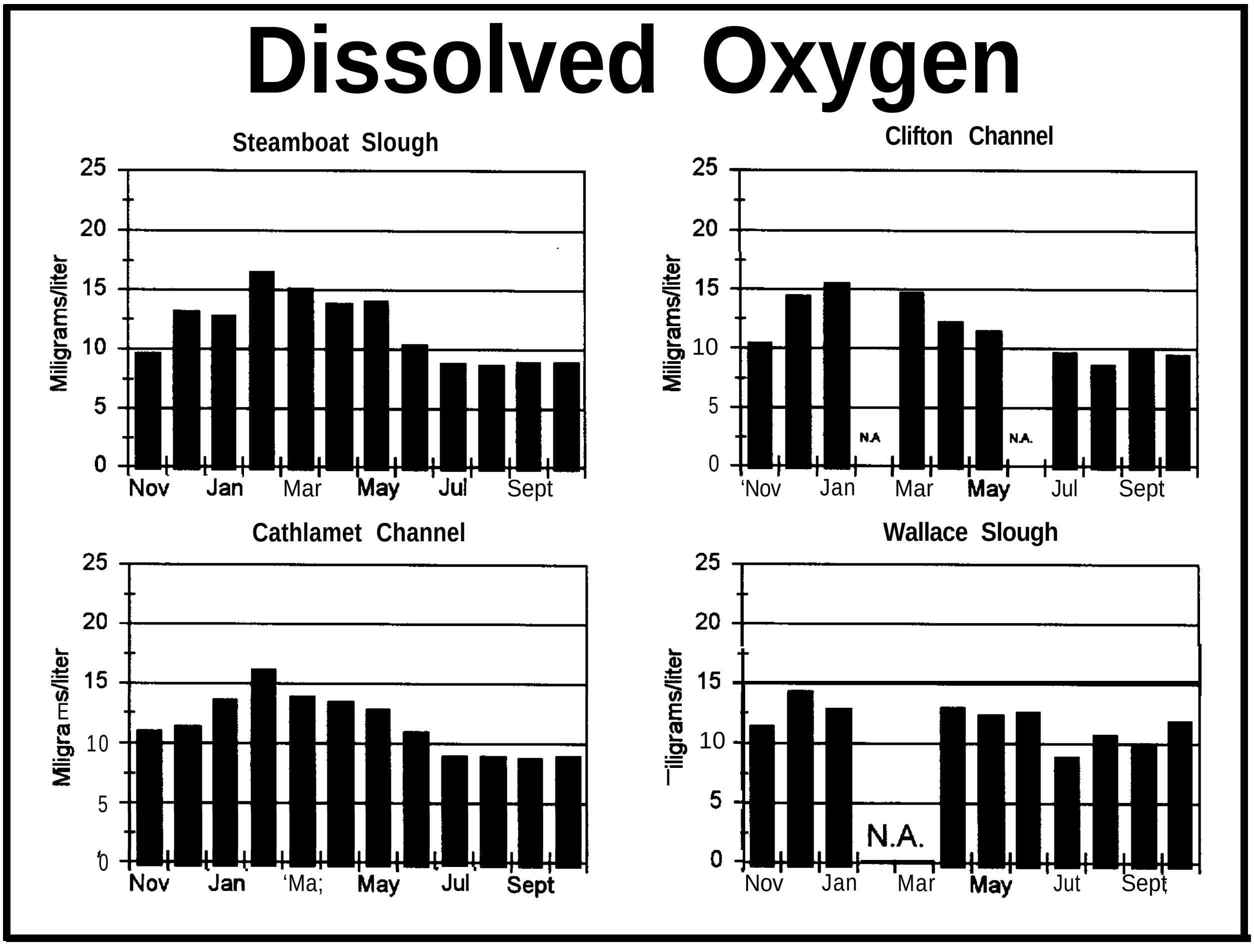

Figure 18. Dissolved oxygen profiles of the four potential net-pen rearing sites, November, 1995 through October, 1996. Note: N.A. signifies data not available.

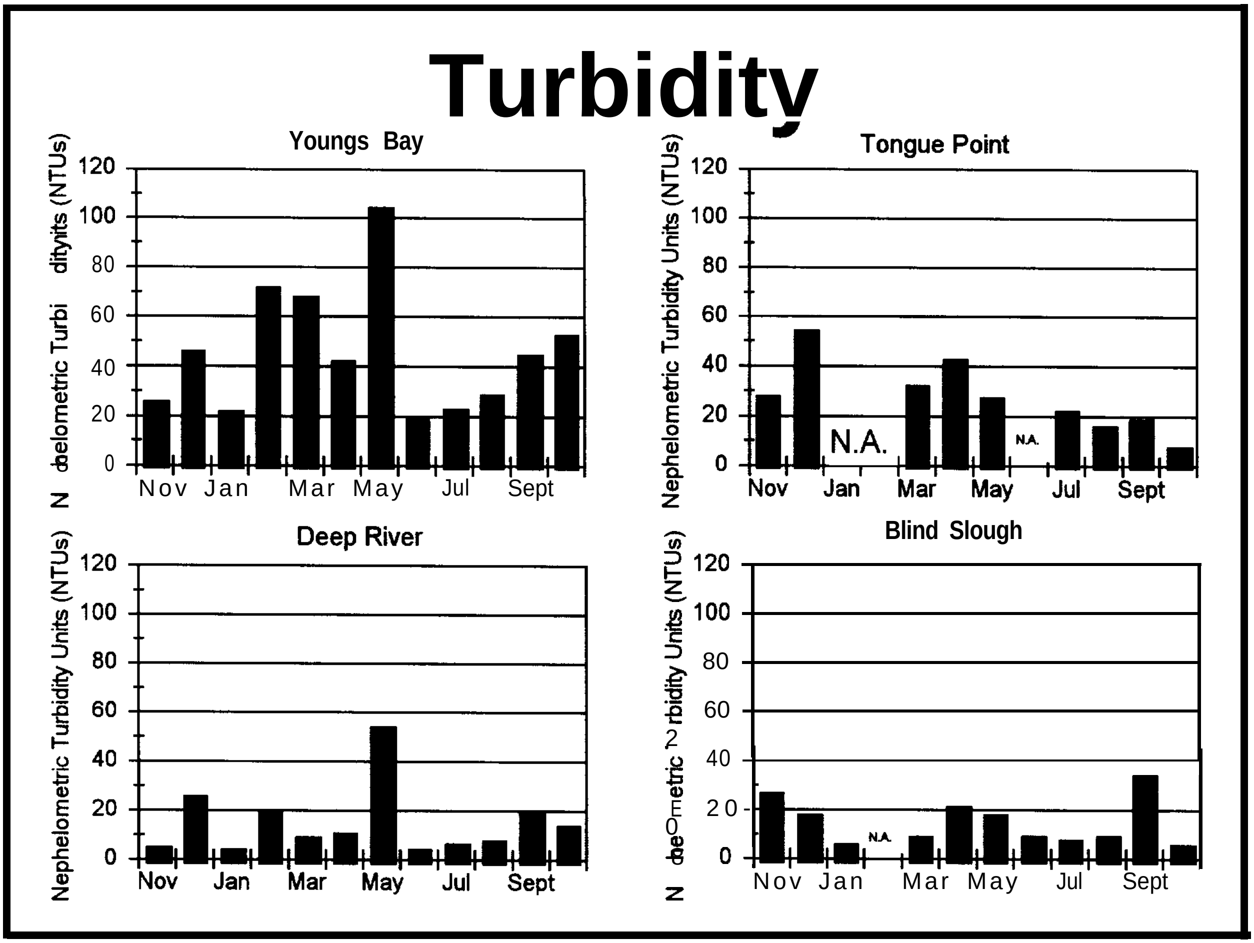

Figure 19. Water turbidity profiles for the four lower river net-pen rearing sites, November, 1995 through October, 1996. Note: N.A. signifies data not available.

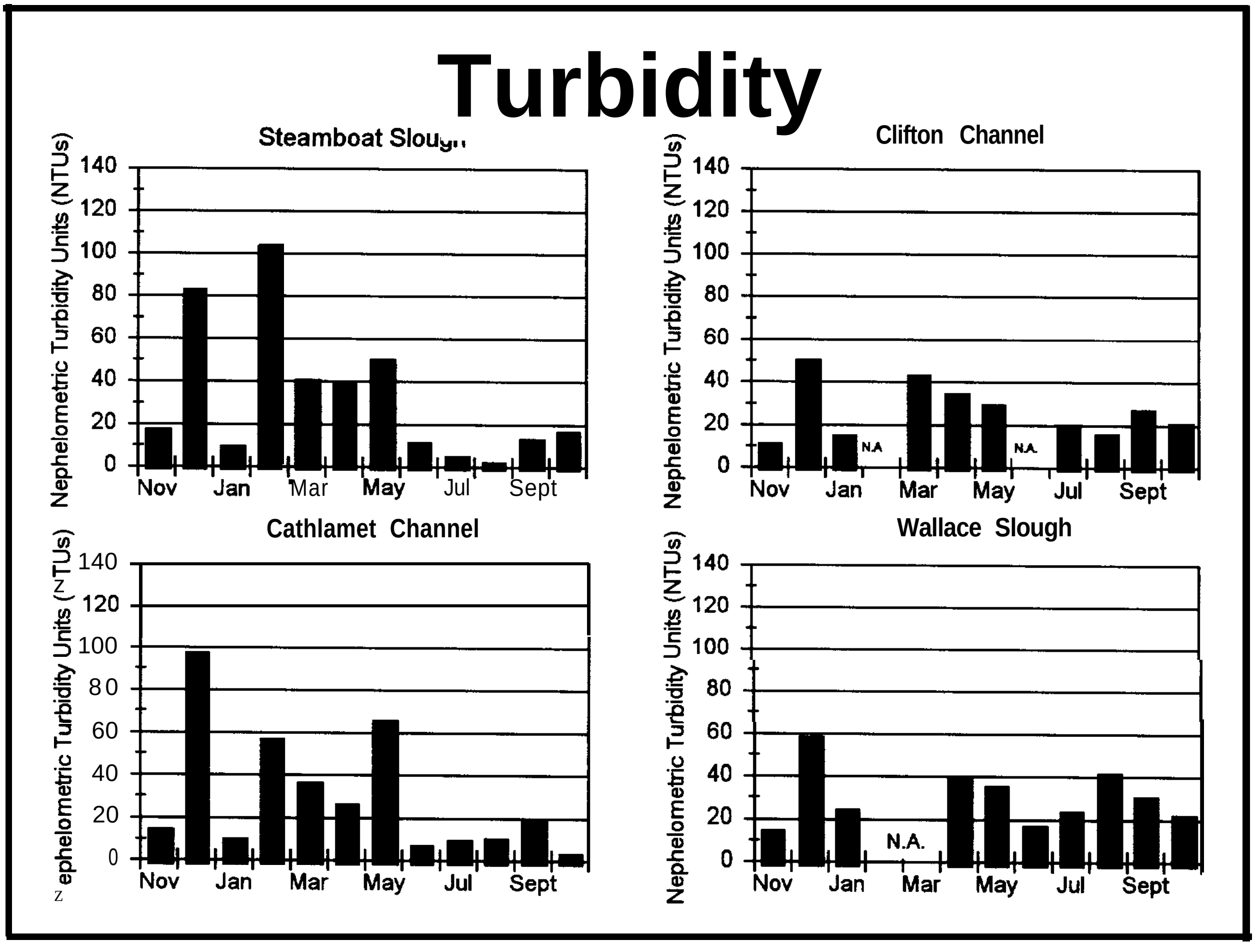

Figure 20. Water turbidity profiles for the four potential net-pen rearing sites, November, 1995 through October, 1996. Note: N.A. signifies data not available.

C. Homing and Straying Information from Current Net-Pen Programs

INTRODUCTION

In the 1994 annual report (Columbia River:Terminal Fisheries Research Project, December 1996) homing and straying data was presented for early stock coho (1988-90 broods) released from CEDC's net pens in Youngs Bay. When compared to the 1988-90 brood Youngs Bay early stock coho programs at the ODFW North Fork Klaskanine Hatchery and CEDC's South Fork Klaskanine Hatchery, the Youngs Bay net-pen program's stray rate of 0.8% compares favorably to 1.7% for North Fork Klaskanine Hatchery and 2.1 % for South Fork Klaskanine Hatchery.

Early stock coho have continued to produce extremely low straying rates from the net-pen program in Youngs Bay. In an evaluation of over-winter acclimation and 2-week acclimation for early stock who in Youngs Bay net pens, a continuation of extremely low stray rates of 0.7% and 0.6% were realized for 1991 brood 2-week and over-winter acclimation releases, while no strays were reported for both groups for the 1992 brood (Hirose, 1997).

In this chapter, straying rates for 1993 brood SAFE Project coho at Youngs Bay, Tongue Point, Blind Slough, and Deep River will be reported. For 1993 brood spring chinook and 1994 brood SAB fall chinook, the final significant return as adults will be in 1998, deferring evaluation for future reports. Additionally, recent data from select area bright (SAB, formerly Rogue River bright, RRB) stock fall chinook will be presented.

METHODS

Homing and straying rates are calculated using the Pacific States Marine Fisheries Commission's (PSMFC) coded-wire-tag (CWT) recovery data base. Specifically, escapement recoveries to all hatcheries and spawning grounds are combined with CWT recoveries in each select area fishery to calculate total escapement returns for each select area production site.

RESULTS AND DISCUSSION

1993 Brood Coho. **In Table 33 stray rates observed for Youngs Bay, Tongue Point, Blind Slough, and Deep River select area project sites ranged from 0% for** Youngs Bay to 4.8% for Tongue Point. All accountable strays were recovered at either Big Creek Hatchery (ODFW) or Grays River Hatchery (WDFW). With no strays reported for Youngs Bay releases, the stray rate from 1988-92 brood releases (0.6%) is **validated. For Blind Slough releases, only two strays (0.5%) were recovered, both at nearby Big Creek Hatchery. Deep River showed a similar stray pattern as Blind Slough, with only five strays (1.3%) recovered and all five recovered at nearby Grays**

River Hatchery. Tongue Point releases showed the highest stray rate (4.8%); however, this is somewhat inflated since only 260 CTW's were accountable in the Tongue Point select area harvest. During the late fall commercial season, Tongue Point Basin waters were open and fish caught within the basin were not reported as select area harvest. The Tongue Point strays were recovered primarily at Big Creek Hatchery (12 fish), with a single recovery from Grays River Hatchery.

Table 33. Coded-Wire-Tag Recoveries in Escapement Areas in 1996 for 1993 Brood Coho Released from Select Area Net-Pen Projects at Youngs Bay, Tongue Point, Blind Slough, and Deep River.

Select Area Project Sites	Expanded CWT Recoveries[1] Select Area Harvest	Streams	(%)	Recovery Location of Strays	
Youngs Bay	885	0	(0.0)		--
Tongue Point	260	13	(4.8)	(12) (1)	Big Creek H. Grays River H.
Blind Slough	431	2	(0.5)	(2)	Big Creek H.
Deep River	369	5	(1.3)	(5)	Grays River H.

[1] *CWT recoveries in select area harvest locations are considered to have homed successfully.*

SAB Fall Chinook. Stray rates for SAB fall chinook released from Big Creek Hatchery have recently been cause for concern. During 1984-93 return years, SAB fall chinook homing rate averaged 90% (ODFW, 1994). In 1994 and 1995, the homing rate decreased to 67% and 74% (Hirose, March 20, 1996 memo to Don McIsaac). Since the vast majority of SAB smolts have been released from Big Creek Hatchery since the inception of the program, the increase in strays is probably attributed to those releases. Based on analysis of CWT recoveries in escapement areas for Big Creek releases (1990 and 1991 broods) and Youngs Bay releases (1989 and 1991 broods) stray rates were consistently higher for Big Creek releases (Table 34). Strays from Youngs Bay net-pen releases were more localized, with only 2% straying to Washington streams, while 22% of the total escapement resulting from Big Creek releases were from Washington streams.

As a result of this information and no solutions to reduce the straying of Big Creek releases, 1995 brood program releases were modified to reduce Big Creek releases from 1.0 million down to 0.5 million, with the remaining 0.5 million juveniles transferred to net pens at Youngs Bay (425,000 fish), Tongue Point (25,000 fish), and Blind Slough (25,000 fish). The remaining 25,000 juveniles were transferred to North Fork Klaskanine Hatchery to initiate a transition to move the brood stock program to a location with greater potential of adult homing potential. As in past years, since the inception of the SAB program, all releases of this stock were fin clipped with the left ventral fin to prevent cross breeding with native hatchery stocks.

Beginning with the 1998 brood (1997 releases) all SAB fall chinook releases will be restricted to Youngs Bay either from net pens to optimize adult survival and harvest potential or from North Fork Klaskanine Hatchery to ensure brood stock and realize a necessary reduction in straying rates and distribution. Adult returns will be monitored closely to evaluate the effectiveness of this strategy.

Table 34. Coded-Wire-Tag Recoveries in Escapement Areas for Select Area Bright Fall Chinook Released from Big Creek Hatchery (1990 and 1991 Broods) and Youngs Bay Net Pens (1989 and 1991 Broods).

Release Site	Expanded Coded-Wire-Tao Recoveries					
	Brood	Escapement	Total Strays	(%)	WA Streams	(%)
Big Creek H.	1990	614	171	(28)	145	(24)
	1991	651	158	(24)	133	(20)
		1,265	329	(26)	278	(22)
Youngs Bay N.P.	1989	254	28	(11)	6	(2)
	1990	34	4 [1]	(12)	0	(-)
		288	32	(11)	6	(2)

[1] Stray recoveries *from Youngs Bay* net-pen *releases* are comprised *of 12* recoveries at North fork *Klaskanine Hatchery,* four recoveries *at South Fork Klaskanine Hatchery,* and 10 recoveries *at Big Creek Hatchery.* Only six *recoveries* were from *Washington hatcheries (one* at *Grays* River and *five at Elochoman), a 2% stray* rate *to* Washington *streams.*

REFERENCES

Hirose, P.S. 1997. Evaluation of the 1991-l 992 brood overwinter-reared coho released from net pens in Youngs Bay, Oregon. Final Completion Report. Prepared for Bonneville Power Administration.

Hirose, P.S. 1998. Memorandum: straying issue relating to RRB stock fall chinook. March 20, 1998.

ODFW. 1994. Staff report: A proposal to increase Rogue River bright fall chinook in the lower Columbia River. September 28, 1994.

CHAPTER 2. HARVEST POTENTIAL OF TARGET AND NON-TARGET FISH SPECIES

A. 1995 Spring Test Fishery in Potential Select Area Fishing Sites

INTRODUCTION

In preparation for potential harvest in select fishing areas, gillnet test fisheries were conducted in each of the seven areas designated as having highest select area fishery potential. Test fisheries will be conducted in all areas over the next few years to establish a baseline of information. The general purpose in having test fisheries is to assess the harvest potential in selected sites in terms of catch and timing of nontarget fish stocks, variation in gear type, and fishing area boundaries.

With salmon runs being particularly weak in 1995 (Table 35), added emphasis has been placed on protecting upriver spring chinook. The 1995 spring test fishery was allowed following ESA mandated guidelines of six upriver spring chinook, with two mortalities, for all fishing sites combined.

Plans are to continue this program each spring for the duration of the select area fishery experimental study. Results during years of adult returns from test rearing programs will provide information to formulate season dates for full-fleet evaluation fisheries. A fall test fishing program is conducted with the same objectives and structure as the spring program.

This report is a summarization of data pertinent to this incidental catch monitoring project, including catch by area, CWT, age and skin color data. One report alone cannot be considered as a true representation of general conditions in any area, and must be reviewed in the context that it is only part of a multiple-year and multiple-season study.

METHODS

Four Oregon and three Washington sites were selected based on rearing and harvest criteria established and described in Chapter 1 of the 1994 project annual report. All selected sites were within Columbia River commercial statistical Zone 2 (Figure 21). The areas sampled were:

Site	State	River Mile
Tongue Point Turning Basin	OR	18
Deep River/Grays Bay	WA	22
Blind Slough	OR	27
Steamboat Slough/Skamokawa	WA	34
Clifton Channel	OR	36
Cathlamet Channel	WA	40
Wallace Slough	OR	49

Fishing was conducted over the period of 25 April through 31 May of 1995 with each site fished weekly for a total of six trips per site.

Each site was fished by a single local gillnetter for all six weeks, with an ODFW or WDFW observer aboard every trip. Fishermen were Frank Tarabochia, Les Clark, Alan Takalo, Art Pedersen, Jack Marincovich and Jim Hogan. Generally, three drift locations were fished at each site weekly in order to spread effort geographically, with fishing conducted during high or low, and daylight or dark, tides. Each boat distributed effort between both small (5 - 6 inch) and large (7 - 8 inch) mesh nets in order to provide a reference of the occurrence of the larger spring chinook and smaller steelhead. Gear specifications are displayed in Table 36. Generally, each drift of the net was fished for about l/2 hour, with a day's three drifts being distributed over the change of the high or low tide.

Observations made were: 1) net specifications and fathoms fished, 2) set location, 3) weather, water temperature and turbidity (Secchi disk), 4) layout and pickup times, and 5) catch of all fish species with biological data:

Chinook: Data collected with each fish removed from the gillnet were fork length, condition (live or dead), marine mammal damage, occurrence of mark and/or CWT, stock determination using visual stock identification (VSI) and scales removed for aging. VSI is a method to determine spring chinook stocks (upriver or lower river origin) based on phenotypic differences. This is the accepted methodology to determine the stock composition of the mainstem March sport fishery in recent years. Live fish were opercle punched to identify recaptures. **If** the fish was killed by the net, or coded-wire tagged, fish weight **and sex were recorded, and the snout removed for later CWT removal.**

Steelhead: Data collected include fork length, race/maturity, fin marks and **CWTs, and marine mammal damage. Scales were taken for aging and determination of hatchery/wild. Live fish were opercle punched to identify recaptures.**

Sturgeon: All sturgeon caught were sampled for total and fork length, and examined for the occurrence of spaghetti tags or tag scars. Depending on the availability of time, sturgeon over 80 centimeters in fork length were spaghetti tagged and scute marked.

<u>Other species</u>: All other species of fish were enumerated by fishing site, time and gear type.

Water temperature and turbidity readings were taken at each location except when darkness prevented turbidity readings or instruments were not available. The data is presented to compare relative temperature and turbidity at each location for a given week and the change observed through time for each location.

Chinook, steelhead and sturgeon catches at each site were converted to a standardized unit of **Catch per Hour per 100 Fathoms of Net** to compare catch rates within sites as well as between sites. Actual fishing time of the gear is difficult to determine since pick time (beginning to end) was highly variable and depended on the amount of gear in the water and number of fish caught. Pick time varied from as little as 1.2 minutes (Deep River, Steamboat Slough) to as much as 3 hours, 13 minutes (Wallace Slough) Calculation of fishing time for purposes of this study is defined as:

$$\frac{(S_E - S_B)}{2} + (P_B - S_E) + \frac{(P_E - P_B)}{2}$$

Where, S_E = Time at end of set,
S_B = Time at begin of set,
P_E = Time at end of pick,
P_B = Time at begin of pick, and
$(P_B - S_E)$ = "Soak" time period that the total net is in the water.

RESULTS AND DISCUSSION

The total catch of chinook at all sites was comprised of 39 lower river type and five upriver type, with most lower river type (29) and all upriver type captured during the first half of the program (Tables 37 - 39). Of the 44 fish total, 10 were immediate mortalities, including no upriver origin mortalities. Age composition of catch based on scale readings showed 13% 3-year-olds, 49% 4-year-olds, 36% 5-year-olds and 3% 6-year-olds. CWTs were recovered from 11 chinook, as follows:

Location	Stock	Hatchet-v	B.y.	Tan Code
Cathlamet Channel	S. Santiam	Dexter Ponds	90	7-56-26
	Deschutes	Warm Springs	92	5-32-34
	Klickitat	Klickitat	92	63-53-07
Wallace Slough	N. Santiam	Marion Forks	91	7-61-14
	Clackamas	Clackamas	90	7-56-61
	N. Santiam	Marion Forks	91	7-61-17
	S. Santiam	Dexter Ponds	91	7-l 4-58
	S. Santiam	Dexter Ponds	91	7-l 4-57
	Kalama	L. Kalama	90	63-41-36
	S. Santiam	Dexter Ponds	90	7-56-26
Clifton Channel	Kalama	L. Kalama	91	63-46-l 2

A total of 11 steelhead were caught, spread fairly evenly over time through the season. Summer run steelhead were dominant with seven (all adipose clipped hatchery fish), while four winter steelhead (one wild) were caught. A total of two steelhead (both summer run) were immediate mortalities.

Sturgeon catch totalled 665 fish at all sites, all being white sturgeon and coming mostly from Wallace Slough, Deep River (Grays Bay), Clifton Channel and Tongue Point, in descending order.

Sightings of harbor seals were noted at all sites but Deep River and Wallace Slough, while sea lions were observed only at Clifton Channel. Seals were observed working the test fishery nets at several locations. Marine mammal interactions are a concern and can interfere with evaluation of catches.

Total catches and catch per unit of effort (CPUE) at each site are displayed in Tables 37 and 38. Sample data, by drift, are totalled in Appendix 2. Tongue Point, Blind Slough, Steamboat Slough and Deep River showed the lowest salmonid harvest and CPUE (**<4** fish or 0.3 fish/hour/l00 fathoms of net). Higher numbers were caught at Cathlamet Channel, Clifton Channel, and Wallace Slough.

Tongue Point (Figure 22): Fishing was conducted as a conventional floater drift net fishery. Two chinook, no steelhead, 109 white sturgeon and three shad were caught.

Deep River/Grays Bay (Figure 24): After the 1994 experience, operations were modified for the 1995 season. Fishing continued to be conducted both in Deep River and Grays Bay, with no low tide fishing in Deep River due to limited water availability. A new drift site was utilized in waters of Grays Bay to be more selective for sturgeon. Large and small mesh nets were fished at all locations.

A total of no chinook, , one steelhead, 133 sturgeon, and two shad were caught. All fish were caught at the Grays Bay sites.

Blind Slouah (Figure 26): Fishing operations were restricted to heavy leaded gear because of bottom debris primarily resulting from log raft storage. Two sites were located within Blind Slough while one site was at the Knappa dock approximately l/2 mile below the mouth of Blind Slough. Only one chinook was caught during the program, one steelhead, and 46 white sturgeon. Other species in the catch were one squawfish and one carp. As in 1994, no salmonids were caught at the sites within Blind Slough.

Steamboat Slough/Skamokawa (Figure 27): Fishing sites of the Steamboat Slough area include a drift within the slough, another at Skamokawa, and two in the mainstem gap between Steamboat and Elochoman sloughs. Due to the great variety in fishing conditions a number of nets were used. All were floater nets, with the large mesh nets being 7 l/2 to 8 inch and the small mesh net being 5 - 5 l/4 inch. The Skamokawa and Steamboat drifts were fished with short (60 fathom) nets, while the gap drifts were fished with 200 fathom nets extending into the main channel. A total of two spring chinook, four steelhead, five sturgeon and 24 shad were caught. All were caught at the gap drift at the entry to Elochoman Channel.

Clifton Channel (Figure 28): Clifton Channel is an established fishing drift. The gear employed was a 7 l/2 inch mesh diver gillnet which was restricted to fishing periods of ebb and a 5 5/8 inch floater gillnet which was restricted to high and low water slack current periods. Seven chinook were caught including one of upriver origin. A total of two steelhead were caught. Of the 116 white sturgeon, the majority (79%) were caught in the first half of the program, and all except 13 were caught in the large mesh gear. Shad was the only other species caught (18).

Cathlamet Channel (Figure 29): Floater gillnets were used; the small mesh net had 5 inch mesh, while the large mesh net had 100 fathoms of 7 7/8 inch and 100 fathoms of 8 inch mesh. Four drifts sites were fished: one just above the Cathlamet-Puget Island bridge, and three evenly spaced below the bridge to the downriver end of Cathlamet Channel. A total of 10 chinook (two upriver), three steelhead, 38 sturgeon and 83 shad were caught. All of the chinook were caught in the first half of the season. All ten chinook were caught at night time.

Wallace Slouah (Figure 30): Fishing was conducted with floater gillnets of large (7 l/4 inch) and small (5 318 inch) mesh. Two drift sites were fished: one site in the lower slough, and the Patton Drift upstream and outside of the slough. Catch totalled 22 chinook, of which 20 were of lower river origin, no steelhead, 218 sturgeon, 27 shad, and one squawfish.

Catch by Date

Table 39 subdivides the total catch by the first three weeks versus last three weeks of the season. In total, fairly equal time was fished during the two periods. Of the 44 chinook caught, 34 were caught in the first three weeks. Steelhead catch was divided equally for the two periods, 70% of sturgeon were caught in the first half, while most shad (87%) were caught in the second half. This general pattern was consistent over all areas.

Catch by Net

Comparisons of catch by mesh size were made by grouping nets in to either a small (5 - 6 inch) or large (7 - 8 inch) category (Table 40). In general, salmon were caught equally between the two nets, steelhead more frequently in the small mesh nets, and sturgeon more frequently in the large mesh nets.

Dav and Night

Table 41 presents catch and CPUE for day and night sets. Fishing effort was equally split between day and night. During this fishery more chinook and sturgeon were caught at night, with the reverse being the case with shad, and equal numbers for day and night for steelhead.

CONCLUSIONS

1. Tongue Point, Deep River, Blind Slough and Steamboat Slough show the greatest potential for selective harvest of local spring chinook salmon stocks. The higher catch rates on white sturgeon at Tongue Point and Deep River may need creative management considerations.

2. The remaining locations, Clifton Channel, Cathlamet Channel and Wallace Slough all showed guarded harvest potential, with increased catch of spring chinook at all sites, and more white sturgeon at Clifton Channel and Wallace Slough.

3. Use of small (5 - 6 inch) and large (7 - 8 inch) mesh gear was effective to show the relative magnitude and diversity of species within the test fishing sites. Regulations restricting the fleet to selective mesh sizes will be of use when there is a need to minimize catch of certain species.

4. Comparison of CPUE for day and night show similar catch rates for steelhead. Catch rates for chinook and white sturgeon are higher during night sets.

5. Fishery timing is a factor that needs further consideration. In those sites with higher nontarget spring chinook potential, later season openings are a possibility.

6. Boundaries of all areas need continued evaluation. Fishing locations outside of Wallace Slough needs further evaluation. Of the locations with greatest harvest potential, more restrictive locations would be needed to eliminate the catch of nontarget species. The Deep River area should not include Grays Bay, and Steamboat Slough should avoid the upriver gap area approaching Elochoman Slough.

RECOMMENDATIONS

Continue the spring test fishing program using the same general methodology as in 1994-l 995.

Expand operations at: 1) locations upstream and adjacent to the Tongue Point Basin in the South Channel (mouth of John Day River to the mouth of Bear Creek), and 2) downstream and adjacent to the Blind Slough site including Knappa Slough and Prairie Channel.

Examine in more detail the potential boundaries and timing of the areas to be considered, especially where a limited harvest potential has been shown.

Table 35. Minimum numbers (in thousands of adults) of lower river spring chinook, upriver spring chinook, and lower river summer steelhead entering the Columbia River, 1980-95.

Year	Spring Chinook		Lower River
	Lower River	Upriver	Summer Steelhead
1980	73.0	<53.1	47.8
1981	93.9	<63.6	56.6
1982	110.3	71.1	49.1
1983	93.6	55.9	19.7
1984	115.7	47.4	68.5
1985	83.3	84.6	56.9
1986	90.5	120.6	89.9
1987	132.4	100.0	58.4
1988	146.0	97.0	77.9
1989	136.9	83.3	35.0
1990	151.4	99.4	61.9
1991	130.1	59.7	31.8
1992	102.4	89.8	48.0
1993	88.8	111.5	47.0
1994	60.6	21.0	47.1
1995	50.1	10.2	39.3

Source: WDFW and ODFW, 1997.

Table 36. Net specifications for 1995 spring select area test fishery, by site.

Site	Net Type	Mesh Size	Length	Details
Tongue Point	1. Floater	5 1/2"	200 fm	17.5 ft. deep
	2. Floater	7 1/2"	60 fm	19 ft. deep
		7"	130 fm	19 ft. deep
Deep River	1. Floater	5"	100 fm	25 ft. deep
	2. Floater	7 1/4"	120 fm	25 ft. deep
Blind Slough	1. Floater	5 3/4"	100 fm	15 ft. deep
	2. Floater	7 1/4"	100 fm	15 ft. deep
Steamboat Slough	1. Floater	5 1/4"	200 fm	28 ft. deep
	2. Floater	7"	200 fm	30 ft. deep
	3. Floater	5"	60 fm	15 ft. deep
	3. Floater	7"	60 fm	22 ft. deep
Clifton Channel	1. Floater	5 1/2"	100 fm	16 ft. deep
	2. Diver	7 1/2"	200 fm	12 ft. deep
Cathlamet Channel	1. Floater	5 1/4"	200 fm	28 ft. deep
	2. Floater	7"	200 fm	30 ft. deep
Wallace Slough	1. Floater	5 3/8"	150 fm	16 ft. deep
	2. Floater	7 1/4"	150 fm	16 ft. deep

Table 37. Spring select area test fishery catch, by site and date, 1995.

Site	Date	Spring Chinook Lower	Spring Chinook Upper	Steelhead	Sturgeon	Shad
Tongue Point	427	1			98	
	504				1	
	511					1
	518				2	1
	525	1			6	
	530				2	1
	Total	2	0	0	109	3
Deep River	425			1	88	
	503				12	
	509				2	
	517				10	1
	523				11	
	Total	0	0	1	133	1 / 2
Blind Slough	427	1			5	
	504				21	
	511				1	
	518				4	
	525			1	10	
	530				5	
	Total	1	0	1	46	0
Steamboat Slough	425				5	3
	503					
	509	1		1		1
	517	1		3		20
	523					
	530					
	Total	2	0	4	5	24
Clifton Channel	426		1*		56	4
	503	3		1	17	
	510				19	
	517	1			6	10
	525	2			10	2
	Total	6	1	1 / 2	8 / 116	2 / 18
Cathlamet Channel	426	7*	1	2	11	3
	504	1	1*		1	
	510				1	2
	516				24	48
	524				1	6
	531			1		24
	Total	8	2	3	38	83
Wallace Slough	426	9			52	4
	503	4	2*		27	1
	510	2			48	1
	517	3			10	10
	524	2			55	5
	531				26	6
	Total	20	2	0	218	27
Total		39	5	11	665	157

* = Jacks included in catches. Total of 4 jacks.

Table 38. Spring select area test fishery catch and CPUE, by area, 1995.

Area	Sets	Chinook Lower	Chinook Upper	Chinook Total	Sthd	Stgn	Shad
CATCH (in numbers)							
Tongue Point	19	2	0	2	0	109	3
Deep River	18	0	0	0	1	133	2
Blind Slough	18	1	0	1	1	46	0
Steamboat Slough	20	2	0	2	4	5	24
Clifton Channel	18	6	1	7	2	116	18
Cathlamet Channel	18	8	2	10	3	38	83
Wallace Slough	18	20	2	22	0	218	27
Total	129	39	5	44	11	665	157
CPUE (Numbers/hour/l 00 fm)							
Tongue Point	19	0.1	0.0	0.1	0.0	4.8	0.1
Deep River	18	0.0	0.0	0.0	0.1	13.2	0.2
Blind Slough	18	0.1	0.0	0.1	0.1	3.3	0.0
Steamboat Slough	20	0.1	0.0	0.1	0.3	0.3	1.6
Clifton Channel	18	0.3	0.1	0.4	0.1	5.9	0.9
Cathlamet Channel	18	0.4	0.1	0.4	0.1	1.7	3.7
Wallace Slough	18	0.9	0.1	1.0	0.0	9.9	1.2
Total	129	0.3	0.0	0.3	0.1	5.2	1.2

Table 39. Comparative catch and CPUE for weeks l-3 and weeks 4-6 of the spring select area test fishery, 1995.

Dates/ Site	Sets	Catch: Chinook Lower	Catch: Chinook Upriver	Catch: Chinook Total	Catch: Sthd	Catch: Stgn	Catch: Shad	CPUE: Chinook Lower	CPUE: Chinook Upriver	CPUE: Chinook Total	CPUE: Sthd	CPUE: Stgn	CPUE: Shad
April 27 - May 11													
Tongue Point	10	1		1		99	1	0.1	0.0	0.1	0.0	9.0	0.1
Deep River	9				1	102		0.0	0.0	0.0	0.2	19.3	0.0
Blind Slough	9	1		1		27		0.1	0.0	0.1	0.0	3.8	0.0
Steamboat Slough	10	1		1	1	5	4	0.1	0.0	0.1	0.1	0.7	0.5
Clifton Channel	9	3	1	4	1	92	4	0.3	0.1	0.4	0.1	8.8	0.4
Cathlamet Channel	9	8	2	10	2	13	5	0.7	0.2	0.9	0.2	1.2	0.4
Wallace Slough	9	15	2	17	—	127	6	1.2	0.2	1.4	0.0	10.2	0.5
Total	65	29	5	34	5	465	20	0.4	0.1	0.5	0.1	7.0	0.3
Mav 16 - 31													
Tongue Point	9	1		1		10	2	0.1	0.0	0.1	0.0	0.9	0.2
Deep River	9					31	2	0.0	0.0	0.0	0.0	6.6	0.4
Blind Slough	9				1	19		0.0	0.0	0.0	0.1	2.7	0.0
Steamboat Slough	10	1		1	3		20	0.1	0.0	0.1	0.4	0.0	2.6
Clifton Channel	9	3		3	1	24	14	0.3	0.0	0.3	0.1	2.6	1.5
Cathlamet Channel	9				1	25	78	0.0	0.0	0.0	0.1	2.3	7.1
Wallace Slough	9	5	—	5	—	91	21	0.5	0.0	0.5	0.0	9.4	2.2
Total	64	10	0	10	6	200	137	0.2	0.0	0.2	0.1	3.3	2.2

Table 40. Comparative catch and CPUE by mesh size of spring select area test fishery, 1995.

		Catch						CPUE					
		Chinook						Chinook					
Site	Sets	Lower	Upper	Total	Sthd	Stgn	Shad	Lower	Upper	Total	Sthd	Stgn	Shad
Small Mesh													
Tongue Point	9	0	0	0	0	4	2	0.0	0.0	0.0	0.0	0.3	0.2
Deep River	9	0	0	0	1	20	2	0.0	0.0	0.0	0.3	5.1	0.5
Blind Slough	8	0	0	0	0	5	0	0.0	0.0	0.0	0.0	0.9	0.0
Steamboat Slough	10	2	0	2	4	5	24	0.2	0.0	0.2	0.5	0.6	2.9
Clifton Channel	6	2	1	3	2	13	18	0.5	0.3	0.8	0.5	3.4	4.8
Cathlamet Channel	9	4	1	5	3	31	82	0.3	0.1	0.4	0.3	2.6	6.9
Wallace Slough	7	10	1	11	0	187	2 3	1.2	0.1	1.3	0.0	22.3	2.7
Total	58	18	3	21	10	265	151	0.3	0.1	0.4	0.2	5.0	2.8
Large Mesh													
Tongue Point	10	2	0	2	0	105	1	0.2	0.0	0.2	0.0	9.8	0.1
Deep River	9	0	0	0	0	113	0	0.0	0.0	0.0	0.0	18.1	0.0
Blind Slough	10	1	0	1	1	41	0	0.1	0.0	0.1	0.1	4.7	0.0
Steamboat Slough	10	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Clifton Channel	12	4	0	4	0	103	0	0.2	0.0	0.2	0.0	6.4	0.0
Cathlamet Channel	9	4	1	5	0	7	1	0.4	0.1	0.5	0.0	0.7	0.1
Wallace Slough	11	10	1	11	0	31	4	0.7	0.1	0.8	0.0	[illegible]	0.3
Total	71	21	2	23	1	400	6	0.3	0.0	0.3	0.0	[illegible]	0.1

Table 41. Comparative day and night and CPUE in spring select area test fishery, 1995.

		Catch						CPUE					
		Chinook						Chinook					
Site	Sets	Lower	Upper	Total	Sthd	Stgn	Shad	Lower	Upper	Total	Sthd	Stgn	Shad
Day													
Tongue Point	10	0	0	0	0	4	3	0.0	0.0	0.0	0.0	0.3	0.3
Deep River	9	0	0	0	0	22	2	0.0	0.0	0.0	0.0	4.4	0.4
Blind Slough	9	0	0	0	0	10	0	0.0	0.0	0.0	0.0	1.4	0.0
Steamboat Slough	9	2	0	2	4	0	21	0.3	0.0	0.3	0.6	0.0	2.9
Clifton Channel	9	1	0	1	1	33	12	0.1	0.0	0.1	0.1	3.4	1.2
Cathlamet Channel	9	0	0	0	1	25	74	0.0	0.0	0.0	0.1	2.1	6.3
Wallace Slough	9	5	0	5	0	8 4	17	0.4	0.0	0.4	0.0	7.2	1.5
Total	64	8	0	8	6	178	129	0.1	0.0	0.1	0.1	2.7	2.0
Night													
Tongue Point	9	2	0	2	0	105	0	0.2	0.0	0.2	0.0	9.6	0.0
Deep River	9	0	0	0	1	111	0	0.0	0.0	0.0	0.2	22.0	0.0
Blind Slough	9	1	0	1	1	36	0	0.1	0.0	0.1	0.1	5.2	0.0
Steamboat Slough	11	0	0	0	0	5	3	0.0	0.0	0.0	0.0	0.6	0.4
Clifton Channel	9	5	I	6	1	83	6	0.5	0.1	0.6	0.1	8.5	0.6
Cathlamet Channel	9	8	2	IO	2	13	9	0.8	0.2	0.9	0.2	1.2	0.8
Wallace Slough	9	15	2	17	0	134	10	1.4	0.2	1.6	0.0	12.8	1.0
Total	65	31	5	36	5	487	28	0.5	0.1	0.6	0.1	7.7	0.4

B. 1995 Fall Test Fishery in Potential Select Area Fishing Sites

INTRODUCTION

Test fisheries were repeated in the seven lower Columbia River select areas initially fished in the spring and fall of 1994, and the spring of 1995. Harvest potential in those locations determined to have the best select area fishery potential will be evaluated continuously throughout the length of this IO-year project.

The fall test fishery of the select area fisheries development project is intended to cover the time period when adult fall chinook and coho are passing through the lower Columbia River. Runs of these species would potentially serve to support select area fisheries. At this time there is concern for returns of hatchery tule fall chinook, listed Snake River wild fall chinook and chum salmon, and summer steelhead, that may be harvested incidentally in such a fishery. Table 42 lists salmon and steelhead run sizes since 1980. The major intent of the test fishery is to enumerate the impact that future select area fisheries might have on species/runs of concern.

This report is a summarization of data pertinent to this incidental catch monitoring project, including success by area, CWT, age and other biological data. One report alone cannot be considered as a true representation of general conditions in any area. It must be reviewed in the context that it is only part of a multiple-year and multiple-season study.

METHODS

Fishing was conducted between 20 September through 26 October of 1995 with each site fished weekly for a total of six trips per site. Four Oregon and three Washington sites were selected based on rearing and harvest criteria established and described under Project Objective #I (BPA, 1994). All selected sites were within Columbia River commercial Zone 2. The areas sampled were:

Site	State	River Mile
Tongue Point Basin	OR	18
Deep River/Grays Bay	WA	22
Blind Slough	OR	27
Steamboat Slough/Skamokawa	WA	34
Clifton Channel	OR	36
Cathlamet Channel	WA	40
Wallace	OR	49

Each site was fished by a single local gillnetter for all six weeks, with an ODFW or WDFW observer aboard every trip. Fishermen were Frank Tarabochia, Les Clark, Alan Takalo, Art Pedersen, Jack Marincovich and Jim Hogan. Generally, three drift locations were fished at each site weekly in order to spread effort geographically, with fishing conducted during high or low, and daylight or dark, tides. Each boat distributed effort between small (5 - 5 3/4 inch) and large (6 ½ - 7 ½ inch) mesh nets in order to provide a reference of the occurrence of the larger chinook and smaller steelhead. Gear specifications are displayed in Table 43. Generally, each drift of the net was fished for about ½ hour, with a day's three drifts being distributed over the change of the high or low tide.

Observations made during the test fishery were: 1) net specifications and fathoms fished, 2) set location, 3) weather, water temperature and turbidity (Secchi disk), 4) layout and pickup times, and 5) catch of all fish species with associated biological data:

> Chinook: Data collected with each fish removed from the gillnet include fork length, condition (live or dead), occurrence of mark and/or CWT, skin color, marine mammal damage, and scales removed for aging. Live fish were opercle punched to identify recaptures. If the fish was killed in the net, or CWT, fish weight and sex were recorded, and the snout removed for later CWT removal.
>
> Coho: Data collected were fork length, skin color, fin marks and/or CWT, and marine mammal damage. Live fish were opercle punched to identify recaptures.
>
> Steelhead: Data collected include fork length, race/maturity, fin marks and/or CWT, and marine mammal damage. Scales were taken for ageing and determination of hatchery/wild. All live fish were opercle punched to identify recaptures.
>
> Sturgeon: Each sturgeon caught was sampled for total and fork length, and examined for the occurrence of spaghetti tags or tag scars. Depending on the availability of time, sturgeon over 90 centimeters in total length were single spaghetti tagged and scute marked.
>
> Other species: All other species of fish were enumerated by fishing site, time and gear type.

Water temperature and turbidity readings were taken at each location except when darkness prevented turbidity readings or instruments were not available. The data are presented to compare relative temperature and turbidity at each location for a given week and the change observed through time for each location.

Chinook, coho, steelhead and sturgeon catches at each site were converted to a standardized unit of **Catch per Hour per 100 Fathoms of Net** to compare catch rates within sites and between sites. Actual fishing time of the gear is difficult to determine since pick time (beginning to end) was highly variable and depended on the amount of gear in the water and number of fish caught. Calculation of fishing time for purposes of this study is defined as:

$$\frac{(S_E - S_B)}{2} + (P_B - S_E) + \frac{(P_E - P_B)}{2}$$

Where, S_E = Time at end of set,
S_B = Time at begin of set,
P_E = Time at end of pick,
P_B = Time at begin of pick, and
$(P_B - S_E)$ = "Soak" time period that the total net is in the water.

RESULTS AND DISCUSSION

During the six weeks of test fishing over 91 hours of net time was fished. The resulting harvest consisted of 19 chinook, 36 coho, one chum salmon, five steelhead, 198 white sturgeon, two green sturgeon, one shad, and three crawfish (Table 44 and 45). With such small numbers, little can be said about resulting patterns other than few salmon and steelhead were caught in all areas. Sturgeon catches were largest at Deep River, Clifton Channel, Cathlamet Channel and Wallace Slough.

Of the total of 19 chinook salmon caught, no CWTs were recovered. Four chinook salmon were recorded as being net mortalities. Sixteen chinook came from the four most upriver sites (Steamboat Slough, Clifton Channel, Cathlamet Channel and Wallace Slough). Over time, 15 of the 19 total came from the first half of the sampling period. Skin color determination showed 11 bright, two dusky, and two dark ("tule"). Results of age readings from scales were: four 3-year-olds, three 4-year-olds, seven 5-year-olds and one 6-year-old. Lengths ranged from 59.6 to 97 centimeters in fork length, with a mean of 83.0 centimeters.

Few coho were caught at all sites, ranging from a maximum of 15 at Cathlamet Channel and a minimum of one in Wallace Slough. Of the 36 coho salmon caught, no CWTs were recovered. Nine coho were recorded as being net mortalities. CPUE on coho was highest (0.7 fish/hour/100 fm of net) at Cathlamet Channel.

The four of the five steelhead caught were from the two most upriver sites (Cathlamet Channel and Wallace Slough), one being a net mortality. Four whole bodied steelhead were examined, all with adipose marks and two with left ventral marks. The two CWTs were from Steamboat Slough and Wallace Slough, as follows:

Location	Stock	Hatchery	B.Y.	Tag Code
Steamboat Slough	Dworshak B	Magic Valley Hat.	'92	1 O-50-08
Wallace Slough	Dworshak B	Dworshak NFH	'92	5-21-60

Of the total of 200 sturgeon, two were green sturgeon caught at Deep River/Grays Bay. The most successful white sturgeon area was also Deep River/Grays Bay, with a CPUE of 5.3 fish/hour/l00 fathoms of net. The majority of sturgeon (152 or 76%) were caught in the first half of the sampling period.

Marine mammals (harbor seals or sealions) were recorded at all sites but Blind Slough and Wallace Slough. Seal damage was noted on five fish (including two steelhead).

Catch bv Area

Total catches and catch per unit of effort (CPUE) at each site are displayed in Tables 44 and 45. Sample data, by drift, are totaled in Appendix 4.

Tongue Point (Figure 22): Four drift sites were fished in the same general areas as in the spring program. The total catch was comprised of six coho, five sturgeon, and one chum.

Deep River/Grays Bay (Figure 24): Fishing was conducted at four drift sites: one in Deep River and three in Grays Bay. This is one more site than in the spring, the new location being in the deep waters in the center of Grays Bay where it was expected that more sturgeon could be caught. Two floater nets were fished, with a 5 inch and a 7 I/4 inch mesh. Time was fairly evenly spent fishing both high and low tides in Grays Bay, but in Deep River only high tides were fished. A total of one chinook, two coho and 63 sturgeon (including two green sturgeon) were caught. All fish were caught in Grays Bay.

Blind Slough (Figure 26): Three drift sites were fished in the same locations and manner as in the spring program. The same nets as used in the spring were again employed; 100 fathom floater nets, one with 5 3/4 inch mesh and the other with 7 I/4 inch mesh. The total catch, evenly distributed between all drift sites, consisted of two chinook, four coho, nine white sturgeon and one shad.

Steamboat Slough/Skamokawa (Figure 27): Five drift sites were fished in this area: at both ends of the gap between Steamboat Slough and Elochoman Slough, at Skamokawa, and at two within Steamboat Slough. The Steamboat Slough and Skamokawa drifts were in narrow waters where no more than 60 fathoms of net were fished. The Steamboat Slough drifts were fished with 5 or 6 ½ inch mesh nets, while the outside drifts were fished with 5 I/4 or 7 inch mesh nets. The catch totaled three chinook, four coho, one steelhead and one white sturgeon, all coming from the upriver end of Steamboat Slough or the Steamboat Slough - Elochoman Slough gap.

Clifton Channel (Figure 28): Fishing was conducted in the same area and using the same gear as that used during the spring; a 200 fathom 7 ½ inch mesh diver net and a 100 fathom 5 ½ inch mesh floater net. Each fishing trip two drifts with the diver net on an ebb current were made and a single set with the floater net was fished at either the high or low slack water period. The total catch was comprised of five chinook, four coho, and 35 white sturgeon.

Cathlamet Channel (Figure 29): Fishing was conducted with standard floater gillnets, having either 5 1/4 inch or 7 inch mesh, and 200 and 190 fathoms in length, respectively. Four sites were fished; 1) one at the extreme downstream end of Cathlamet Channel, 2) one in Cathlamet Channel at the upriver end of Elochoman Slough, 3) one directly in front of Cathlamet, and 4) one just above the Cathlamet bridge. A total of 18 salmonids (one chinook, 15 coho, two steelhead) was the highest catch of all sites. In addition, 42 white sturgeon were caught.

Wallace Slough (Figure 30): Fishing was conducted in the same area and using the same gear as fished during the spring: a 150 fathom, 5 3/8 inch mesh, floater net; and a 150 fathom, 7 1/4 inch mesh, floater net. The total of 10 salmonids (seven chinook, one coho, and two steelhead) was caught, along with 45 white sturgeon and one shad.

Earlv / Late Catches

Comparisons of catches from the first three weeks (20 September - 5 October) versus the last three weeks (10 October - 26 October) are listed in Table 46. Total fishing time from the two periods was about the same (62 vs 64 sets). A total of 79% of chinook, 75% of coho, and 76% of sturgeon came from the first period. Other species were caught in such small numbers that reliable comparisons cannot be made.

Catch bv Net

Table 47 compares numbers caught and CPUE for small (5 - 5 314 inch) and large (6 ½ - 7 ½ inch) mesh nets, both between areas and for all areas combined. Again, since numbers were small only limited generalizations can be made. In total, small mesh nets caught more coho, steelhead, and sturgeon than large mesh nets.

Day and Night

While slightly more time was fished at daytime (64 sets) than at night time (62 sets), the majority of the catch came at night time: 84% of chinook, 75% of coho and 64% of sturgeon (Table 48). The exception was in the case of steelhead where four of five fish were caught in the daytime. This holds for CPUE on a site-by-site basis, where most showed better chinook, coho and sturgeon fishing success at night. Steamboat Slough and Wallace Slough were the exceptions on white sturgeon.

CONCLUSIONS

In terms of low catch rates of nontarget species and white sturgeon, Tongue Point, Deep River, Blind Slough, Steamboat Slough, and Clifton Channel show the greatest potential although differences in CPUE between these sites and the uppermost sites of Cathlamet Channel and Wallace Slough are minor.

Use of large and small mesh gear was effective in showing the diversity of species and sizes of fish in the area. As expected, CPUE for white sturgeon and coho were higher for small mesh gear.

Comparison of day and night catches showed higher CPUE during night sets for all species except steelhead.

Background abundance levels of fall chinook and coho appear to be favorably low in all sites, however the fact that 1995 returns to the Columbia River of lower river fall chinook, upriver fall chinook, and coho were at or near record low levels needs to be noted.

RECOMMENDATIONS

Continue the fall test fishing program using the same methodology as in 1994.

In the fall of 1996, fisheries will be conducted for the first time on returns to net pen sites at Tongue Point, Deep River and Blind Slough. Test fishery schedules should be adjusted accordingly.

Table 42. Minimum numbers (in thousands of adults) of lower river and upriver fall chinook, coho, chum, and group B summer steelhead entering the Columbia River, 1980-95.

	Chinook		Coho			Group B Summer
Year	Lower River	Upriver	Early	Late	Chum	Steelhead
1980	154.8	166.4	160.3	141.3	0.5	43.7
1981	129.8	154.1	100.3	70.1	1.5	37.7
1982	159.7	201 .o	229.4	223.7	2.9	54.3
1983	116.0	125.2	43.4	57.1	0.6	69.3
1984	120.0	185.5	240.6	173.5	2.3	126.8
1985	136.4	228.9	228.4	137.8	1.3	93.6
1986	197.1	301.6	730.8	796.9	3.0	101.9
1987	402.5	469.2	186.2	121.4	2.5	79.8
1988	382.7	400.3	332.3	332.6	4.8	90.2
1989	221.7	328.3	262.7	438.9	2.0	117.3
1990	111.0	206.6	108.8	87.4	2.9	88.7
1991	102.0	175.0	518.4	415.9	1.3	126.1
1992	92.1	125.8	109.4	101.5	4.9	143.1
1993	77.1	136.8	72.4	41.5	4.5	92.8
1994	82.9	172.4	138.2	32.1	1.2	80.1
1995	78.8	165.9	57.7	16.9	1.5	80.3

Source: WDFW and ODFW, 1997.

Table 43. Net specifications for 1995 fall select area test fishery, by site.

Site	Net Type	Mesh Size	Length	Details
Tongue Point	1. Floater	5 1/2"	200 fm	17.5 ft. deep
	2. Floater	7 1/2"	60 fm	19 ft. deep
		7"	130fm	19 ft. deep
Deep River	1. Floater	5"	IOOfm	25 ft. deep (35 meshes)
	2. Floater	7 1/4"	120fm	25 ft. deep (30 meshes)
Blind Slough	1. Diver	5 3/4"	IOOfm	15 ft. deep
	2. Diver	7 1/4"	IOOfm	15 ft. deep
Steamboat Slough	1. Floater	5 1/4"	200 fm	22 ft. deep (60 meshes)
	2. Floater	7"	150 fm	22 ft. deep (34 meshes)
	3. Floater	5"	60 fm	19 ft. deep
	4. Floater	6 1/2"	60 fm	19 ft. deep
Clifton Channel	1. Floater	5 1/2"	IOOfm	16 ft. deep
	2. Diver	7 1/2"	200 fm	12 ft. deep
Cathlamet Channel	1. Floater	5 1/4"	200 fm	22 ft. deep (60 meshes)
	2. Floater	7	190 fm	22 ft. deep (34 meshes)
Wallace Slough	1. Floater	5 3/8"	150 fm	16 ft. deep
	2. Floater	7 1/4"	150 fm	16 ft. deep

Table 44. Fall 1995 select area test fishery catch, by site and date.

Site	Date	Chinook	Coho	Steelhead	Sturgeon	Shad
Tongue Point	921					
	928		5		1	
	1005					*
	1013				2	
	1019					
	1026		1		2	
	Total	0	6	0	5	-ii
Deep River	921		1		7 "	
	927	1	1		22	
	1004				27	
	1013				2	
	1018				1	
	1026				4	
	Total	1	2	0	63	0
Blind Slough	921				1	
	928	2	2		5	1
	1005		2		2	
	1013					
	1020				1	
	1026					
	Total	2	4	0	9	1
Steamboat Slough	920		1	1		
	928	3	1		1	
	1004		1			
	1011		1			
	1018					
	1025					
	Total	3	4	i	1	0
Clifton Channel	920	1			10	
	927	2	1		3	
	1004		2		8	
	1011		1		5	
	1018				5	
	1025	2			4	
	Total	5	4	0	35	0
Cathlamet Channel	921		1		5	
	927	1	8		18	
	1003				11	
	1010		3	1	4	
	1017		1		2	
	1024		2	1	2	
	Total	i	15	2	42	0
Wallace Slough	920	1		1	15	
	927	4	1		9	
	1004				7	
	1011	1		1	8	
	1018				5	
	1025	1			1	
	Total	7	1	2	45	0
TOTAL		19	36	5	200	1

* One chum (dead) caught at Tongue Point on 10/5.

** Two green sturgeon are included.

Table 45. Fall 1995 select area test fishery catch and CPUE, by area.

Site	Sets	Chin	Coho	Sthd	W. Stgn	Shad
Catch (in numbers)						
Tongue Point	18	0	6	0	5	0
Deep River	18	1	2	0	61	0
Blind Slough	18	2	4	0	9	1
Steamboat Slough	19	3	4	1	1	0
Clifton Channel	19	5	4	0	35	0
Cathlamet Channel	17	1	15	2	42	0
Wallace Slough	17	7	1	2	45	0
Total	126	19	36	5	198	1
CPUE (Numbers/hour/l 00 fm)						
Tongue Point	18	0.0	0.2	0.0	0.2	0.0
Deep River	18	0.1	0.2	0.0	5.3	0.0
Blind Slough	18	0.1	0.3	0.0	0.6	0.1
Steamboat Slough	19	0.3	0.4	0.1	0.1	0.0
Clifton Channel	19	0.3	0.2	0.0	1.8	0.0
Cathlamet Channel	17	0.0	0.7	0.1	2.0	0.0
Wallace Slough	17	0.4	0.1	0.1	2.7	0.0
Total	126	0.2	0.3	0.0	1.6	0.0

Table 46. Comparative catch and CPUE for weeks l-3 and weeks 4-6 of the 1995 fall select area test fishery.

		Catch					CPUE				
Weeks/Site	Sets	Chin	Coho	Sthd	Stgn	Shad	Chin	Coho	Sthd	Stgn	Shad
20 September - 5 October											
Tongue Point							0.0	0.4	0.0	0.1	0.0
Deep River	9	1	2	0	56	0	0.2	0.4	0.0	11.8	0.0
Blind Slough	9	2	4	0	8	1	0.3	0.5	0.0	1.1	0.1
Steamboat Slough	8	3	3	1	1	0	0.6	0.6	0.2	0.2	0.0
Clifton Channel	10	3	3	0	21	0	0.3	0.3	0.0	2.0	0.0
Cathlamet Channel	8	1	9	0	34	0	0.1	0.9	0.0	3.3	0.0
Wallace Slough	9	5	1	1	31	4	0.6	0.1	0.1	3.6	0.0
Total	62	15	2 7	2	152	1	0.2	0.4	0.0	2.5	0.0
10 October - 26 October											
Tongue Point	9	0	1	0	4	0	0.0	0.1	0.0	0.3	0.0
Deep River	9	0	0	0	7	0	0.0	0.0	0.0	1.0	0.0
Blind Slough	9	0	0	0	1	0	0.0	0.0	0.0	0.2	0.0
Steamboat Slough	11	0	1	0	0	0	0.0	0.2	0.0	0.0	0.0
Clifton Channel	9	2	1	0	14	0	0.2	0.1	0.0	1.5	0.0
Cathlamet Channel	9	0	6	2	8	0	0.0	0.6	0.2	0.8	0.0
Wallace Slough	8	2	0	1	14	0	0.3	0.0	0.1	1.8	0.0
Total	64	4	9	3	48	0	01	0.1	0.0	0.8	0.0

Table 47. Comparative catch and CPUE by mesh size of fall 1995 select area test fishery.

Site	Sets	Catch Chin	Catch Coho	Catch Sthd	Catch W. Stgn	Catch Shad	CPUE Chin	CPUE Coho	CPUE Sthd	CPUE W. Stgn	CPUE Shad
Small Mesh											
Tongue Point	9	0	5	0	0	0	0.0	0.3	0.0	0.0	0.0
Deep River	9	1	2	0	14	0	0.2	0.3	0.0	2.3	0.0
Blind Slough	9	1	3	0	6	0	0.1	0.4	0.0	0.8	0.0
Steamboat Slough	10	3	2	0	0	0	0.5	0.3	0.0	0.0	0.0
Clifton Channel	7	1	3	0	17	0	0.2	0.6	0.0	3.6	0.0
Cathlamet Channel	9	1	14	2	31	0	0.1	1.2	0.2	2.6	0.0
Wallace Slough	8	2	1	2	40	0	0.3	0.1	0.3	5.3	0.0
Total	61	9	30	4	108	0	0.2	0.5	0.1	1.8	0.0
Lame Mesh											
Tongue Point	9	0	1	0	5	0	0.0	0.1	0.0	0.4	0.0
Deep River	9	0	0	0	47	0	0.0	0.0	0.0	8.7	0.0
Blind Slough	9	1	1	0	3	1	0.2	0.2	0.0	0.5	0.2
Steamboat Slough	9	0	2	1	1	0	0.0	0.4	0.2	0.2	0.0
Clifton Channel	12	4	1	0	18	0	0.3	0.1	0.0	1.2	0.0
Cathlamet Slough	8	0	1	0	11	0	0.0	0.1	0.0	1.3	0.0
Wallace Slouah	9	5	0	0	5		0.6	0.0	0.0	0.6	0.0
Total	65	10	6	1	90	1	02.	0.1	0.0	1.4	0.0

Table 48. Comparative day and night and CPUE in fall 1995 select area test fishery.

D/N Site	Sets	Catch Chin	Catch Coho	Catch Sthd	Catch W. Stgn	Catch Shad	CPUE Chin	CPUE Coho	CPUE Sthd	CPUE W. Stgn	CPUE Shad
Day											
Tongue Point	9	0	0	0	2	0	0.0	0.0	0.0	0.1	0.0
Deep River	9	0	1	0	8	0	0.0	0.2	0.0	1.4	0.0
Blind Slough	9	0	0	0	2	0	0.0	0.0	0.0	0.3	0.0
Steamboat Slough	10	0	2	1	0	0	0.0	0.3	0.2	0.0	0.0
Clifton Channel	9	1	1	0	20	0	0.1	0.1	0.0	1.8	0.0
Cathlamet Channel	9	0	5	1	11	0	0.0	0.5	0.1	1.1	0.0
Wallace Slough	9	2	0	2	28	0	0.2	0.0	0.2	3.4	0.0
Total	64	3	9	4	71	0	0.0	0.1	0.1	1.2	0.0
Night											
Tongue Point	9	0	6	0	3	0	0.0	0.4	0.0	0.2	0.0
Deep River	9	1	1	0	53	0	0.2	0.2	0.0	9.3	0.0
Blind Slough	9	2	4	0	7	1	0.3	0.5	0.0	0.9	0.1
Steamboat Slough	9	3	2	0	1	0	0.6	0.4	0.0	0.2	0.0
Clifton Channel	10	4	3	0	15	0	0.5	0.3	0.0	1.7	0.0
Cathlamet Channel	8	1	10	1	31	0	0.1	1.0	0.1	3.0	0.0
Wallace Slough	8	5	1	0	17	0	0.6	0.1	0.0	2.1	0.0
Total	62	16	27	1	127	1	0.3	0.4	0.0	2.1	0.0

C. 1996 Spring Test Fishery in Potential Select Area Fishing Sites

INTRODUCTION

For the third year of test fishing in the Columbia River select area fishery evaluation project activities continued on a standard basis. The intent is to assess potential and timing in all areas where fisheries might be conducted to concentrate harvest on net-pen reared salmon and avoid harvest of endangered runs. In particular, before net-pen releases return there have been seasonal evaluations of what would have been caught without net-pen returns, and a continued assessment during net-pen fisheries. Sites with the most potential were test fished in the first three years and efforts will shift to new sites with the growth of the project. Table 49 summarizes run sizes of the lower river and upriver spring chinook, and the lower river summer steelhead since 1980.

This report is a summarization of data pertinent to this incidental catch monitoring project, including success by area, CWT, age and skin color data. One report alone cannot be considered as a true representation of general conditions in any area, and must be reviewed in the context that it is only part of a multiple-year and multiple-season study. Additional more detailed evaluations of these data will be conducted as they are accumulated to help assess site potential.

METHODS

Four Oregon and three Washington sites were originally selected in 1994 based on rearing and harvest criteria. Two new Oregon sites were added to the list this season (South Channel and Prairie Channel) to assess fishing potential in waters adjacent to Tongue Point and Blind Slough, where net pens have been located for two years. The areas sampled were:

Site	State	River Mile
Tongue Point Turning Basin	OR	18
South Channel	OR	20
Deep River / Grays Bay	WA	22
Prairie Channel	OR	24
Blind Slough	OR	27
Steamboat Slough	WA	34
Clifton Channel	OR	36
Cathlamet Channel	WA	40
Wallace Slough	OR	49

Fishing was conducted over the period of 24 April through 31 May of 1996 with each site fished weekly for a total of six trips per site. At Steamboat Slough and Cathlamet Channel fishing was delayed by one week.

Each site was fished by a single local gillnetter for all six weeks, with an ODFW or WDFW observer aboard every trip. Fishermen were Frank Tarabachia, Les Clark, Alan Takalo, Art Pedersen, Jack Marincovich, Jim Hogan and Bruce Jolma. Generally, three drift locations were fished at each site weekly in order to spread effort geographically, with fishing conducted during high or low tides. Test fishing was conducted only during daylight hours during this season. Each boat distributed effort between both small (5 - 6 inch) and large (7 - 8 inch) mesh nets in order to provide a reference of the occurrence of the larger spring chinook and smaller steelhead. Gear specifications are displayed in Table 50. Generally, each drift of the net was fished for about ½ hour, with a day's three drifts being distributed over the change of the high or low tide.

Observations made were: 1) net specifications and fathoms fished, 2) set location, 3) weather, water temperature and turbidity (Secchi disk), 4) layout and pickup times, 5) numbers of incidental fish species and observations of marine mammals and 6) catch of all fish species with biological data:

> Chinook: Data collected with each fish removed from the gillnet were fork length, condition (live or dead), marine mammal damage, occurrence of mark and/or CWT, stock origin using visual stock identification (VSI) and scales removed for aging. VSI is a method to determine spring chinook stocks (upriver or lower river origin) based on phenotypic differences. This is the accepted methodology to determine the stock composition of the mainstem March sport fishery in recent years. Live fish were opercle punched to identify recaptures. If the fish was killed by the net, or coded-wire tagged, fish weight and sex were recorded, and the snout removed for later CWT removal.
>
> Steelhead: Data collected include fork length, race/maturity, fin marks and CWTs, and marine mammal damage. Scales were taken for aging and determination of hatchery/wild origin. Live fish were opercle punched to identify recaptures.
>
> Sturneon: All sturgeon caught were sampled for fork and total length, and examined for the occurrence of spaghetti tags or tag scars. Depending on the availability of time, sturgeon over 80 centimeters in fork length were spaghetti tagged and scute marked.
>
> Other species: All other species of fish were enumerated by fishing site, time and gear type.

Water temperature and turbidity readings were taken at each location except when instruments were not available. The data are presented to compare relative temperature and turbidity at each location for a given week and the change observed through time for each location.

Chinook, steelhead and sturgeon catches at each site were converted to a standardized unit of **Catch per Hour per 100 Fathoms of Net** to compare catch rates within sites as well as between sites. Actual fishing time of the gear is difficult to determine since pick time (beginning to end) was highly variable and depended on the amount of gear in the water and number of fish caught. While set time usually was no more than five minutes, pick time varied from as little as two minutes to as much as 1 ½ hours. Calculation of fishing time for purposes of this study is defined as:

$$\frac{(S_E - S_B)}{2} + (P_B - S_E) + \frac{(P_E - P_B)}{2}$$

Where, S_e = Time at end of set,
S_B = Time at begin of set,
P_E = Time at end of pick,
P_B = Time at begin of pick, and
$(P_B - S_E)$ = "Soak" time period that the total net is in the water.

RESULTS

Test fishing was conducted from 24 April through 31 May, following heavy flooding in the month of February. Appendices 6 and 7 tabulate raw sample and biological data for the test fishery.

Fishing conditions were quite irregular through most of this period, with considerable rain and flooding resulting in constant flushing of currents, excessive debris and quite high turbidity. Temperatures and turbidity recorded aboard the test fishing vessels during this period are listed in Table 51. Temperatures ranged from the upper 40s in the end of April to mid 50s in the end of May. Turbidity was lowest in the first week of May, being as low as 16 inches in Prairie Channel, and highest in the end of May, reaching 38 inches at Tongue Point and Blind Slough.

A total of 117 chinook were caught, of which 91 were of lower river origin and 26 were of upriver origin (Tables 52 and 53). Of the 117 chinook total, 16 (14%) were immediate mortalities. The chinook catch was concentrated in the first half of the test fishery (22 April - 10 May), with 77% of lower river and 88% of upriver fish caught early (Table 54). CWTs were recovered from 14 spring chinook, as follows:

Tao Code	Recovery Site	Date	Brood Year	Hatcher-v	Release Site
5-31-15	Wallace Slough	4/24	92	Little White Salmon NFH	Little White Salmon NFH
5-32-l 9	Prairie Channel	5/03	92	Dworshak NFH	N. Fk. Clearwater R.
7-01-31	Prairie Channel	4/24	92	Willamette Hatchery	Willamette River
7-01-33	Clifton Channel	5/02	92	Willamette Hatchery	Willamette River
7-02-29	Wallace Slough	4/24	92	Round Butte	Deschutes River
7-02-53	Clifton Channel	5/02	92	Willamette Hatchery	Willamette River
7-03-46	Wallace Slough	5/08	92	Clackamas Hatchery	Clackamas River
7-05-27	Wallace Slough	5/08	93	Butte Falls Hatchery	Deschutes River
7-l 5-36	Clifton Channel	5/02	93	Willamette Hatchery	Santiam River
7-59-21	Clifton Channel	5/08	91	Willamette Hatchery	Willamette River
7-61-21	Clifton Channel	5/15	92	McKenzie	McKenzie River
7-63-25	Wallace Slough	5/15	92	Willamette Hatchery	Willamette River
63-50-03	Cathlamet Channel	4/30	92	Klickitat Hatchery	Klickitat River
63-53-06	Prairie Channel	5/03	92	Klickitat Hatchery	Klickitat River

Age composition based on scale reading was available from 106 of the 117 chinook caught, as follows:

Age	Number Sampled	Percent	Fork Length (cm.) Minimum	Maximum
3	4	3.8	48.4	60.2
4	76	71.7	66.0	86.6
5	25	23.6	74.0	96.0
6	1	0.9	85.0	85.0
Total	106	100.0	48.4	96.0

A total of 12 steelhead were caught, of which 8 came from the first half of the fishery. Of those 12, three were net mortalities.

Sturgeon catch totaled 1,208 fish at all sites combined, coming mostly from Prairie Channel (466) and Clifton Channel (512). All were white sturgeon. Of that total, 536 sturgeon were spaghetti tagged.

An incidental catch of 113 shad, 11 carp, one crawfish and one starfish was made.

Sightings of harbor seals were noted at South Channel, Grays Bay, Steamboat Slough and Cathlamet Channel, while no sea lions were observed at any time. Damage from marine mammals was noted on a few occasions, including a limited number of salmon mortalities and some net damage.

Total catches and CPUE at each site are displayed in Table 53. Tongue Point, South Channel, Deep River, Blind Slough and Steamboat Slough showed the lowest salmonid harvest and CPUE (<5 fish and 0.3 fish/hour/l00 fathoms of net). All of those were fairly low in sturgeon catch. Higher numbers of salmon were caught at Prairie Channel, Clifton Channel, Cathlamet Channel, and Wallace Slough. Prairie Channel and Clifton Channel were the dominant sturgeon areas.

Tongue Point (Figure 22): Fishing was conducted using large (7 inch and 7 ½ inch) and small (5 ½ inch) mesh floater gill nets at four sites in the Tongue Point Turning Basin at both stages of tides while attempting to distribute the fishing effort equally between the sites. During the six week period a total of three lower river chinook, one upriver chinook, two sturgeon, 16 white sturgeon, and two shad were caught. Most of the fish for all species were captured on May 2.

South Channel (Figure 23): To explore the potential for expanding the harvest area beyond Tongue Point Basin, two sites were chosen in the adjacent South Channel area with one site selected just outside South Channel extending into Prairie Channel. The sites within South Channel were fished with heavy weighted nets at slack tidal stages using large (7 1/4 inch) and small (5 ½ inch) mesh nets while the third site located adjacent to South Channel was fished with a floater gill net of small (5 ½ inch) mesh and only one drift using large (7-7 ½ inch) mesh. A total of four lower river and one upriver chinook, one steelhead, 26 white sturgeon and 12 shad was caught. All chinook, steelhead, and shad were caught in site 3 outside South Channel.

Deeo River (Figure 24): Fishing was conducted with large (7 1/4 inch) and small (6 inch) mesh floater nets at four sites - one in Deep River and three in Grays Bay, always at the turn of the tide. The attempt was made to distribute these nets equally between sites over the six week period, but the Deep River site and one Grays Bay site were fished only at high tide due to shallow depths. A total of one lower river chinook, one steelhead, 43 white sturgeon, one shad, two carp and one crawfish was caught.

Blind Slouah (Figure 26): In the Blind Slough area three sites were fished: two sites within Blind slough and one site outside Blind Slough at Knappa dock in Knappa Slough. The gear used were heavy weighted gill nets with large (7 1/4 inch) and small (5 3/4 inch) mesh which could be fished at any tidal stage within Blind Slough. At the Knappa Slough site the stronger ebb and flood currents restricted fishing periods during low or high water slack periods. No chinook, steelhead or shad were caught. Only white sturgeon (95 fish) and carp (6 fish) were captured at this location.

Prairie Channel (Figure 25): This test fishing area consists of one site upstream of the mouth of Blind Slough and two sites in Prairie Channel near Minaker Island. The gear fished consisted of floater gillnets designed to drift with the ebb and flood tidal currents in the vicinity of Minaker Island while at the site near the mouth of Blind Slough either high or low slack was fished with the net remaining stationary. Large (7 l/4 inch) or small (5 3/4 inch) mesh gillnets were fished equally at each site throughout the six week period. A total of eight lower river chinook, four upriver chinook, one steelhead, 466 white sturgeon, and three shad were caught. Three coded-wire tagged chinook were recovered: two were of upriver origin (Klickitat River and North Fork Clear-water River) and one of lower river origin (Willamette River).

Steamboat Slouah (Figure 27): Fishing sites of the Steamboat Slough area include one at Skamokawa, two within the slough, and another at the upriver exit from the slough. Four floater nets were used: large (7 inch) and small (5 1/4 inch) mesh shallow nets inside the slough, and large (7 inch) and small (5 1/4 inch) mesh deeper nets for the deeper outside waters. The one chinook caught was of lower river origin, caught in the last week of the test fishery. The one steelhead was caught in the first week. In addition, three sturgeon, two shad and one carp were caught.

Clifton Channel (Figure 28): Two sites were fished within Clifton Channel each requiring specific gear. At the upstream site (2) a diver gillnet with large (7 ½ inch) mesh was used. This gear is designed to drift with the ebbing river current along the bottom. During the top of the flood tide a small (5 ½ inch) mesh floater gillnet was fished. At low water during slack tidal stage the small mesh floater was fished at site 1. A total of 21 lower river chinook, six upriver chinook, one steelhead, 512 white sturgeon, and eighteen shad were caught. Coded-wire tags were recovered from five chinook, all originating from Willamette River hatcheries.

Cathlamet Channel (Figure 29): A large (7 inch) and small (5 1/4 inch) mesh floater net was used in Cathlamet Channel. Four drifts were fished, from one just above the Cathlamet-Puget Island bridge, to three evenly spaced to the downstream end of Cathlamet Channel. A total of 11 chinook were caught, one of upriver origin. All but one were caught in the first three weeks of the fishery. Incidental to the salmon catch was one steelhead, 32 white sturgeon, 33 shad and one carp.

Wallace Slouqh (Figure 30): Three sites were selected for test fishing in this area. Sites 1 and 2 are within Wallace Slough while site 3 is outside of the slough and closer to the shipping channel. Because of high river flows during the six week period, site 2 could not be fished since slack current conditions are necessary to fish effectively and avoid gear damage. On a typical fishing day, a single drift was fished at site 3 while two drifts were made at site 1 within Wallace Slough. Large (7 1/4 inch) and small (5 3/8 inch) mesh floater gillnets were alternated in each site. A total of 43 lower river chinook, 13 upriver chinook, four steelhead, 16 white sturgeon, and 42 shad were caught. Coded-wire tag recoveries from five chinook showed a variety of stock origins: Little White Salmon (I), Deschutes River (2), Clackamas River (I), and Willamette

River (1). In general, both sites significantly contributed to the large number of chinook caught.

Catch by Date

Table 54 lists catch and CPUE by site for the two halves of the 6-week season. Spring chinook and white sturgeon were caught most heavily during the early half of the season, at a rate of 79 and 64 percent, respectively. The 12 steelhead were caught evenly across the season, and the 113 shad were caught more heavily in the second half of the season.

Catch bv Net

Catches for small (5-6 inch) and large (7-7 ½ inch) mesh nets are listed in Table 55, by fishing location. In terms of total catch and CPUE, large mesh nets were more successful in the capture of salmon and steelhead for all areas combined. On an individual site basis, there was considerable variation. Shad were caught mostly by the small mesh nets.

Dav and Night

Fishing was conducted only during daylight hours in this test fishery. Comparisons had been made between daylight and night-time fishing in previous seasons, and little difference had been noted, especially between spring-time salmon catches. When salmon returns increase there may be a return to fishing both time periods.

Combined 1994 - 1996 Spring Test Fishery Data

Before conclusions can be drawn about the future of each of the individual potential select area fishing areas, a more detailed examination of data collected thus far will be necessary. With three years of information it is time to re-consider the ranking of each area as a potential stock selective location, the selection of drift sites within each area and their relative contributions to that area's catch, and the dynamics of each area's fishery.

First, for all seven areas (nine in 1996), a total spring test fishery harvest for each year, by species, is listed as follows:

Year	Chinook Lower	Chinook Upper	Steelhead	Stgn.	Shad
1994	52	5	21	1,824	62
1995	39	5	11	665	157
1996	91	26	12	1,208	113
Total	182	36	44	3,697	332
Mean/area/year	7.9	1.6	1.9	160.7	14.4

A primary question being asked of a potential gillnet fishery is the mortality of upriver origin spring chinook and steelhead. Over the 1994-96 period, 36 of 218 (16.5%) spring chinook were upriver fish and 10 of 44 (23%) steelhead were killed by the fishing gear. An initial examination of average success (catch/hour/l 00 fathoms of net) for each area over the 3-year period shows:

	Catch/Hour/l 00 Fathoms of Net					
	Chinook					
Area	Lower	Upper	Total	Steel head	Stgn.	Shad
Tongue Point	0.1	0.0	0.1	0.1	2.4	0.1
South Channel	0.2	0.0	0.2	0.0	1.2	0.5
Deep River	0.1	0.0	0.1	0.1	6.1	0.1
Blind Slough	0.0	0.0	0.0	0.0	4.0	0.0
Prairie Channel	0.6	0.3	1.0	0.1	38.2	0.2
Steamboat Slough	0.2	0.0	0.2	0.3	0.4	1.3
Clifton Channel	0.6	0.2	0.8	0.1	16.7	0.7
Cathlamet Channel	0.6	0.1	0.7	0.2	3.7	2.3
Wallace Slough	1.3	0.3	1.6	0.1	22.1	1.4

The lower most river areas of Tongue Point, South Channel, Deep River, Blind Slough and Steamboat Slough caught relatively few spring chinook. All locations, with the possible exception of Steamboat Slough, were mostly clear of steelhead. For ranking considerations these two species are of primary concern due to their potential or status as threatened species. Of secondary concern are sturgeon, especially when considering distribution of harvest between commercial users. Higher successes at Prairie Channel, Clifton Channel and Wallace Slough should be accounted for in setting future seasons.

Test fish strategies were established before fishing started, with a certain amount of evolution in direction over time. In particular, several potential select area sites were approached with limited knowledge as to where a fishery might eventually occur and select area fishing therefore covered more area than test fishing would show to be reasonable. Test fishing therefore occurred both inside and outside the eventual site, both to better define site boundaries and to determine the density of fish in areas adjacent to the test site in times when run sizes were very small. The result is that data presented thus far were for **all** test fishing, both inside and adjacent to the test fishing site. Following is a listing of fishing success from drifts inside and outside each site:

		Catch/Hour/l 00 Fathoms of Net					
		Chinook					
I/O	Area	Lower	Upper	Total	Sthd	Stgn.	Shad
Inside	Tongue Point	0.0	0.1	0.1	0.1	1.1	0.2
	Deep River	0.0	0.0	0.0	0.0	0.0	0.0
	Blind Slough	0.0	0.0	0.0	0.0	3.0	0.0
	Steamboat Sl.	0.0	0.0	0.0	0.1	0.4	0.0
	Clifton Channel	0.2	0.6	0.8	0.1	16.7	0.7
	Cathlamet Ch.	0.1	0.6	0.7	0.2	3.7	2.3
	Wallace Slough	0.2	1.3	1.4	0.1	15.7	1.4
Outside	Tongue Point	0.0	0.0	0.0	0.0	5.1	0.0
	Deep River	0.0	0.1	0.1	0.1	6.8	0.2
	Blind Slough	0.0	0.1	0.1	0.1	5.9	0.0
	Steamboat Sl.	0.0	0.3	0.3	0.4	0.4	1.8
	Clifton Channel	–	–	–	–	--	–
	Cathlamet Ch.	–	–	–	–	–	–
	Wallace Slough	0.6	1.3	1.9	0.1	41.2	1.3

Over the 1994-96 time period test fishing was conducted annually at the seven original sites listed above. In all of those but Clifton Channel and Cathlamet Channel fishing was conducted both inside and outside the potential area. The general conclusion from examining just those drifts from inside the area is that very limited numbers of chinook salmon and steelhead were caught at Tongue Point, Deep River, Blind Slough and Steamboat Slough. The three upriver most areas, Clifton Channel, Cathlamet Channel and Wallace Slough, though, showed considerably more salmon and steelhead, as well as more sturgeon and shad.

Several factors have potential use in conducting fisheries where endangered species might be impacted: fishery timing, mesh size and individual area density. Timing of the fishery could be a prime factor, as illustrated in the following table:

	3-Year Catch by Week					
	Chinook					
Mo.: Wk.	Lower	Upper	Total	Sthd	Stgn	Shad
4:3	50	13	63	4	1,176	17
4:4	61	17	78	9	750	16
5:1	28	3	31	2	546	14
5:2	20	1	21	7	420	132
5:3	10	0	10	4	547	56
5:4	13	2	15	18	258	97
Total	182	36	218	44	3,697	332
Mean	30.3	6.0	36.3	7.3	616.2	55.3

During 1994-96, 172 of the 218 chinook total, or **79%,** were caught in the first three weeks of the 6-week test season. These are the last two weeks of April and the first week of May. Where non-local chinook are a problem, a delay in opening until the first of May would be useful. Sturgeon show the same trend, with 2,472 fish, or 67% of the total, caught in the first half of the season. With steelhead the pattern may be reversed, though not as dramatic. With smaller numbers caught over the 3-year period (44 fish), a trend of increased harvest with time is possible, though not well defined.

Catch for nets having differential mesh sizes of 5-6 (small) versus 7-8 (large) inches were compared, and are summarized as follows:

			Catch/Hour/l 00 Fathoms of Net					
			Chinook					
Mesh	Year	Sets	Lower	Upper	Total	Sthd	Stnn	Shad
Small	94	48	0.3	0.0	0.4	0.3	22.9	1.0
	95	58	0.3	0.1	0.4	0.2	5.0	2.8
	96	68	0.4	0.1	0.5	0.1	3.1	1.5
	Total	174	0.3	0.1	0.4	0.2	9.2	1.8
Large	94	80	0.4	0.0	0.5	0.1	8.8	0.2
	95	71	0.3	0.0	0.3	0.0	5.4	0.1
	96	87	0.7	0.2	1.0	0.0	11 3	0.1
	Total	238	0.5	0.1	0.6	0.0	8 . 7	0.1

With three years of spring test fishing it is time to make examinations to help decide how experimentations should be modified and how select area fisheries might be conducted. Table 56 summarizes totals of catch and CPUE for each of the three test years by site.

Test fisheries have been conducted at each location at several standard drift sites, each found within the bounds of each location for specific needs. Some were located in areas thought to be overly abundant in non-local salmon stocks or protected fish species, thus providing references for area boundaries. Three years of test fishing data should be sufficient to make subdivisions of each fishing area.

DISCUSSION

1) With three years of test fishery data accumulated we can now start deciding where these fisheries should be conducted. The sites of Deep River and Steamboat Slough have been clean of all major species over the period, and can safely evolve to the next stage of rearing in the spring with what should be clean harvests. Tongue Point and Blind Slough have been free of chinook and steelhead, with limited numbers of sturgeon, and can advance, too.

2) Clifton Channel, Cathlamet Channel and Wallace Slough cannot advance to pen rearing and single source harvest without having additional management

considerations to prevent the overharvest of non-local spring chinook, steelhead, and potentially sturgeon.

3) Project results show that timing is a tool that will be effective in preventing the harvest of upriver spring chinook. Mesh size will be a factor in avoiding steelhead. Both of these factors should allow for expansion into new areas where uncertainty exists about the ability to fish cleanly.

4) The two new Oregon sites at South Channel and Prairie Channel will be fished in 1997 to further define reference for future harvest boundaries.

Table 49. Minimum numbers (in thousands of adults) of lower river spring chinook, upriver spring chinook, and lower river summer steelhead entering the Columbia River, 1980-96.

Year	Spring Chinook		Lower River
	Lower River	Upper	Summer Steelhead
1980	73.0	c53.1	47.8
1981	93.8	<63.6	56.6
1982	110.3	71.1	49.1
1983	91.6	57.7	19.7
1984	114.7	48.5	68.5
1985	81.7	86.4	56.9
1986	90.4	120.4	89.9
1987	132.4	100.0	58.4
1988	146.0	97.0	77.9
1989	136.9	83.3	35.0
1990	151.4	99.4	61.9
1991	130.1	59.7	31.8
1992	101.3	89.8	48.0
1993	89.6	111.5	47.0
1994	60.6	21.0	47.1
1995	50.1	10.2	39.3
1996	42.2	51.5	35.2

Source: WDFW and ODFW, 1997.

Table 50. Net specifications for 1996 spring select area test fishery, by site.

Site	Net Type	Mesh Size	Length	Details
Tongue Point	1. Floater	5 ½"	220 fm	17 ft. deep
	2. Floater	7"	130fm	19 ft. deep
		7 ½"	80 fm	19 ft. deep
South Channel	1. Floater	5 ½"	220 fm	17 ft. deep
	2. Diver	7 1/4"	112fm	21 ft. deep
	3. Floater	7"	130fm	19 ft. deep
		7 ½"	80 fm	19 ft. deep
Deep River	1. Floater	6"	145 fm	22 ft. deep
	2. Floater	7 1/4"	160 fm	25 ft. deep
Blind Slough	1. Floater	5 3/4"	IOOfm	15 ft. deep
	2. Floater	7 1/4"	IOOfm	15 ft. deep
Prairie Channel	1. Floater	5 3/4"	IOOfm	15 ft. deep
	2. Floater	7 1/4"	IOOfm	30 ft. deep
	3. Floater	7 1/4"	IOOfm	15 ft. deep
Steamboat Slough	1. Floater	5 1/4"	60 fm	19 ft. deep (34 meshes)
	2. Floater	7"	60 fm	19 ft. deep (34 meshes)
Clifton Channel	1. Floater	5 ½"	IOOfm	16 ft. deep
	2. Diver	7 ½"	170fm	12 ft. deep
Cathlamet Channel	1. Floater	5 1/4"	150fm	22 ft. deep (70 meshes)
	2. Floater	7"	150fm	22 ft. deep (34 meshes)
Wallace Slough	1. Floater	5 3/8"	150fm	16 ft. deep
	2. Floater	7 1/4"	150fm	16 ft. deep

Table 51. Water temperature and turbidity for 1996 spring select area test fishery, by site.

Site	Week Number					
	1	2	3	4	5	6
Temperature (F)						
Tongue Point		52	53	54-56	54	55
South Channel	48	50-52	52	54-55	56	55
Deep River	50-52	51	54	54	54	57
Blind Slough	49-50	51-53	51	55	54	55-56
Prairie Channel	48	50	52-53	54	56	55-56
Steamboat Slough			52	52	54	54
Clifton Channel	46	51	52	54	53-54	55
Cathlamet Channel		50	52	54	54	56
Wallace Slough	48	50-51	52-53	54	54	54
Turbidity (in.)						
Tongue Point	29	23	18-21	28-30	30-33	38
South Channel	22-29	19-22	22	23-29	25-33	26
Deep River		17	21	24	24	32
Blind Slough	21-29	24-41	25-27	31	29-54	35-38
Prairie Channel	27-29	16	22-23	29-31	26-31	28
Steamboat Slough		20	17	24	20	30
Clifton Channel	26	21-22	20	31	24-25	29-33
Cathlamet Channel		19	16	28	21	28
Wallace Slough	22	25-27	18-19	28-32	28	26-28

Table 52. Spring select area test fishery catch, by site and date, 1996.

		Chinook				
Site	Date	Lower	Upper	Sthd	Stgn	Shad
Tongue Point	4/25				5	
	5/02	3	1	1	9	1
	5/09					
	5/16					
	5/23				1	
	5/28			1		1
	Total	3	1	2	16	2
South Channel	4/26				5	
	5/03	2			6	4
	5/10	1			3	2
	5/17	1	1		5	
	5/24				2	5
	5/31			1	5	1
	Total	4	1	1	26	12
Deep River	4/25				10	
	5/01				16	1
	5/10	1			5	
	5/15				1	
	5/23					
	5/29			1	11	
	Total	1		1	43	1
Blind Slough	4/25				8	
	5/01				4	
	5/09				16	
	5/16				45	
	5/23				13	
	5/30				9	
	Total				95	
Prairie Channel	4/24	3	2		27	
	5/03	3	2		113	
	5/10				110	
	5/17	1		1	44	2
	5/24				125	1
	5/31	1			47	
	Total	8	4	1	466	3
Steamboat Sl.	N.S.					
	5/01			1		
	5/07				1	
	5/15				2	2
	5/22					
	5/29	1				
	Total	1		1	3	2
Clifton Channel	4/24	4	1		121	
	5/02	8	4	1	218	3
	5/08	3	1		69	
	5/15	2			33	5
	5/22	2			41	8
	5/29	2			30	2
	Total	21	6	1	512	18
Cathlamet Ch.	N.S.					
	4/30	6	1		17	
	5/08	1			7	1
	5/14	2			7	15
	5/21					4
	5/28	1		1	1	13
	Total	10	1	1	32	33
Wallace Slough	4/24	9	6	1	2	
	5/01	12	4	1	2	3
	5/08	14	1	1	3	2
	5/15	6		1	7	4
	5/22					10
	5/29	2	2		2	23
	Total	43	13	4	16	42
Total	Week 1	16	9	1	178	
	Week 2	34	12	4	385	12
	Week 3	20	2	1	214	5
	Week 4	12	1	2	144	28
	Week 5	2			182	28
	Week 6	7	2	4	105	40
	Total	91	26	12	1,208	113

Table 53. Spring select area test fishery catch and CPUE, by area, 1996.

Area	Sets	Chinook Lower	Chinook Upper	Chinook Total	Sthd	Stgn	Shad
CATCH (in numbers)							
Tongue Point	18	3	1	4	2	15	2
South Channel	18	4	1	5	1	26	12
Deep River	18	1	0	1	1	43	1
Blind Slough	18	0	0	0	0	95	0
Prairie Channel	18	8	4	12	1	466	3
Steamboat Slough	15	1	0	1	1	3	2
Clifton Channel	17	21	6	27	1	512	18
Cathlamet Channel	15	10	1	11	1	32	33
Wallace Slough	18	43	13	56	4	16	42
Total	155	91	26	117	12	1,208	113
CPUE (Numbers/hour/l 00 fm)							
Tongue Point	18	0.1	<0.1	0.1	0.1	0.4	0.1
South Channel	18	0.2	<0.1	0.2	<0.1	1.2	0.5
Deep River	18	0.1	0.0	0.1	0.1	2.9	0.1
Blind Slough	18	0.0	0.0	0.0	0.0	6.3	0.0
Prairie Channel	18	0.6	0.3	1.0	0.1	37.3	0.2
Steamboat Slough	15	0.2	0.0	0.2	0.2	0.6	0.4
Clifton Channel	17	1.1	0.3	1.4	0.1	26.7	0.9
Cathlamet Channel	15	0.7	0.1	0.8	0.1	2.3	2.4
Wallace Slough	18	2.2	0.7	2.9	0.2	0.8	2.1
Total	155	0.6	0.2	0.7	0.1	7.6	0.7

Table 54. Catch and CPUE for early versus late spring select area test fishery, 1996.

		Catch						CPUE					
		Chinook						Chinook					
Site	Sets	Lower	Upper	Total	Sthd	Stgn	Shad	Lower	Upper	Total	Sthd	Stgn	Shad
April 22 - May 10													
Tongue Point	9	3	1	4	1	14	1	0.1	co.1	0.2	co.1	0.7	co.1
South Channel	9	3	0	3	0	14	6	0.2	0.0	0.2	0.0	1.1	0.5
Deep River	9	1	0	1	0	31	1	0.1	0.0	0.1	0.0	3.8	0.1
Blind Slough	9	0	0	0	0	28	0	0.0	0.0	0.0	0.0	3.4	0.0
Prairie Channel	9	6	4	10	0	250	0	0.9	0.6	1.5	0.0	36.6	0.0
Steamboat Slough	6	0	0	0	1	1	0	0.0	0.0	0.0	0.5	0.5	0.0
Clifton Channel	8	15	6	21	1	408	3	1.5	0.6	2.1	0.1	40.8	0.3
Cathlamet Channel	6	7	1	8	0	24	1	1.3	0.2	1.5	0.0	4.4	0.2
Wallace Slouah	9	35	11	46	3	7	5	3.4	1.1	4.5	0.3	0.7	0.5
Total	74	70	23	93	6	777	17	0.8	0.3	1.1	0.1	9.4	0.2
May 13 - May 31													
Tongue Point	9	0	0	0	1	1	1	0.0	0.0	0.0	0.1	0.1	0.1
South Channel	9	1	1	2	1	12	6	0.1	0.1	0.2	0.1	1.3	0.6
Deep River	9	0	0	0	1	12	0	0.0	0.0	0.0	0.1	1.8	0.0
Blind Slough	9	0	0	0	0	67	0	0.0	0.0	0.0	0.0	9.7	0.0
Prairie Channel	9	2	0	2	1	216	3	0.4	0.0	0.4	0.2	38.2	0.5
Steamboat Slough	9	1	0	1	0	2	2	0.3	0.0	0.3	0.0	0.6	0.6
Clifton Channel	9	6	0	6	0	104	15	0.7	0.0	0.7	0.0	11.4	1.6
Cathlamet Channel	9	3	0	3	1	8	32	0.4	0.0	0.4	0.1	0.9	3.8
Wallace Slouah	9	8	2	10	1	9	37	0.9	0.2	1.1	0.1	10	3.9
Total	81	21	3	24	6	431	96	0.3	0.0	0.3	0.1	5.7	1.3

Table 55. Comparable catch and **CPUE** by mesh size of spring select area test fishery, 1996.

		Catch						CPUE					
		Chinook						Chinook					
Site	Sets	Lower	Upper	Total	Sthd	Stgn	Shad	Lower	Upper	Total	Sthd	Stgn	Shad
Small Mesh													
Tongue Point	9	0	1	1	2	0	2	0.0	co.1	<0.1	0.1	0.0	0.1
South Channel	7	3	0	3	1	9	12	0.3	0.0	0.3	0.1	0.8	1.1
Deep River	9	0	0	0	0	17	1	0.0	0.0	0.0	0.0	2.2	0.1
Blind Slough	10	0	0	0	0	43	0	0.0	0.0	0.0	0.0	5.1	0.0
Prairie Channel	5	0	0	0	0	57	0	0.0	0.0	0.0	0.0	17.2	0.0
Steamboat Slough	8	1	0	1	0	1	2	0.3	0.0	0.3	0.0	0.3	0.7
Clifton Channel	6	5	0	5	1	56	18	1.3	0.0	1.3	0.3	14.6	4.7
Cathlamet Channel	6	2	0	2	1	19	33	0.3	0.0	0.3	0.2	3.3	5.7
Wallace Slouah	8	16	4	20	3	10	3 8	1.8	0.5	2.3	0.3	1.1	4.3
Total	68	27	5	32	8	212	106	0.4	0.1	0.5	0.1	3.1	1.5
Large Mesh													
Tongue Point	9	3	0	3	0	15	0	0.2	0.0	0.2	0.0	0.8	0.0
South Channel	11	1	1	2	0	17	0	0.1	0.1	0.2	0.0	1.4	0.0
Deep River	9	1	0	1	1	26	0	0.1	0.0	0.1	0.1	3.6	0.0
Blind Slough	8	0	0	0	0	52	0	0.0	0.0	0.0	0.0	7.6	0.0
Prairie Channel	13	8	4	12	1	409	3	0.9	0.4	1.3	0.1	44.6	0.3
Steamboat Slough	7	0	0	0	1	2	0	0.0	0.0	0.0	0.4	0.9	0.0
Clifton Channel	11	16	6	22	0	456	0	1.0	0.4	1.4	0	28.7	0.0
Cathlamet Channel	9	8	1	9	0	13	0	1.0	0.1	1.1	0.0	1.6	0.0
Wallace Slough	10	27	9	36	1	6	4	2.5	0.8	3.3	0.1	0.6	0.4
Total	87	64	21	85	4	996	7	0.7	0.2	1.0	0.0	11.3	0.1

Table 56. Comparable catch and CPUE, by site and year, of spring select area test fishery, 1994-96.

		Catch						CPUE					
		Chinook						Chinook					
Site	Sets	Lower	Upper	Total	Sthd	Stgn	Shad	Lower	Upper	Total	Sthd	Stgn	Shad
Tongue Point													
1994	20	0	0	0	3	71	5	0.0	0.0	0.0	0.1	3.3	0.2
1995	16	2	0	2	0	109	3	0.1	0.0	0.1	0.0	4.8	0.1
1996	18	3	1	4	2	15	2	0.1	0.0	0.1	0.1	0.4	0.1
South Channel													
1994	N.S.												
1995	N.S.												
1996	18	4	1	5	1	26	12	0.2	0.0	0.2	0.0	1.2	0.5
Deep River													
1994	17	1	0	1	1	48	2	0.1	0.0	0.1	0.1	4.0	0.1
1995	18	0	0	0	1	133	2	0.0	0.0	0.0	0.1	13.2	0.2
1996	18	1	0	1	1	43	1	0.1	0.0	0.1	0.1	2.9	0.1
Blind Slough													
1994	18	1	0	1	0	43	0	0.1	0.0	0.1	0.0	2.6	0.0
1995	18	1	0	1	1	46	0	0.1	0.0	0.1	0.1	3.3	0.0
1996	18	0	0	0	0	95	0	0.0	0.0	0.0	0.0	6.3	0.0
Prairie Channel													
1994	N.S.												
1995	N.S.												
1996	18	8	4	12	1	466	3	0.6	0.3	1.0	0.1	37.3	0.2
Steamboat Slough													
1994	18	5	0	5	6	5	18	0.4	0.0	0.4	0.5	0.4	1.2
1995	20	2	0	2	4	5	24	0.1	0.0	0.1	0.3	0.3	1.6
1996	15	1	0	1	1	3	2	0.2	0.0	0.2	0.2	0.6	0.4
Clifton Channel													
1994	18	13	3	16	3	412	7	0.6	0.1	0.7	0.1	17.6	0.2
1995	18	6	1	7	2	116	18	0.3	0.1	0.4	0.1	5.9	0.9
1996	17	21	6	27	1	512	18	1.1	0.3	1.4	0.1	26.7	0.9
Cathlamet Channel													
1994	18	17	1	18	7	145	17	0.7	0.1	0.8	0.3	6.5	0.7
1995	18	8	2	10	3	38	83	0.4	0.1	0.4	0.1	1.7	3.7
1996	18	10	1	11	1	32	33	0.7	0.1	0.8	0.1	2.3	2.4
Wallace Slough													
1994	19	15	1	16	1	1,000	13	0.8	0.1	0.9	0.1	59.0	0.7
1995	18	20	2	22	0	218	27	0.9	0.1	1.0	0.0	9.9	1.2
1996	18	43	13	56	4	16	42	2.2	0.7	2.9	0.2	0.8	2.1
Total													
1994	128	52	5	57	21	1,824	62	0.4	0.0	0.4	0.2	13.9	0.5
1995	129	39	5	44	11	665	157	0.3	0.0	0.3	0.1	5.2	1.2
1996	155	91	26	117	12	1,208	113	0.6	0.2	0.7	0.1	7.6	0.7

D. 1996 Fall Test Fishery in Potential Select Area Fishing Sites

INTRODUCTION

In the fall of 1996, test fisheries were repeated in the seven lower Columbia River select areas initially fished in the spring and falls of 1994 - 1996. Harvest potential in those locations determined to have the best select area fishery capability will be evaluated continuously throughout the length of this lo-year project.

The fall test fishery of the select area fishery evaluation project is intended to cover the time period when adult fall chinook and coho salmon are passing through the lower Columbia River. Runs of these species would potentially serve to support select area fisheries. At this time there is concern for returns of hatchery tule fall chinook, listed Snake River wild fall chinook and chum salmon, and summer steelhead, that may be harvested incidentally in such a fishery. Table 57 lists salmon and steelhead run sizes since 1980. The major intent of the test fishery is to enumerate the impact future select area fisheries might have on species/runs of concern.

With the initiation of select area fisheries in the fall of 1996 on ‘93 brood coho released at the new sites of Tongue Point, Deep River and Blind Slough, test fishery emphasis changed at these locations. New nets of larger and smaller mesh sizes were fished to test the presence of sturgeon and jack coho (‘94 brood), and schedules were reduced with lessening needs where commercial gillnetting was already providing most answers.

This report is a summarization of data pertinent to this incidental catch monitoring project, including success by area, CWT, age and other biological data. One report alone cannot be considered as a true representation of general conditions in any area. It must be reviewed in the context that it is only part of a multiple-year and multiple-season study.

METHODS

Fishing was conducted between 23 September through 31 October of 1996 with many sites fished weekly. Four Oregon and three Washington sites were selected based on rearing and harvest criteria established and described under Project Objective #1 (BPA, 1994). Two new Oregon sites were added to the list in the spring to assess fishing potential in waters adjacent to Tongue Point and Blind Slough, where net pens have been located since 1994. The third new test area site, Youngs Bay, had limited fishing to test for jacks. All selected sites were within Columbia River commercial Zones 1 and 2. The areas sampled were:

Site	State	River Mile	Test Fishery Emphasis
Youngs Bay*	OR	12	Coho jacks
Tongue Point Turning Basin*	OR	18	Coho jacks, sturgeon
South Channel	OR	20	Salmon/steelhead
Deep River/Grays Bay*	WA	22	Salmon/steelhead/jacks
Prairie Channel	OR	24	Salmon/steelhead
Blind Slough*	OR	27	Coho jacks
Steamboat Slough/Skamokawa	WA	34	Salmon/steelhead
Clifton Channel	OR	36	Salmon/steelhead
Cathlamet Channel	WA	40	Salmon/steelhead
Wallace Slough	OR	49	Salmon/steelhead

** Select area fishery conducted at each of these locations.*

Fall test fishing in Oregon sites in 1996 was initiated at four sites: South Channel on September 26, Prairie Channel on September 25, Clifton Channel on September 26, and Wallace Slough on September 25. Large (7-7 ½ inch) and small (5-6 inch) mesh gillnets were fished at each site.

Test fishing resumed in the Tongue Point Basin during October 11, 16, and 23 to assess the abundance of legal-sized (4-5 feet) white sturgeon by using 9-inch mesh "sturgeon" gear. During this period retention of sturgeon was not allowed by the commercial fishery.

During October 29-31, test fishing was conducted in Youngs Bay (10/31), Tongue Point (10/29) and Blind Slough (10/31) using extremely small mesh gill nets targeting coho jacks. A heavily weighted, monofilament herring gillnet with 3 5/8 inch mesh size was fished at Youngs Bay and Tongue Point, while sockeye gear (4 1/8 inch floater gillnet) with added weight on the lead line was used at Blind Slough.

Each site was fished by a single local gillnetter for all six weeks, with an ODFW or WDFW observer aboard every trip. Fishermen were Frank Tarabochia, Les Clark, Alan Takalo, Art Pedersen, Jack Marincovich, and Bruce Jolma. Generally, three drift locations were fished at each site weekly in order to spread effort geographically, with fishing conducted during high or low tides. Salmon/steelhead boats distributed effort between small (5 - 5 3/4 inch) and large (6 ½ - 7 ½ inch) mesh nets in order to provide a reference of the occurrence of the larger chinook and smaller steelhead. Those fishing for coho jacks utilized less than 4 1/8 inch mesh nets, while the Tongue Point sturgeon test fishery was conducted with 9 inch mesh net. Gear specifications are displayed in Table 58. Generally, each drift of the net was fished for about ½ hour, with a day's three drifts being distributed over the change of the high or low tide.

Observations made during the test fishery were: 1) net specifications and fathoms fished, 2) set location, 3) weather, water temperature and turbidity (Secchi disk), 4) layout and pickup times, and 5) catch of all fish species with associated biological data:

Chinook: Data collected with each fish removed from the gillnet include fork length, condition (live or dead), occurrence of mark and/or CWT, skin color, marine mammal damage, and scales removed for aging. Live fish were opercle punched to identify recaptures. If the fish was killed in the net, or CWT, fish weight and sex were recorded, and the snout removed for later CWT removal.

Coho: Data collected were fork length, skin color, fin marks and/or CWT, and marine mammal damage. Live fish were opercle punched to identify recaptures.

Steelhead: Data collected include fork length, race/maturity, fin marks and/or CWT, and marine mammal damage. Scales were taken for ageing and determination of hatchery/wild. All live fish were opercle punched to identify recaptures.

Sturgeon: Each sturgeon caught was sampled for total and fork length, and examined for the occurrence of spaghetti tags or tag scars. Depending on the availability of time, sturgeon over 90 centimeters in total length were single spaghetti tagged and scute marked.

Other species: All other species of fish were enumerated by fishing site, time and gear type.

Water temperature and turbidity readings were taken at each location except when darkness prevented turbidity readings or instruments were not available. The data are presented to compare relative temperature and turbidity at each location for a given week and the change observed through time for each location.

Chinook, coho, steelhead and sturgeon catches at each site were converted to a standardized unit of **Catch per Hour per 100 Fathoms of Net** to compare catch rates within sites and between sites. Actual fishing time of the gear is difficult to determine since pick time (beginning to end) was highly variable and depended on the amount of gear in the water and number of fish caught. Calculation of fishing time for purposes of this study is defined as:

$$\frac{(S_E - S_B)}{2} + (P_B - S_E) + \frac{(P_E - P_B)}{2}$$

Where, S_E = Time at end of set,
S_B = Time at begin of set,
P_E = Time at end of pick,
P = Time at begin of pick, and
$(P_B - S_E)$ = "Soak" time period that the total net is in the water.

RESULTS AND DISCUSSION

During the six weeks of test fishing over 59.3 hours of net time was fished. The resulting harvest consisted of two chinook, 45 coho, one chum, three steelhead, 59 white sturgeon, one green sturgeon, and three carp (Tables 59 - 61). With such variety in emphasis and small numbers caught, little can be said about meanings of the overall catch.

The two chinook caught both came from the Cathlamet Channel test fishery. Both were of lower river origin and neither was coded wire tagged.

All 43 coho were caught with 5" - 7" gillnets as part of the standard test fishery. Of that total, 28 coho were harvested as part of the commercial gillnet fishery on returning '93 brood Deep River net-pen coho. All six CWTs were caught in the Deep River test fishery, and were '94 brood coho from the Deep River tag release group.

No jack coho were caught with 4 1/8 inch mesh. The jack coho test fishery was conducted on October 29-31. It should be noted that '94 brood coho were caught in each of the select area commercial fisheries, but several weeks earlier. Future jack test fishing will be conducted in the opening weeks of the fisheries.

The one chum was caught in Cathlamet Channel on October 29.

The three steelhead were caught in the Youngs Bay, Steamboat Slough, and Cathlamet Channel test fisheries.

Of the 59 sturgeon caught, 15 were caught with 9-inch mesh in the Tongue Point sturgeon test fishery and the remaining 44 were caught with 5- to 7-inch mesh in Prairie Channel (21), Cathlamet Channel (1 1), Wallace Slough (6), Deep River (4) and South Channel (2). Numbers cannot be compared between areas due to differing relative times fished at each area (Table 61).

Marine mammals (harbor seals or sea lions) were recorded at Steamboat Slough and Cathlamet Channel.

Sturgeon Test Fishing

Large mesh net (g-inch) was utilized to key on sturgeon at Tongue Point over a 3-week period (October 11, 16 and 23). A total of 15 white sturgeon were caught in 11 sets with three sturgeon of legal size. No salmon or steelhead were caught.

Coho Jack Test Fishing

Small mesh net (4 1/8 inch) was utilized to key on ‘94 brood coho returning to each of the select area net-pen sites, with hopes of providing an indicator of abundance for the 1997 fisheries. All small mesh test fishing was conducted in the last week of October, and resulted in a harvest of no jacks. A wild subadult steelhead (fork length 37 cm) caught in Youngs Bay was the only fish caught. Commercial fisheries were being conducted weekly at each of the four sites since the end of September (Chapter 2E), with jack observations occurring in the biological sampling in the first weeks of the fishery. Future jack test fishing will be conducted in the beginning of the select area fisheries.

Pre-Commercial Test Fishing

Standard nets (5- to 7-inch mesh) were fished at four Oregon sites (South Channel, Prairie Channel, Clifton Channel, and Wallace Slough) prior to the opening of the select area fisheries. The catch for combined Oregon sites totaled two coho (South Channel only) and 29 sturgeon. No chinook or steelhead were caught. Since the late fall gillnet season targeting coho was set to open on September 30 with weekly fishing periods thru October 25, the program was terminated after the first week. All of mainstem in zones 1-5 (mouth of the river to Bonneville Dam) was open inclusive of the four sites.

Full Term Test Fishing

Standard nets (5- to 7-inch mesh) were fished at the three Washington sites (Deep River, Steamboat Slough and Cathlamet Channel) from the last week of September through the last week of October. Deep River test fishing was conducted both inside the river while the commercial select area fishery was occurring, and outside Deep River in Grays Bay as a comparison to fishery success. Fishing inside Deep River resulted in a harvest of 28 coho, while fishing in Grays Bay resulted in a harvest of 5 sturgeon.

The only test fishing conducted weekly by previous years’ standards was in Steamboat Slough and Cathlamet Channel. The harvest at Steamboat Slough was 3 coho and one steelhead, while the Cathlamet Channel harvest was two chinook, 12 coho, one steelhead and 11 sturgeon.

CONCLUSIONS AND RECOMMENDATIONS

Little can be said from the 1996 fall select area test fishery results. Irregular schedules and new gear does not allow for the comparisons previously made of catch by area, time period, and gear. The presentation of 3-year spring test fishery data (Chapter 3C) is not possible in the fall for the same reasons.

Jack test fisheries will be conducted in the future, but much earlier to better match with jack timing. Sturgeon test fishing at Tongue Point Basin shows that with large mesh (9 inch) gear, legal sized sturgeon can be targeted during late October. Future test fishing at areas where no immediate fish rearing is planned (Cathlamet Channel, Clifton Channel and Wallace Slough) should be discontinued.

Table 57. Minimum numbers (in thousands of adults) of lower river and upriver fall chinook, coho, chum, and group B summer steelhead entering the Columbia River, 1980-96.

	Chinook		Coho			Group B
Year	Lower River	Upriver	Early	Late	Chum	Summer Steelhead
1980	***154.8***	***166.4***	***160.3***	***141.3***	***0.5***	***43.7***
1981	129.8	***154.1***	***100.3***	***70.1***	***1.5***	***37.7***
1982	159.7	***201.0***	229.4	***223.7***	2.9	***54.3***
1983	***116.0***	***125.2***	***43.4***	***57.1***	***0.6***	69.3
1984	***120.0***	***185.5***	***240.6***	***173.5***	***2.3***	***126.8***
1985	***136.4***	228.9	***228.4***	***137.8***	***1.3***	93.6
1986	197.1	***301.6***	***730.8***	796.9	***3.0***	101.9
1987	***402.5***	469.2	***186.2***	***121.4***	***2.5***	79.8
1988	***382.7***	***400.3***	***332.3***	***332.6***	***4.8***	90.2
1989	***221.7***	***328.3***	***262.7***	438.9	***2.0***	***117.3***
1990	111.0	***206.6***	***108.8***	***87.4***	2.9	***88.7***
19'91	***102.0***	***175.0***	***518.4***	415.9	***1.3***	***126.1***
1992	92.1	***125.8***	109.4	***101.5***	4.9	***143.1***
1993	***77.1***	***136.8***	***72.4***	***41.5***	***4.5***	92.8
1994	82.9	***172.4***	***138.2***	***32.1***	***1.2***	***80.1***
1995	***78.8***	165.9	***57.4***	***16.7***	***1.5***	***80.3***
1996	***113.8***	***217.2***	***83.2***	***28.4***	***3.3***	69.3

Source: WDFW and ODFW, 1997

Table 58. Net specifications for 1996 fall select area test fishery, by site.

Site	Net Type	Mesh Size	Length	Details
Youngs Bay	1. Floater	3 5/8"	165fm	18 ft. deep
Tongue Point	1. Floater	3 5/8"	165 fm	18 ft. deep
	2. Floater	9"	220 fm	
	3. Diver	9"	180fm	
South Channel	1. Floater	5 1/4"	65 fm	
	2. Floater	5 3/8"	200 fm	
	2. Floater	7 1/4"	110 fm	
Deep River	1. Floater	4"	100 fm	18 ft. deep
	2. Floater	6"	100 fm	20 ft. deep
	3. Floater	7 1/4"	120 fm	25 ft. deep
Prairie Channel	1. Floater	5 ½"	100 fm	
	2. Floater	7 1/4"	100 fm	
Blind Slough	1. Diver	4 1/8"	100 fm	60 meshes deep
Steamboat Slough	1. Floater	5 1/4"	60 fm	19 ft. deep (45 meshes)
	2. Floater	7"	60 fm	19 ft. deep (30 meshes)
	3. Floater	7"	150fm	22 ft. deep (34 meshes)
	4. Floater	5 ½"	200 fm	22 ft. deep (60 meshes)
Clifton Channel	1. Floater	5 ½"	100 fm	16 ft. deep
	2. Diver	7 ½"	160 fm	12 ft. deep
Cathlamet Channel	1. Floater	5 1/4"	150 fm	22 ft. deep (50 meshes)
	2. Floater	7"	150 fm	19 ft. deep (34 meshes)
Wallace Slough	1. Floater	5 3/8"	100 fm	16 ft. deep
	2. Floater	7 1/4"	150 fm	16 ft. deep

Table 59. Fall select area test fishery catch, by site, date and mesh size, 1996.

Mesh / Site	Date	Chinook	Coho	Sthd	Stgn	Shad
5 - 7 ½ Inch Mesh						
South Channel	9/26		2		2	
Prairie Channel	9/25				21	
Clifton Channel	9/26					
Wallace Slough	9/25				6	
Deep River	9/23		6		1	
	IO/IO				4	
	10/15		22			
	10/30					
	Total		28		5	
Steamboat Sl.	9/25					
	10/03		2			
	10/09					
	10/17		1			
	10/23					
	10/30			1		
	Total		3	1		
Cathlamet Ch.	9/24	2	1			
	10/02		4			
	10/08				1	
	10/15		2			
	10/22		3	1	8	
	10/29		2		2	
	Total	2	12	1	11	
Sturgeon Mesh						
Tongue Pt.	10/11				3	
	10/16				9	
	10/23				3	
	Total				*15*	
Jack Mesh						
Youngs Bay	10/31			1		
Tongue Point	10/29					
Blind Slough	10/31					
Deep River	10/30					
	Total			1		

Table 60. Comparative catch and CPUE by site in fall select area test fishery, 1996.

Mesh / Site	Sets	Catch				CPUE[1]			
		Chin	Coho	Sthd	Stgn	Chin	Coho	Sthd	Stgn
5 to 7 ½ Inch Mesh									
Deep River	11	0	28	0	4	0	6.3	0	0.9
South Channel	3	0	2	0	2	0	0.6	0	0.6
Prairie Channel	3	0	0	0	21	0	0	0	8.1
Steamboat Slough	18	0	3	1	0	0	0.3	0.1	0
Clifton Channel	3	0	0	0	0	0	0	0	0
Cathlamet Channel	18	2	12	1	11	0.1	0.6	0.1	0.6
Wallace Slough	3	0	0	0	6	0	0	0	2.5
Total	59	2	45	2	44	0	1.0	0	1.0
Sturgeon Mesh									
Tongue Point	11	0	0	0	15	4	4	0	0.6
Total	11	0	0	0	15	0	0	0	0.6
Jack Mesh									
Youngs Bay	1	0	0	1	0	0	0	0.4	0
Deep River	2	0	0	0	0	0	0	0	0
Tongue Point	3	0	0	0	0	0	0	0	0
Blind Slough	1	0	0	0	0	0	0	0	0
Total	7	0	0	1	0	0	0	0.1	0

[1] *CPUE = Numbers caught/hour/100 fathoms of netting,*

Table 61. Comparative catch and CPUE by mesh size in fall select area test fishery, 1996.

Mesh / Site	Sets	Catch Chin	Catch Coho	Catch Sthd	Catch Stgn	CPUE' Chin	CPUE' Coho	CPUE' Sthd	CPUE' Stgn
5 - 6 Inch Mesh									
Deep River	9	0	22	0	4	0	6.2	0	1.1
South Channel	2	0	2	0	0	0	0.9	0	0
Prairie Channel	1	0	0	0	5	0	0	0	5.8
Steamboat Slough	7	0	2	1	0	0	0.6	0.3	0
Clifton Channel	1	0	0	0	0	0	0	0	0
Cathlamet Channel	10	2	11	1	3	0.1	1.0	0.1	.03
Wallace Slough	2	0	0	0	5	0	0	0	3.6
Total	32	2	37	2	17	0.1	1.6	0.1	0.7
7 - 7 ½ Inch Mesh									
Deep River	2	0	6	0	0	0	7.1	0	0
South Channel	1	0	0	0	2	0	0	0	1.6
Prairie Channel	2	0	0	0	16	0	0	0	9.2
Steamboat Slough	11	0	1	0	0	0	0.2	0	0
Clifton Channel	2	0	0	0	0	0	0	0	0
Cathlamet Channel	8	0	1	0	8	0	0.1	0	1.2
Wallace Slough	1	0	0	0	1	0	0	0	1.0
Total	27	0	8	0	27	0	0.4	0	1.3
Sturgeon Mesh									
Tongue Point	11	4	0	0	15	0	0	0	0.6
Total	11	0	0	0	15	0	0	0	0.6
Jack Mesh									
Youngs Bay	1	0	0	1	0	0	0	0.4	0
Deep River	2	0	0	0	0	0	0	0	0
Tongue Point	3	0	0	0	0	0	0	0	0
Blind Slough	1	0	0	0	0	0	4	0	0
Total	7	0	0	1	0	0	0	0.1	0

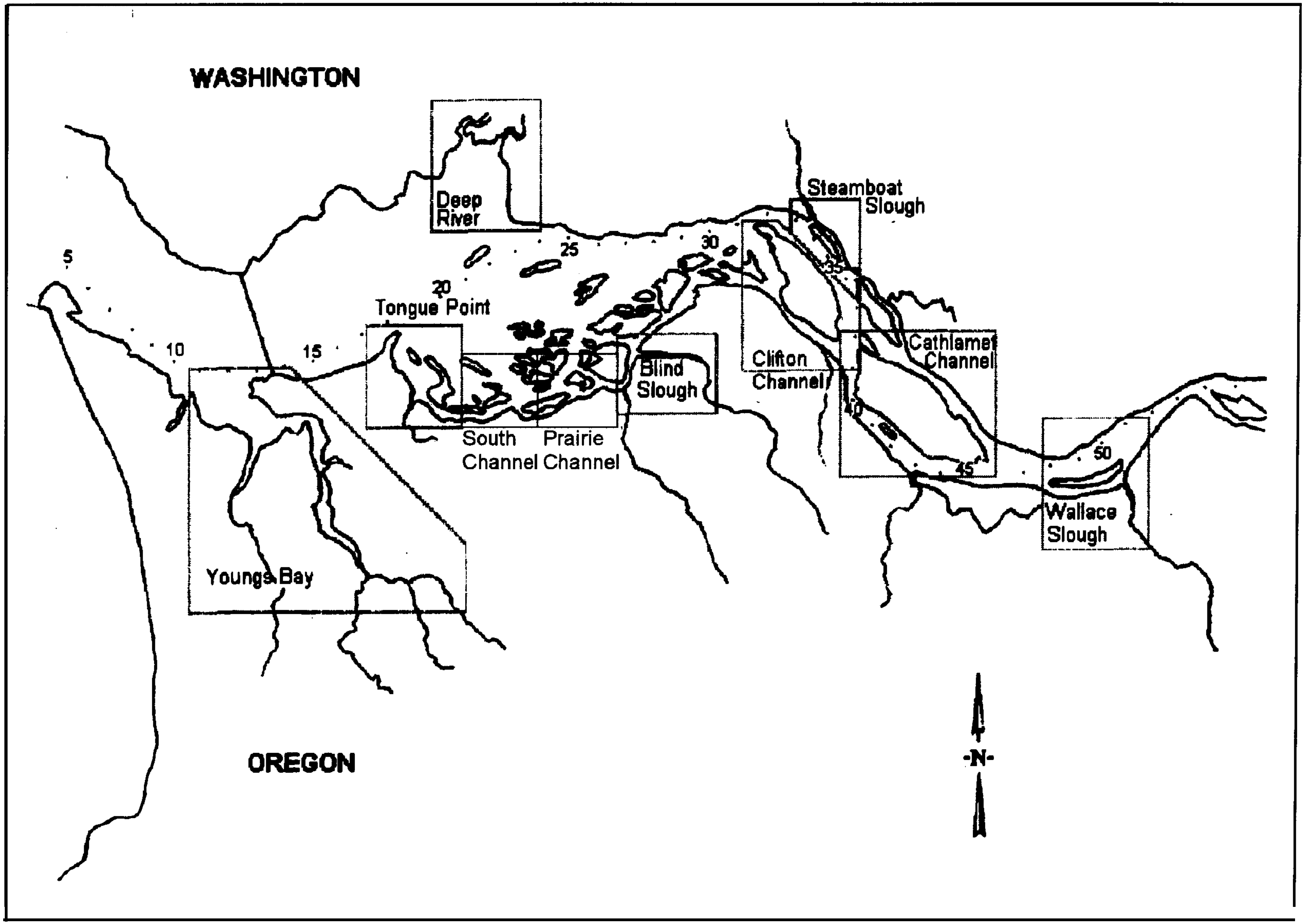

Figure 21. Select area test fishery locations, 1995-96.

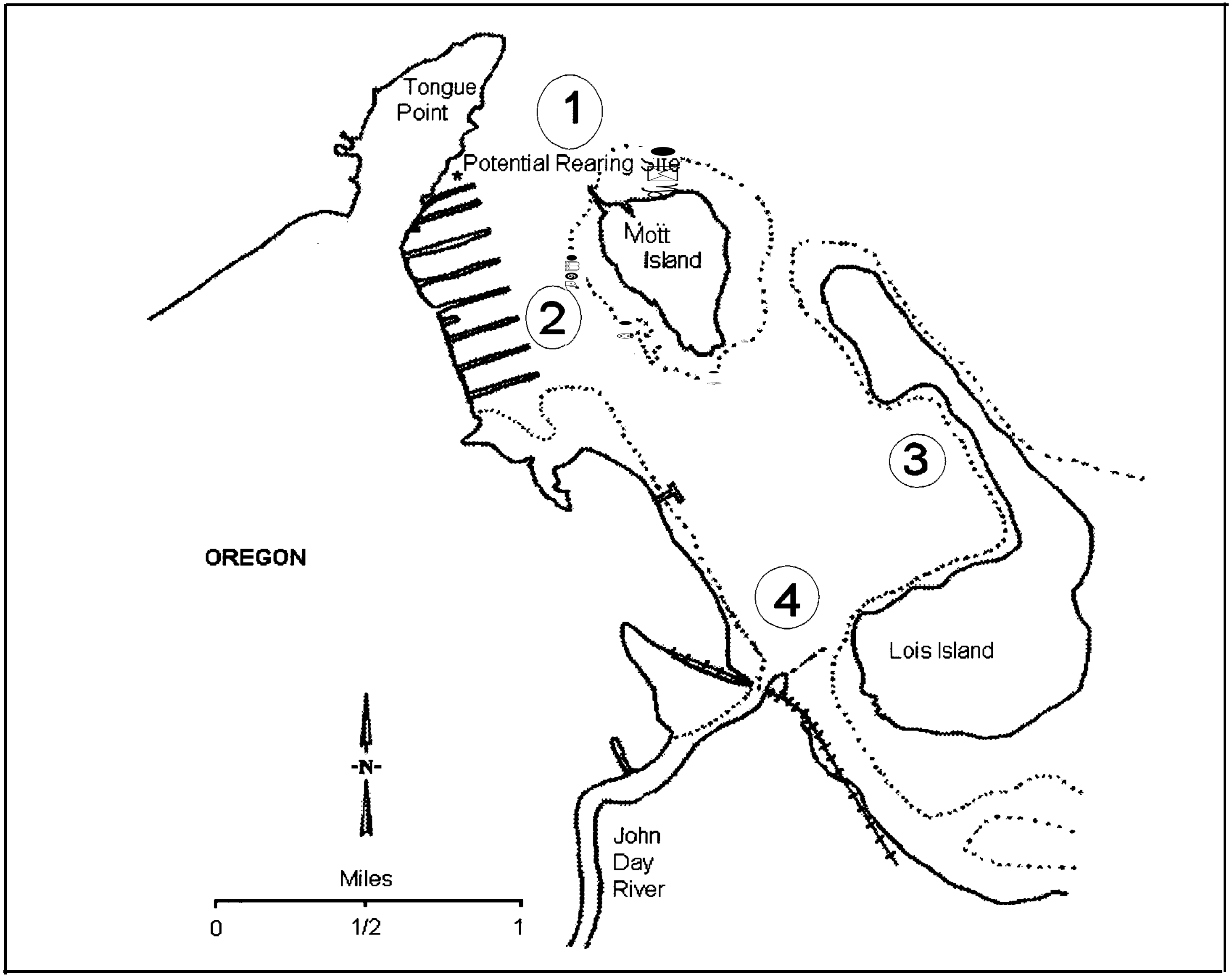

Figure 22. Tongue Point Basin test fishery drift sites 1995-96.

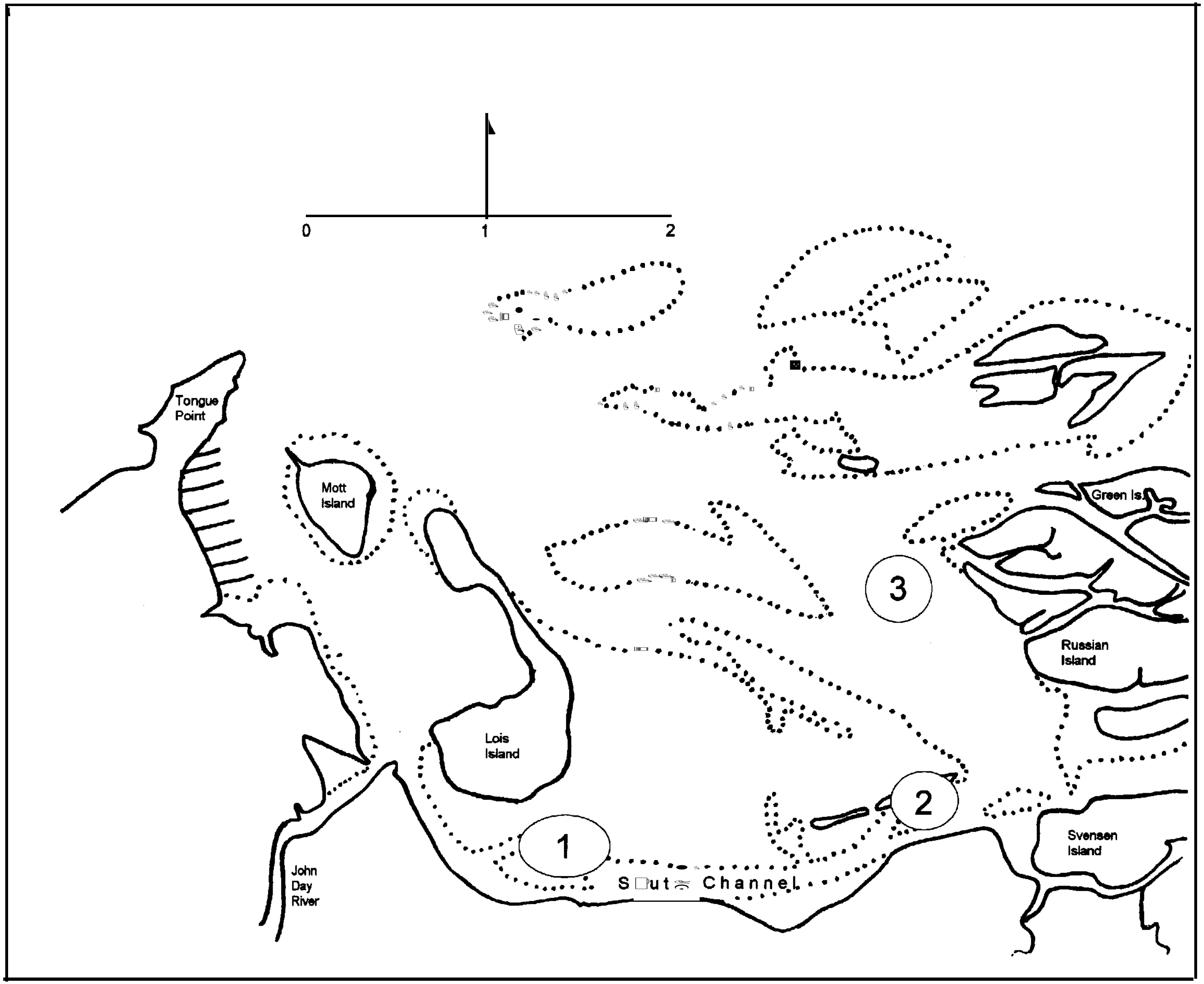

Figure 23. South Channel test fishery drift sites, 1995-96.

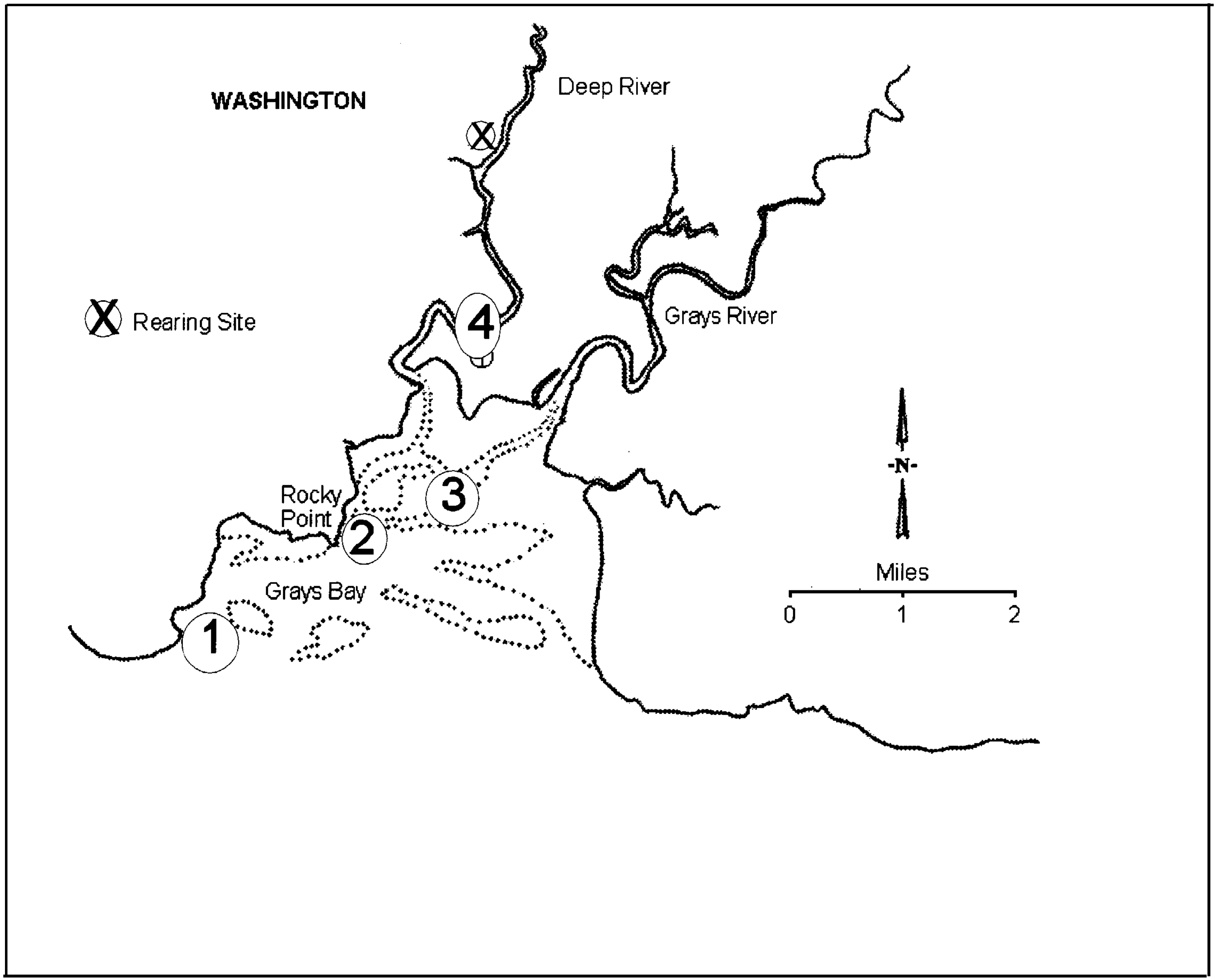

Figure 24 Deep River test fishery drift sites 1995-96

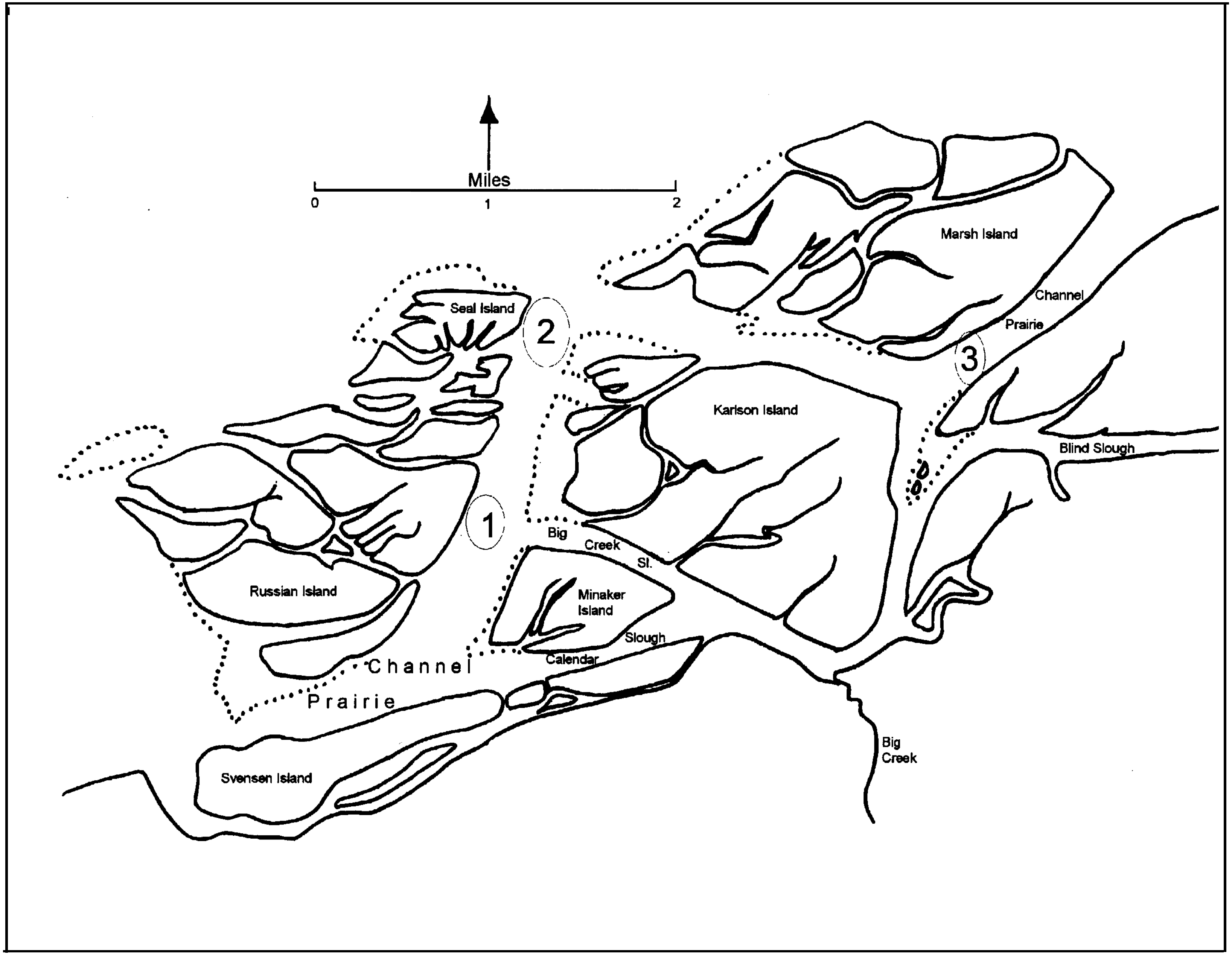

Figure 25 Prairie Channel test fishery drift sites 1995-96

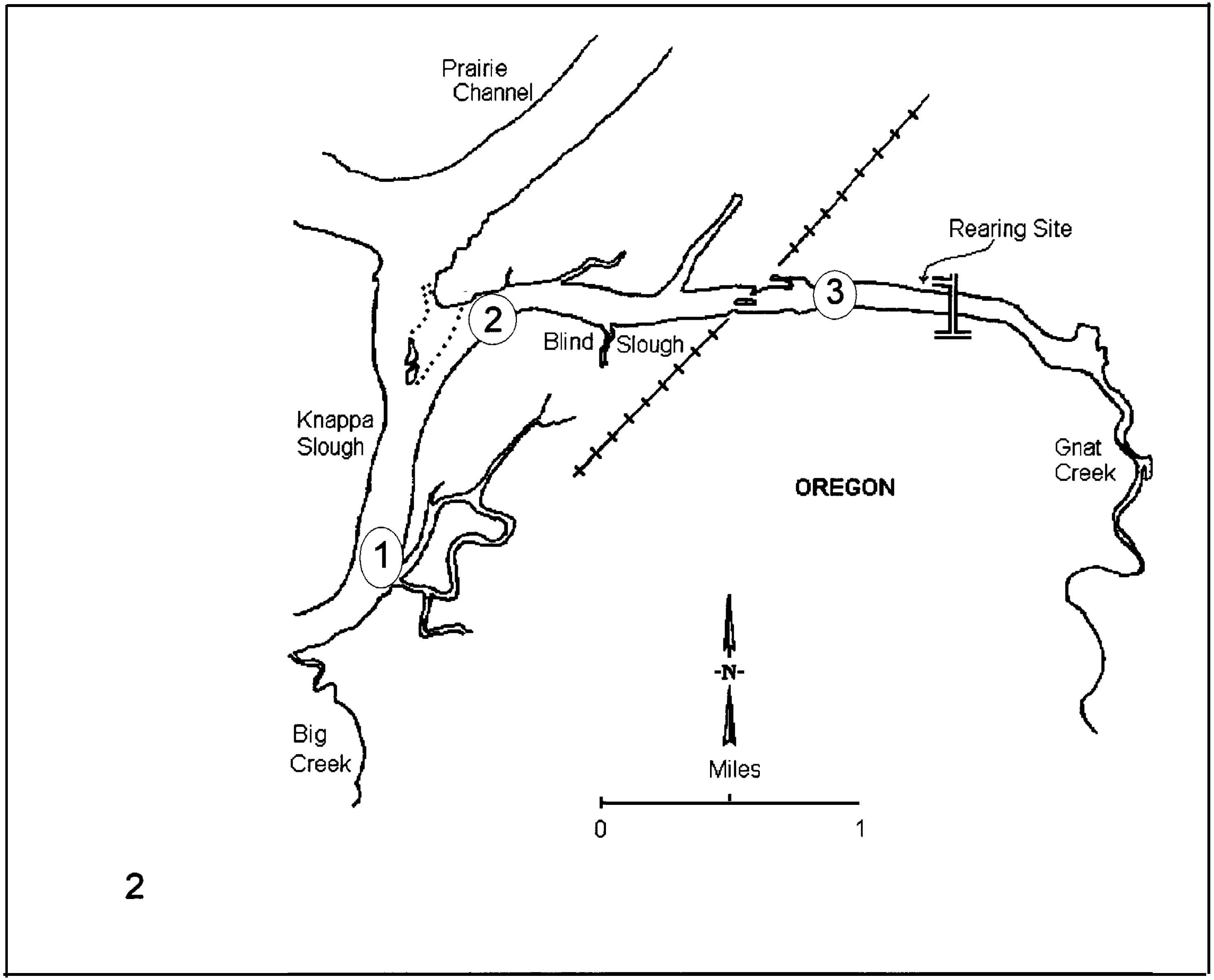

Figure 26 Blind Slough test fishery drift sites, 1995-96.

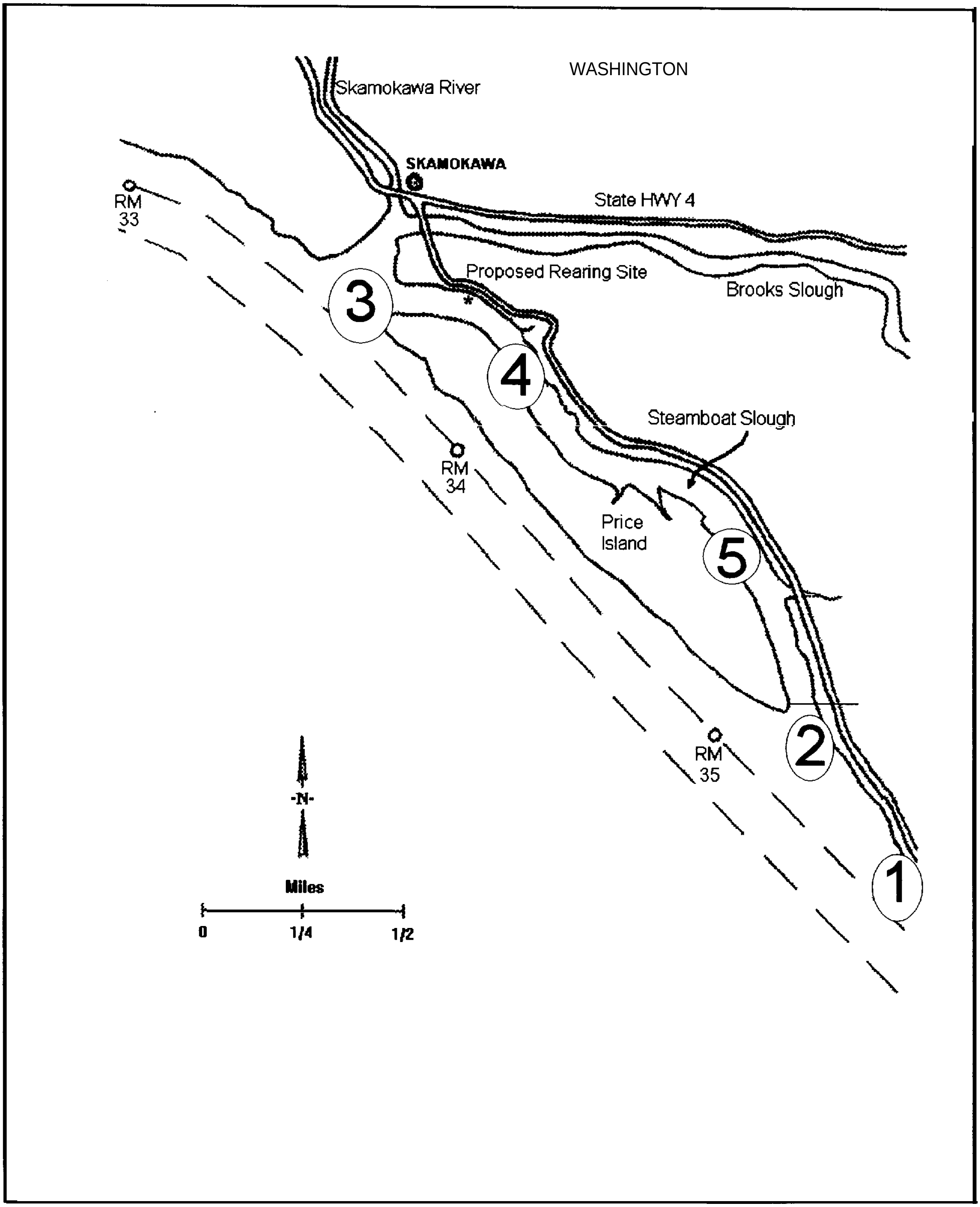

Figure 27. Steamboat Slough test fishery drift sites, 1995-96.

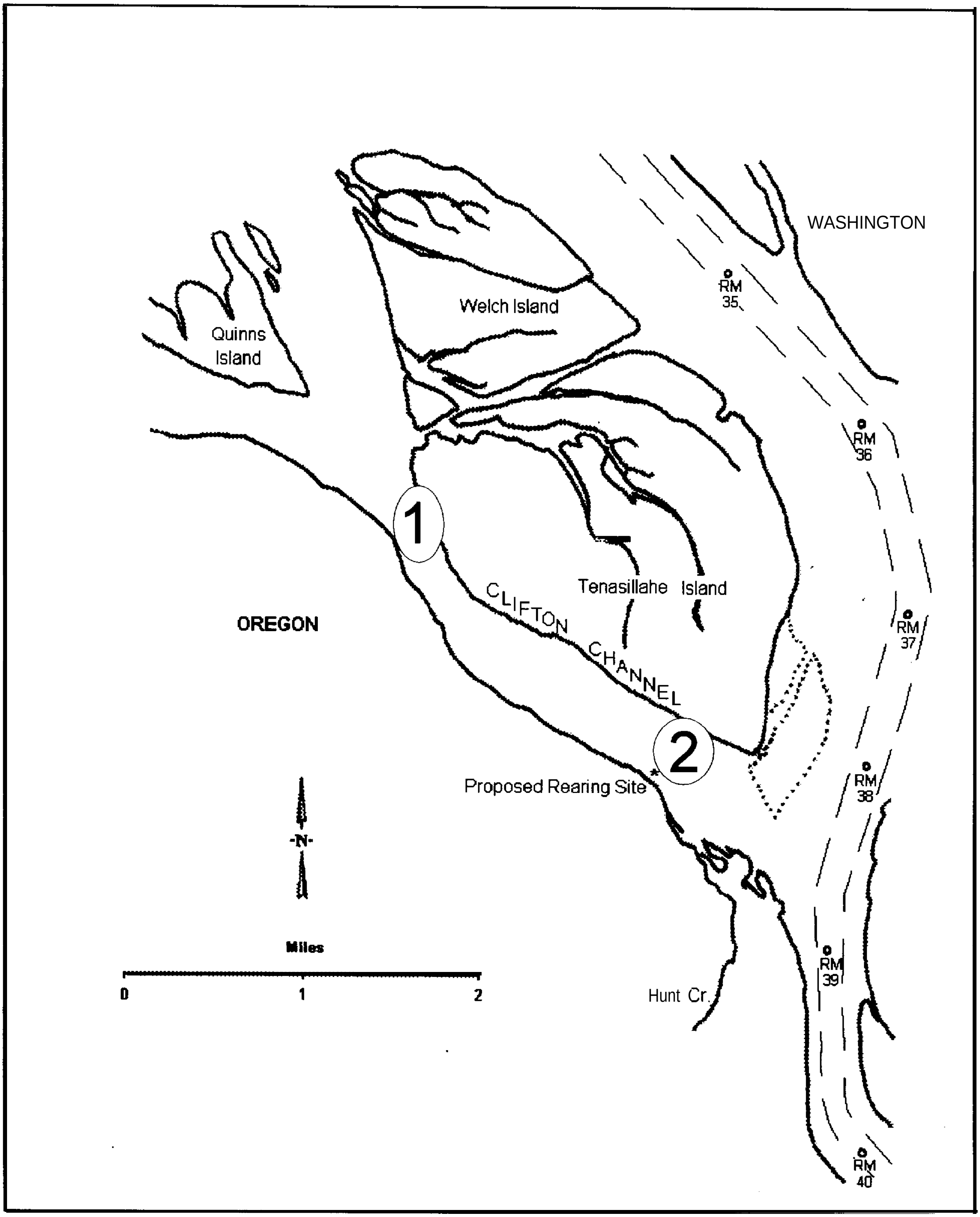

Figure 28. Clifton Channel test fishery drift sites, 1995-96.

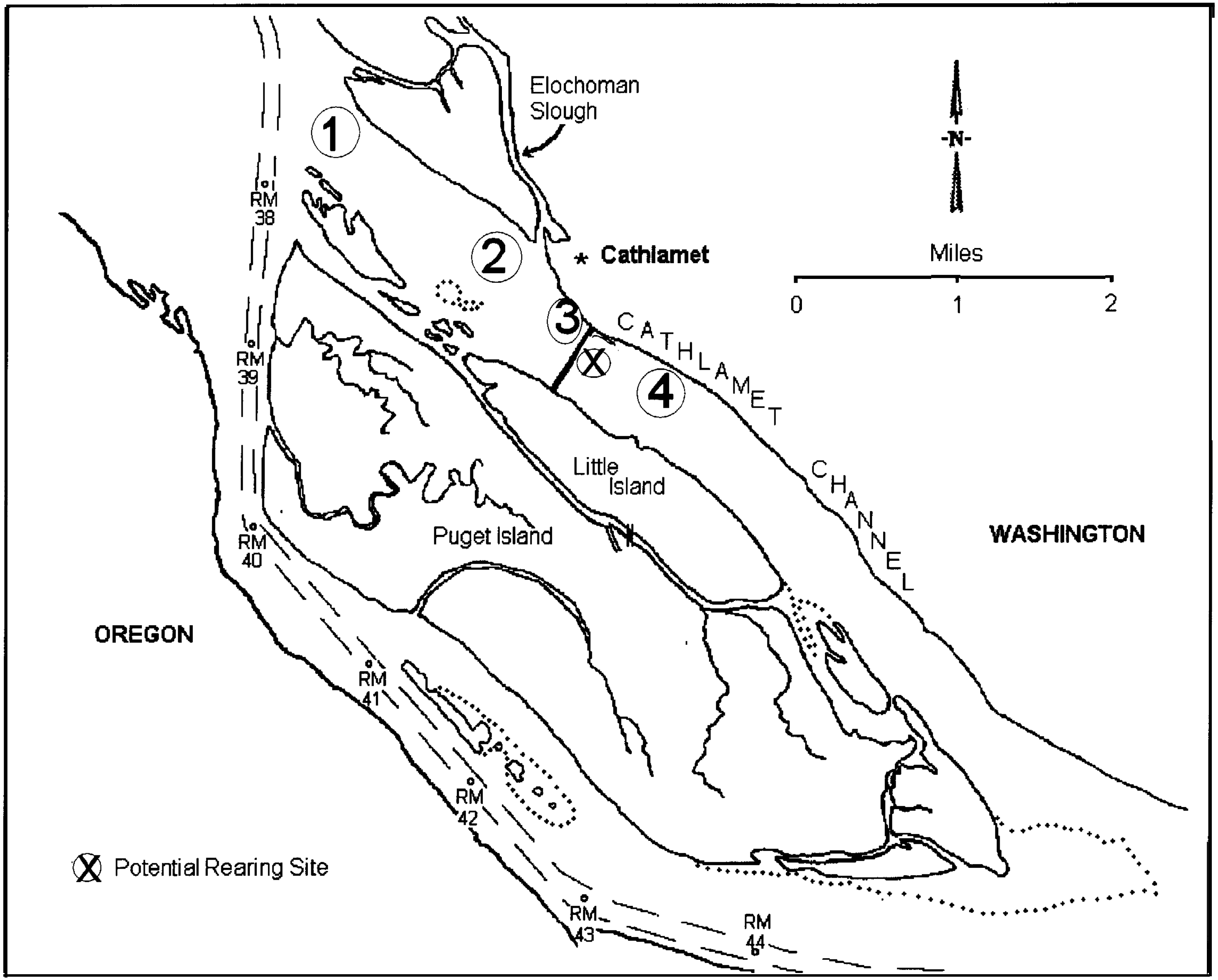

Figure 29 Cathlamet Channel test fishery drift sites, 1995-96.

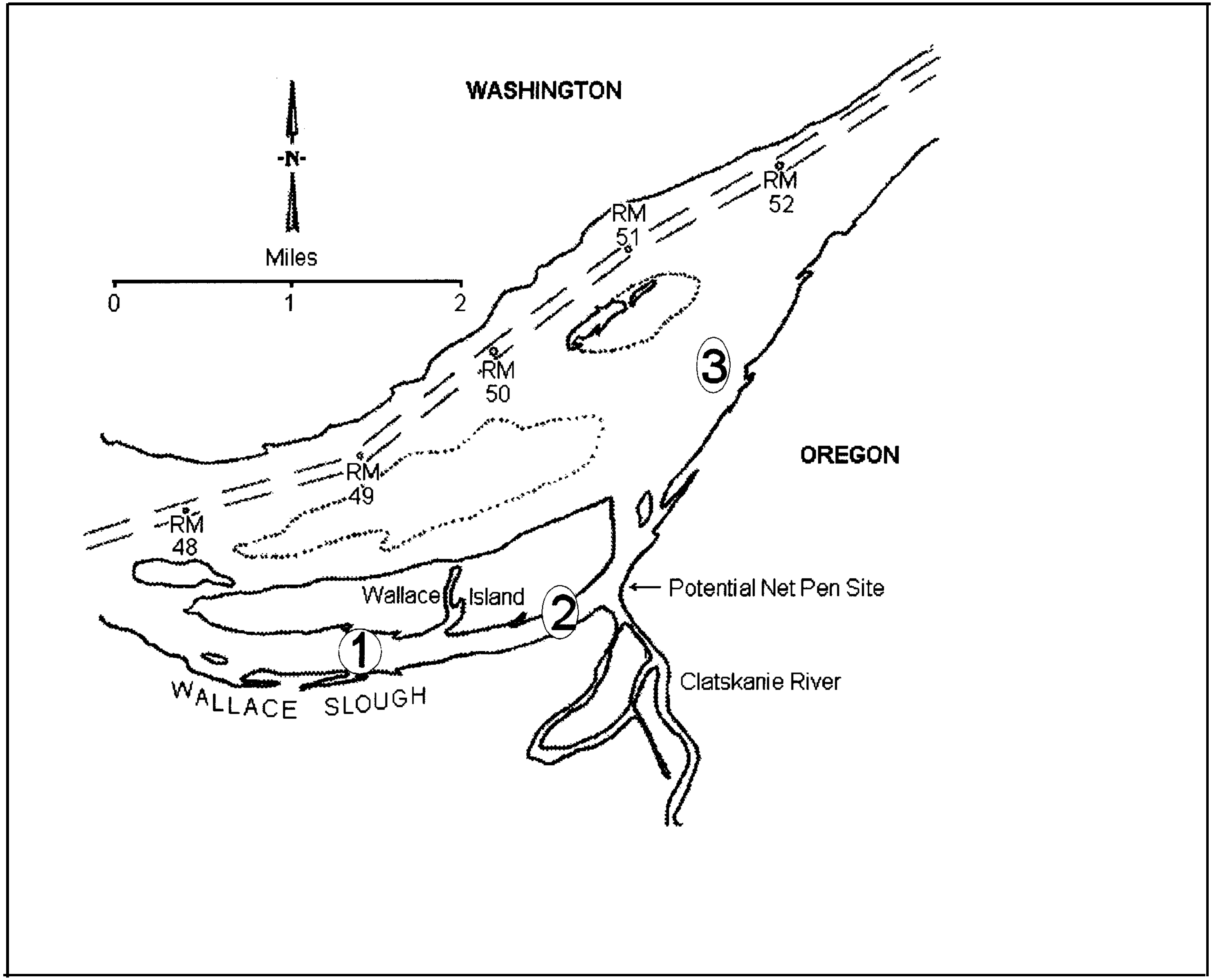

Figure 30 Wallace Slough test fishery drift sites 1995-96

E. Initiation and Evaluation of Commercial and Recreational Select Area Fisheries

INTRODUCTION

The SAFE projects initial return of adult coho occurred in the 1996 fall season. Seasons were established for commercial and sport fishers in the new select area fishery sites in Oregon at Tongue Point Basin and Blind Slough and in Washington at Deep River (Figure 31). In Youngs Bay, Oregon, fall fishing seasons have been established annually since 1963. The initial step in the process of season setting for 1996 select area fall fisheries was scheduling a public informational meeting to present 1996 fall salmon return expectations and solicit public involvement in sport and commercial season planning. On June 10, 1996, a public meeting was held in Astoria, Oregon, and attended by 30 interested public, primarily commercial industry representatives and local media in attendance.

The following sections in this chapter will cover the season setting process, season recommendations, results of the fisheries, analysis of the survival rates and catch distribution of each release group, and evaluation of 1996 fall select area fisheries. Finally a conclusions section will delineate the successes of the 1996 fall select area fisheries and recommend directions for the future.

Season Setting Process

Following the June 10, 1996 public meeting, a joint staff report was completed and included specific recommendations for commercial and sport fishing (Joint Staff, July 22, 1996).

The joint staff report was distributed several days prior to the Compact and joint state meeting on August 8, 1996 at ODFW headquarters in Portland, Oregon. The select area fisheries considered for 1996 included Youngs Bay, Big Creek, Tongue Point, and Blind Slough in Oregon and Deep River, Washington (Figures 32-35). In the past, seasons in Youngs Bay and Big Creek have been established; however, for Tongue Point, Blind Slough, and Deep River first-ever seasons were recommended. Since the Big Creek fishery was not a coho directed fishery, it will be excluded from further discussion.

Impacts on federally listed species were addressed in the “Biological Assessment of the Impacts of Anticipated 1996-98 Fall Season Columbia River Mainstem and Tributary Fisheries on Snake River Salmon Species Listed Under the Endangered Species Act” authored by U.S. v. Oregon Technical Advisory Committee.

Season Recommendations

I. YOUNGS BAY

A. Commercial season:

Noon, Aug 12 - 6 PM Aug 14	(2 days)
Noon, Aug 19 - 6 PM Aug 21	(2 days)
Noon, Aug 26 - 6 PM Aug 29	(3 days)
Noon, Sep 3 - 6 PM Sep 6	(3 days)
Noon, Sep 9 - 6 PM Oct 31	(52 days)
	62 days

- Early opener to optimize harvest opportunity for local chinook stocks.

- Weekend closures minimize interception of nonlocal salmon and steelhead stocks.

B. Commercial area (Figure 32):

- Same as last year except:

1. Change lower deadline to the Hwy. 101 bridge (previously, an imaginary line 150' above Hwy. 101 bridge). Gear in contact with the bridge is illegal.

2. Change Lewis and Clark River deadline up to the alternate Hwy. 101 bridge (previously a line through Buoy 11 easterly and westerly to markers on the bank). Early stock who in the Lewis and Clark River are not a conservation concern.

3. In-season consideration to move the existing upper deadline at Battle Creek Slough to the confluence of the Klaskanine and Youngs rivers.

- Liberalizing the fishing deadlines will not adversely impact other salmonid populations in Youngs Bay.

- Escapement needs at ODFW Klaskanine Hatchery will dictate change in upper deadline location.

C. Commercial gear:

- No changes proposed.

D. Other commercial restrictions:

- Same fish transportation rules as 1995.

E. Sport Fishery:

- Commercial closed fishing periods provide for weekend recreational opportunity through the Labor Day weekend.

- Additional sport opportunity during peak abundance of salmon through 2nd week in September.

II. NEW SELECT AREAS (Tongue Point, Blind Slough, and Deep River)

A. Commercial seasons:

- Blind Slough and Deep River; each of the following 12-hr fishing periods start at 7 PM and end at 7 AM

Sep 16 (Mon) - Sep 17 (Tue)
Sep 19 (Thur) - Sep 20 (Fri)
Sep 23 (Mon) - Sep 24 (Tue)
Sep 26 (Thur) - Sep 27 (Fri)
Sep 30 (Mon) - Oct 1 (Tue)
Oct 3 (Thur) - Oct 4 (Fri)
Oct 7 (Mon) - Oct 8 (Tue)
Oct 10 (Thur) - Oct 11 (Fri)
Oct 14)(Mon) - Oct 15 (Tue)
Oct 17 (Thur) - Oct 18 (Fri)
Oct 21 (Mon) - Oct 22 (Tue)
Oct 24 (Thur) - Oct 25 (Fri)
Oct 28 (Mon) - Oct 29 (Tue)

Total 13 nights

- Tongue Point Basin; each of the following 12-hr fishing periods start at 7 PM and end at 7 AM

Sep 17 (Tue) - Sep 18 (Wed)
Sep 18 (Wed) - Sep 19 (Thur)
Sep 24 (Tue) - Sep 25 (Wed)
Sep 25 (Wed) - Sep 26 (Thur)
Oct 1 (Tue) - Oct 2 (Wed)
Oct 2 (Wed) - Oct 3 (Thur)
Oct 8 (Tue) - Oct 9 (Wed)
Oct 9 (Wed) - Oct 10 (Thur)
Oct 15 (Tue) - Oct 16 (Wed)
Oct 16 (Wed) - Oct 17 (Thur)
Oct 22 (Tue) - Oct 23 (Wed)
Oct 23 (Wed) - Oct 24 (Thur)
Oct 29 (Tue) - Oct 30 (Wed)
Oct 30 (Wed) - Oct 31 (Thur)

Total 14 nights

- Night fishing will maximize catch and reduce potential interaction with recreational boaters and other river commerce.

- Tongue Point openings during closed periods for Deep River and Blind Slough allows fishers flexibility and maximizes harvest opportunity.

- Weekend closures minimizes interaction with recreational boats.

B. Commercial fishing area:

- Tongue Point Basin (Figure 33) open to fishing in all waters bounded by a line from red light at Tongue Point to flashing green light at the rock jetty on the northwesterly tip of Mott Island, a line from a marker at the south end of Mott Island easterly to a marker on the northwest bank on Lois Island, and a line from a marker on the southwest end of Lois Island due westerly to a marker on the opposite bank. All open waters will be under concurrent jurisdiction.

- Blind Slough (Figure 34) open waters extend from markers at the mouth of Gnat Creek located approximately 1/2 mile upstream of the county road bridge downstream to markers at the mouth of Blind Slough. Concurrent waters extend downstream from the railroad bridge. State waters extend upstream of the railroad bridge.

- Deep River (Figure 35) open to fishing downriver from the town of Deep River to the mouth of Deep River, plus Grays Bay as follows:

  (1) September 16-October 1: All waters of Grays Bay north on a line running east and west through channel marker "8," with markers on the eastern and western shores, and

  (2) October 3-29: All waters of Grays Bay north of a line from a marker on the western shore through channel marker "8," thence east to a new fishery marker, thence northeasterly to a marker at Miller Point.

  Concurrent waters extend downstream of the Highway 4 bridge. State waters extend upstream of the Highway 4 bridge. Area restriction for October 3-29 are recommended for protection of chum destined for Grays River.

C. Gear:

- Tongue Point Basin: Legal gear restricted to a maximum length of 250 fathoms and weight on leadline not to exceed 2 pounds of weight on any 1 fathom. No mesh restriction.

- Blind Slough: Length of net restricted to 50 fathoms, with no weight restrictions on leadline. No mesh restriction.

- Deep River: Same as Blind Slough.

D. Other commercial restrictions:

- Unlawful to transport or possess fish outside of the fishing area, except by licensed buyers.

- Exception to above rule would allow transportation out of fishing area with a permit issued by an authorized agency employee after examining the catch.

E. Sport fishery:

- Tongue Point Basin and that portion of Blind Slough downstream of the railroad bridge are Columbia River waters and scheduled to open August 1 to salmon fishing (season to be established subject to U.S. v. Oregon and ESA consultations).

- Blind Slough upstream of the railroad bridge and Deep River are under permanent state regulations.

  - Blind Slough (listed as Gnat Creek) is presently closed for coho in September. Recommend opening Blind Slough/Gnat Creek to coho from the Aldrich Point Road Bridge downstream to the railroad bridge during September.

  - Deep River is open August 1 -December 31 for salmon as per permanent regulations.

III. SPECIAL CONSIDERATIONS OR RESTRICTIONS

Fall commercial allocation of white sturgeon to select area fisheries is an issue to be determined later by industry following the development of a plan to manage the 1997 and future seasons. The 1996 fall commercial allocation is about 6,800 fish.

- Allow sturgeon catch in Youngs Bay. Expected catch of less than 100.

- Sturgeon not allowed to be sold in new select area fisheries (Tongue Point, Blind Slough, and Deep River), unless the allocation is not expected to be attained by established main-stem and select area fisheries; sales of sturgeon in new select area fisheries should be allowed.

- Sturgeon directed test fishing will be conducted during closed periods at Tongue Point and Deep River using large mesh gear to assess level of abundance.

Results of the Fisheries

The recommended season dates and regulations were adopted by Compact action in concurrent waters and by state action within state waters for all 1996 fall select area fisheries. Combined catches of coho for Youngs Bay, Tongue Point, Blind Slough, and Deep River select area commercial fisheries totaled 22,279 fish (Table 62), which comprised 79% of the total commercial catch (28,210 coho) in the entire Columbia River in 1996. Chinook catch was dominated by fall chinook released from Youngs Bay net pens with minor interceptions of hatchery tule stocks in Tongue Point, Blind Slough, and Deep River fisheries. Only 18 upriver bright stock (URB) fall chinook were caught in the combined fisheries or less than one Snake River wild fall chinook.

Participation in select area fisheries was encouraged by setting season dates in Tongue Point Basin during closed periods for Blind Slough and Deep River and delaying the openings in these areas until after the peak harvest in Youngs Bay. Peak deliveries occurred with 60 deliveries on September 10 at Youngs Bay, 19 deliveries on September 25 at Tongue Point, 14 deliveries on September 27 at Blind Slough, and seven deliveries on September 27 at Deep River. Some fishers were mobile and participated in several select areas fisheries.

Table 62. 1996 Select Area Fall Commercial Season Catches.

Fisheries	Season	Catch in Numbers of Fish			[1]
		Chinook	Coho	Chum	W. Sturgeon
Youngs Bay	Aug 12-Oct 31 (62 days)	1,439	15,783	3	85
Tongue Point[2]	Sep 17-Oct 31 (14 nights)	50	1,955	0	--
Blind Slough	Sep 16-Oct 29 (13 nights)	82	2,301	2	--
Deep River	Sep 16-Oct 29 (13 nights)	3 5	2,240	0	--
Total		1,606	22,279	5	85

1 *Sturgeon* sales ***not*** *allowed in Tongue Point, Blind Slough, and Deep River fisheries and in Youngs* Bay ***after the first*** *week.*

2 *Does not include Tongue Point* Basin *landings while main-stem fisheries were open.*

Value of the catch to the fishers was low due to coastwide depressed market conditions. Coho averaged 62 cents per pound generating $113,000 ex-vessel value for the commercial fleet. Fall chinook landings generated an additional $13,000.

Results of 1993 Brood Coho Studv Groups

Rearing and release of 1993 brood coho is reported in Chapter 4. Returns as adults in 1996 will be reported in this chapter based on recoveries of coded-wire tags (CWT) in fisheries and escapement areas. The CWT recovery data base available through the Pacific States Marine Fisheries Commission was utilized. Mark sampling goals of a minimum 20% for all fisheries are the rule for recovery of CTWs; however, in the new select area fisheries (Tongue Point, Blind Slough, and Deep River) 100% catch sampling was the goal. In Youngs Bay 39% of the coho were sampled and for the new select area fisheries, high sample rates were achieved with 95% at Tongue Point, 96% at Blind Slough, and 93% at Deep River.

Total accountability in 1996 of coho adults resulting from study releases are shown in Figure 36. Adult survival rates ranged from 3.8% for Youngs Bay to 1.6% for Deep River. Total adult production resulting from study releases ranged from 5,308 coho adults for the Youngs Bay release to 2,723 coho adults for the Blind Slough release. Harvest in the areas adjacent to the release location dominated the returns with 80% for Youngs Bay, 85% for Blind Slough, and 78% for Deep River. Only 32% of the coho caught in the

Tongue Point select area were credited to Tongue Point releases; however, an additional 38% were harvested in the Columbia River main-stem seasons, which included the Tongue Point area. Harvest accounted for the entire adult return for the Youngs Bay group and at least 98% for Tongue Point, Blind Slough, and Deep River.

Accountability in escapement areas (hatcheries, spawning grounds, and fish traps) is very low for net-pen released fish, since fish collection facilities do not exist. Instead, the gill-net fleet efficiently captures those fish homing to the site of release. In contrast, 1993 brood coho released from lower Columbia River hatcheries (Klaskanine, Grays River, Big Creek, Eagle Creek, Sandy, and Bonneville) returned at a much higher rate to facilities in 1996 (Figure 37).

Because of severely restricted harvest in ocean and Columbia River main-stem fisheries, a large proportion of the returning adults were accountable at the hatchery, especially at Big Creek, Eagle Creek, Sandy, and Bonneville hatcheries. At Grays River, which is adjacent to Deep River, a few adults were intercepted by the commercial fishery in Deep River, reducing the proportion returning to the hatchery to 62%. At Klaskanine Hatchery a greater portion of the return was intercepted by the Youngs Bay commercial fleet since the hatchery is located on the Klaskanine River, which empties into an arm of the bay. The proportion of returning adults to Klaskanine Hatchery was reduced to 13%.

Comparison of adult survival rates for 1993 brood coho released from select area net pen sites and lower Columbia River hatcheries is displayed in Figure 38. Production releases for early stock coho at Grays River, Klaskanine, Big Creek, Eagle Creek, Sandy, and Bonneville hatcheries produced adult survival rates ranging between 0.2% and 0.9%, while net-pen-released coho ranged between 1.6% to 3.8%. In general net-pen releases survived far better than traditional hatchery releases, but quantifying the survival advantage is difficult due to variables in release size, time, condition, stock, migration distance, and other factors.

Perhaps, the best example showing survival advantages for net-pen releases over traditional hatchery releases for 1993 brood coho is comparison of the Deep River project to Grays River Hatchery (Table 63). Release data is similar for each group, with exception of size at release; Deep River smolts were larger. At both locations the smolts were healthy at release, with no signs of disease. Adult survival for Deep River net-pen releases was three times that observed for Grays River Hatchery.

For net-pen releases, adult survival rates ranged from 3.8% for Youngs Bay to 1.6% for Deep River. Rearing and release conditions were standardized with healthy smolts released at all sites. A pattern of increased survival for the sites nearest the estuary in large bodies of water (Youngs Bay and Tongue Point) appears to be emerging. Both Blind Slough and Deep River net-pen locations are in smaller, quieter bodies of water, further from the main stem of the river and from the estuary. With a longer, more confined migration route, smolts could have been more vulnerable to predators enroute to the estuary. Results for future returns of coho will help to define survival differences between sites.

Table 63. Comparison of 1993 Brood Coho Release Data and Survival as Adults for Deep River Net Pens and Grays River Hatchery.

	Release Data	
	Deep River Net Pens	Grays River Hatchery
Tag Code	63 54 44	63 53 63
Release site	Deep River	Grays River W.F.
Release date	May 11, 1995	May 11, 1995
Number tagged	30,535	29,517
Number unmarked	120,474	206,695
Length (mm)	165	152
Weight (gm)	58.15	41.24
Stock	Grays & Toutle	Toutle
Adult survival (%)	1.8	0.5

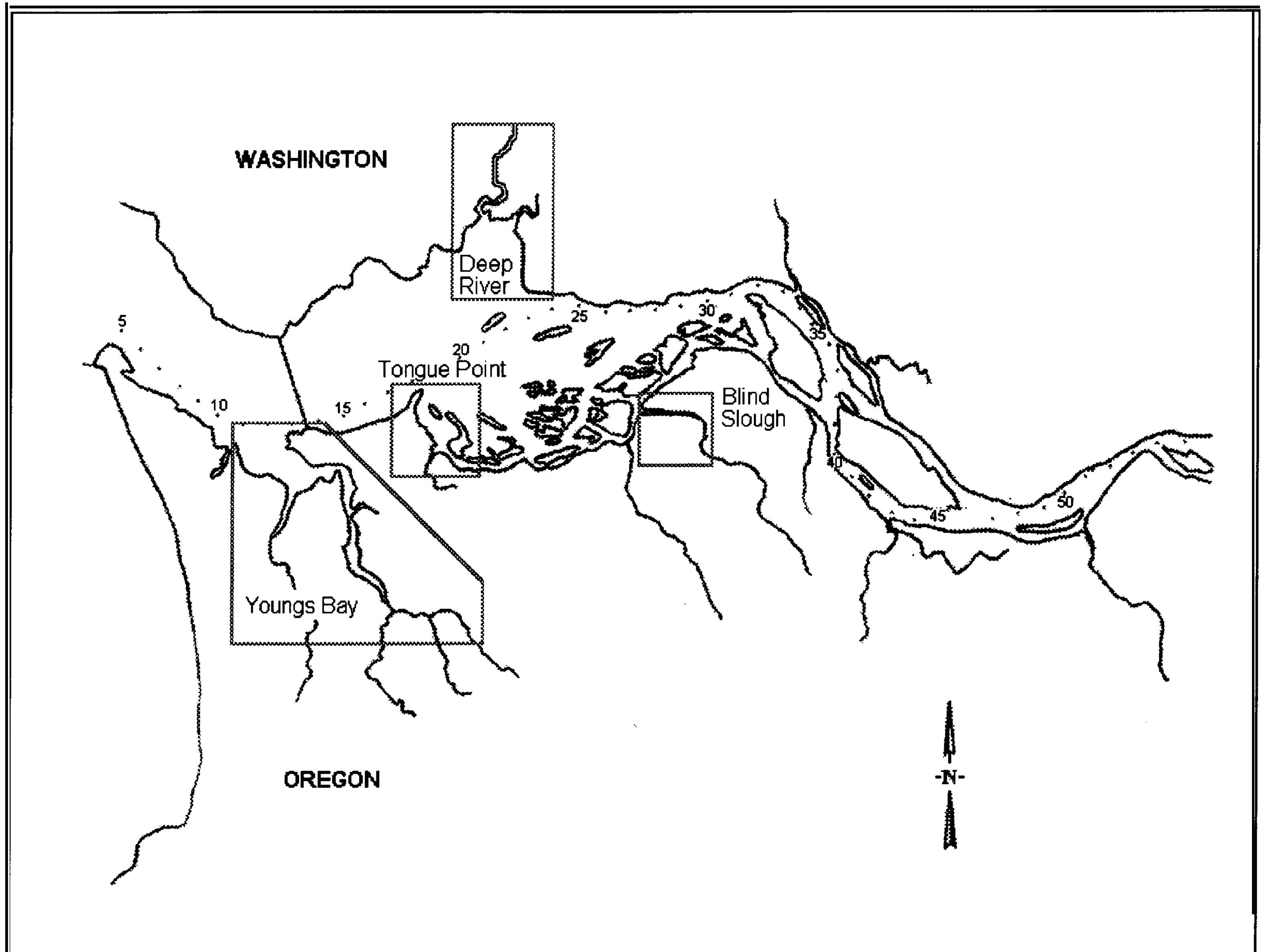

Figure 31 Fall 1996 select area fishery locations

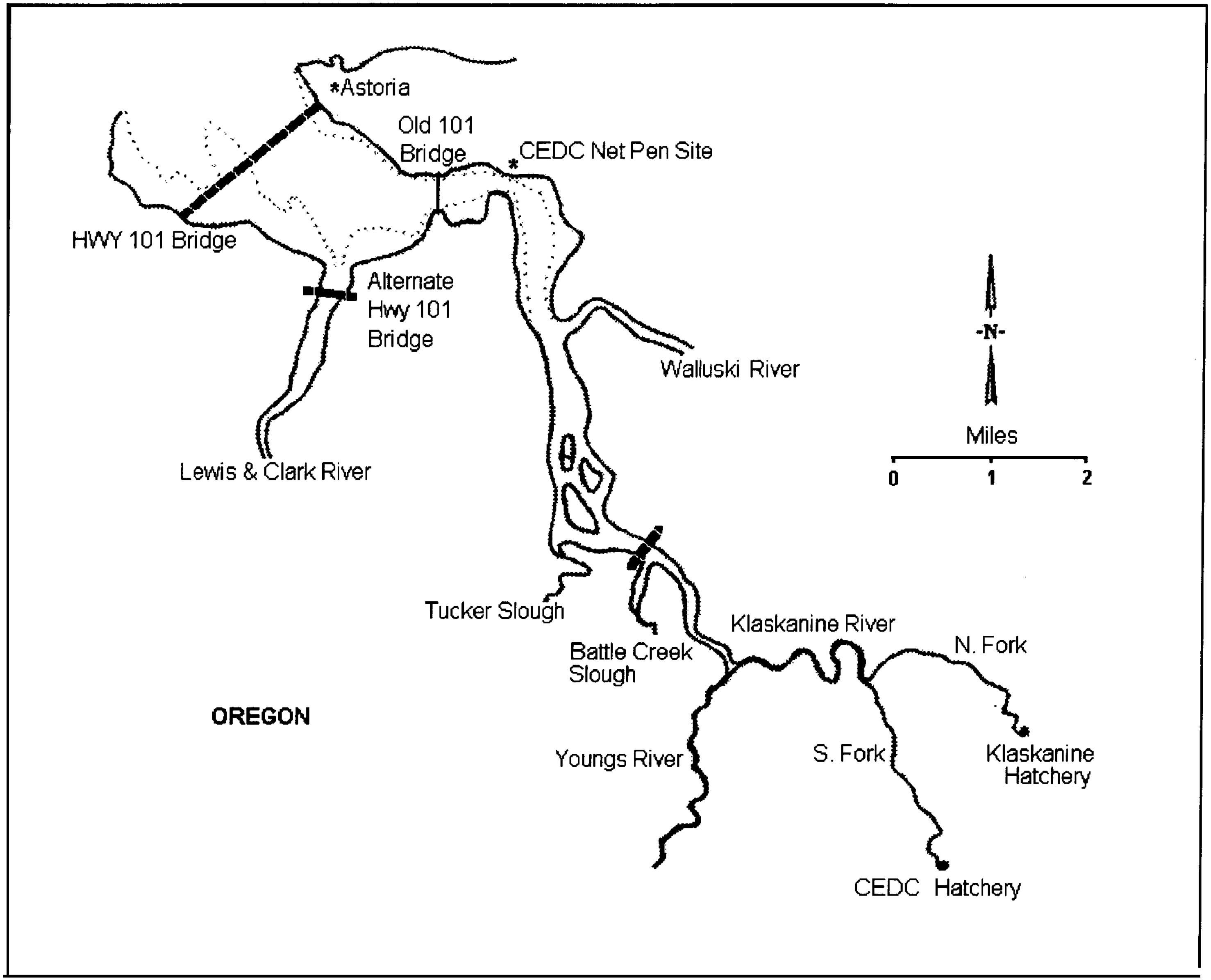

Figure 32 Youngs Bay select fishery arω all 1996

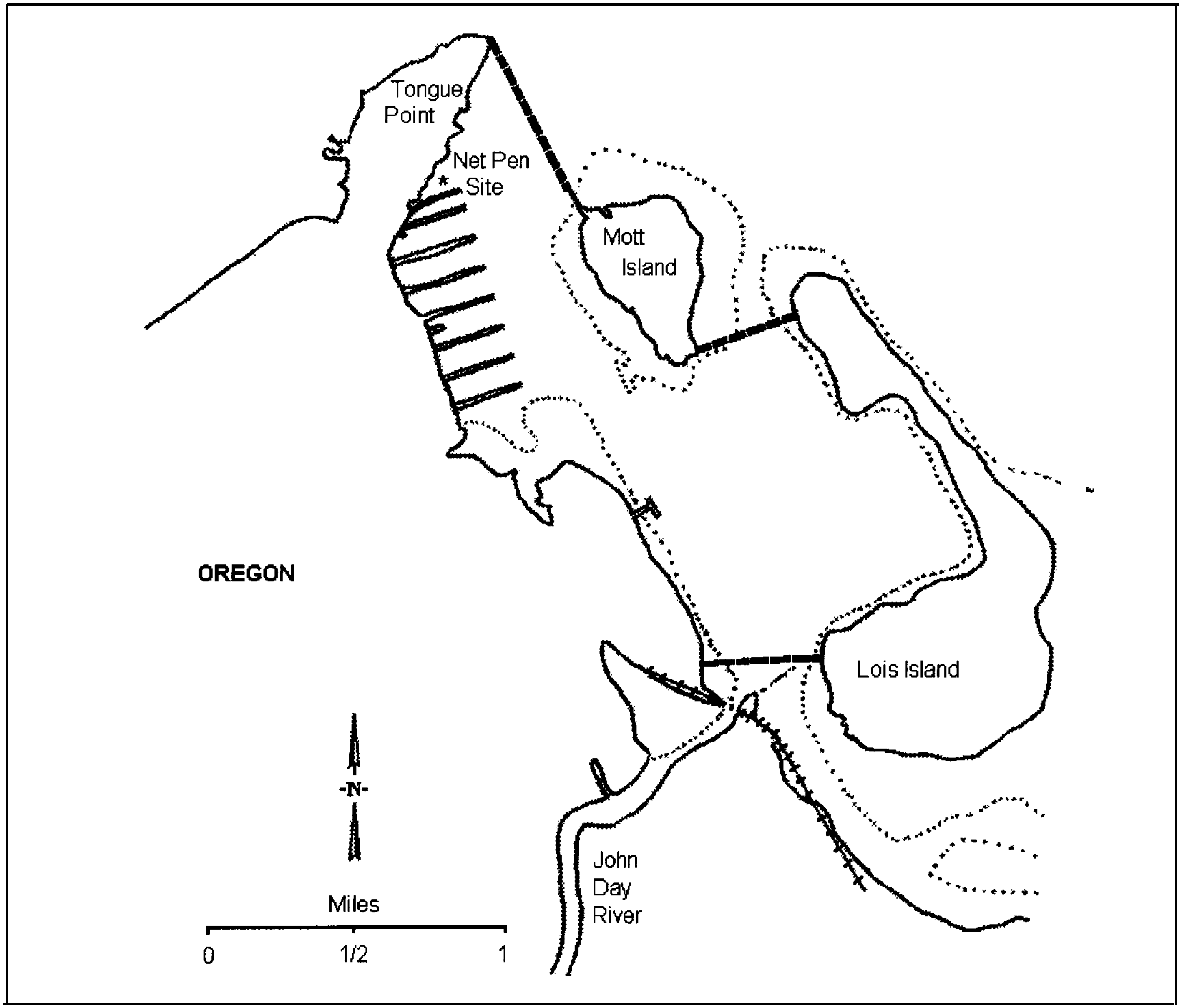

Figure 33. Tongue Point select fishery area, fall 1996.

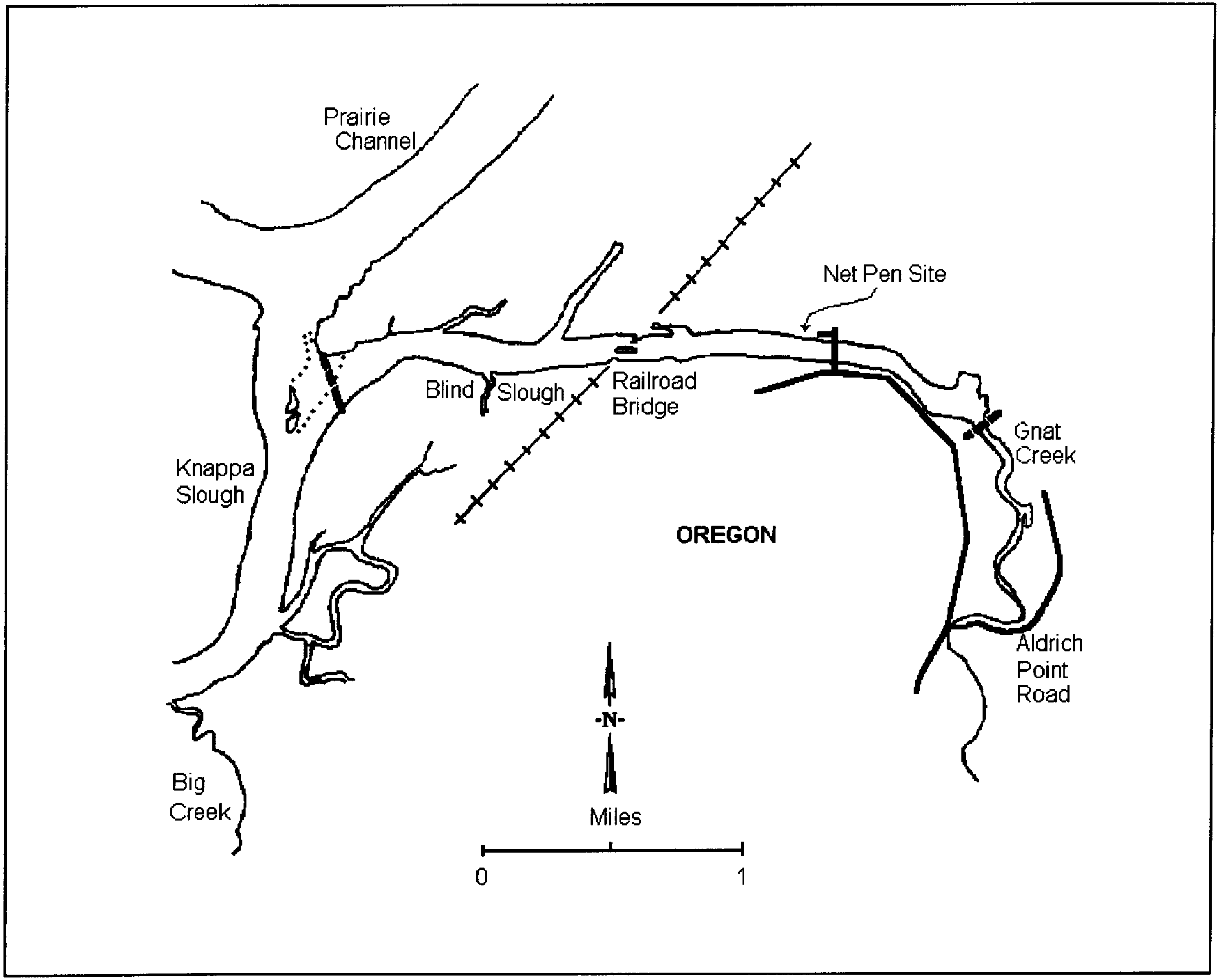

Figure 34. Blind Slough select fishery area, fall 1996.

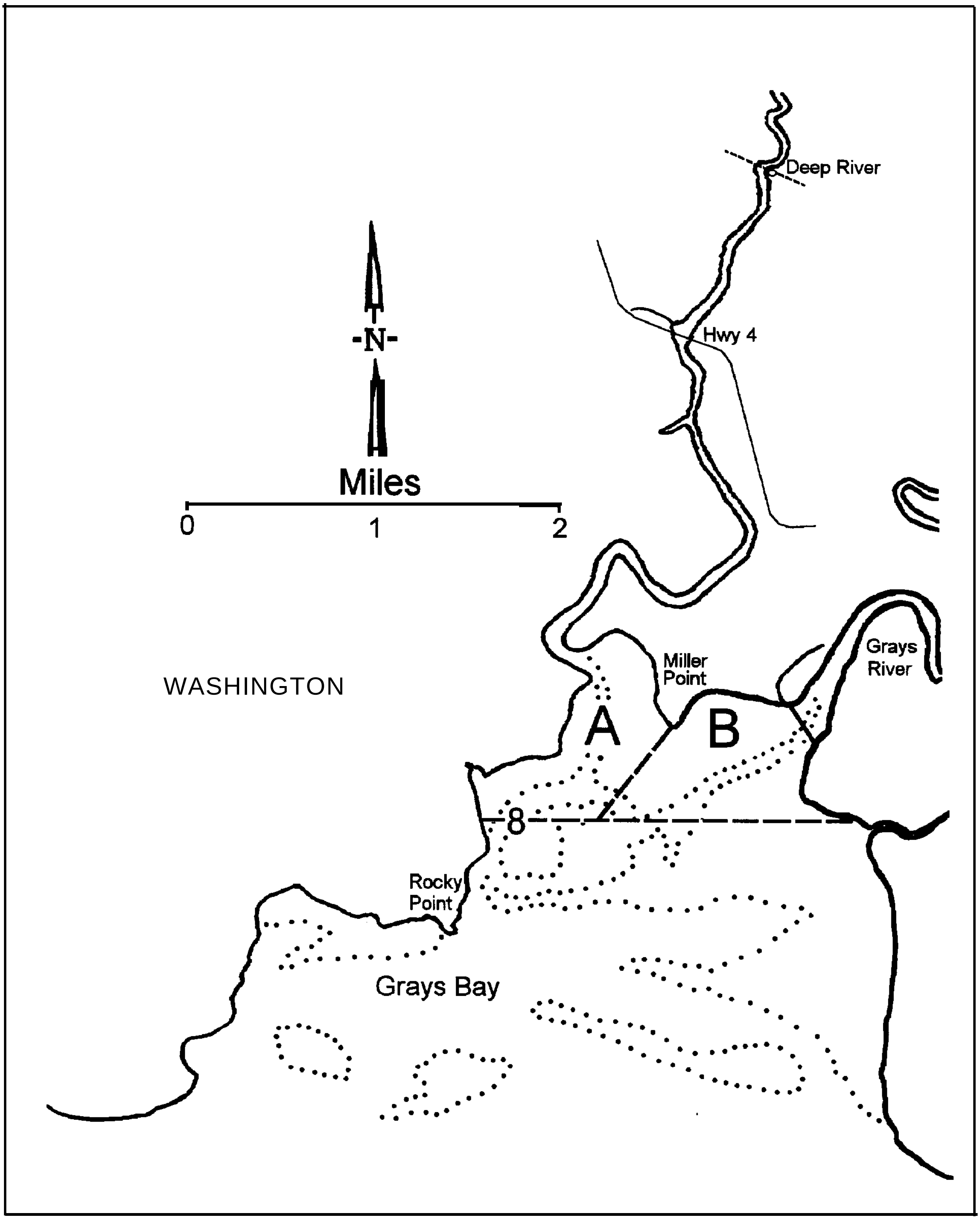

Figure 35. Deep River select fishery area, fall 1996.

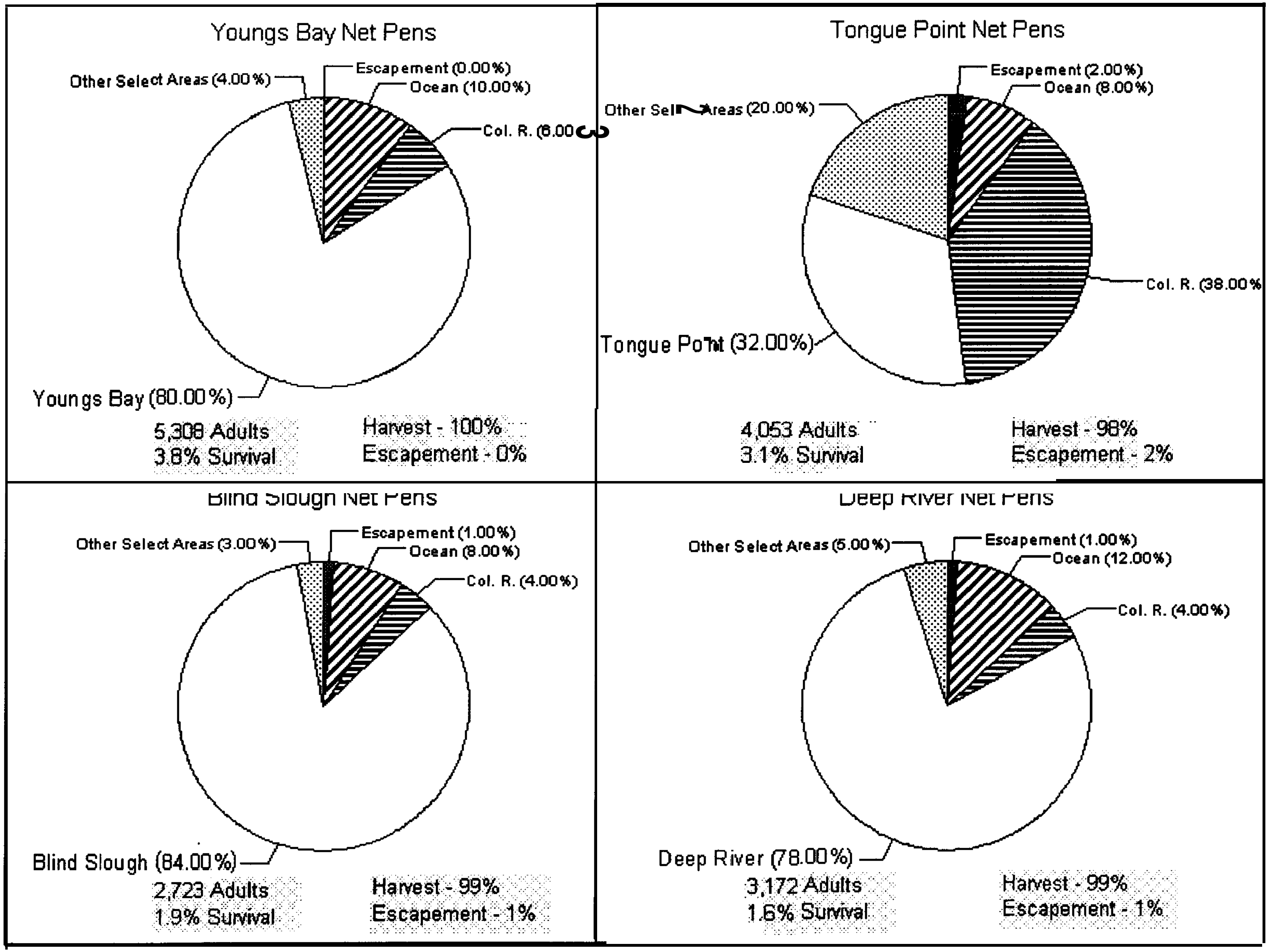

Figure 36. 1996 returns of adult coho resulting from releases at Columbia River select area net-pen sites.

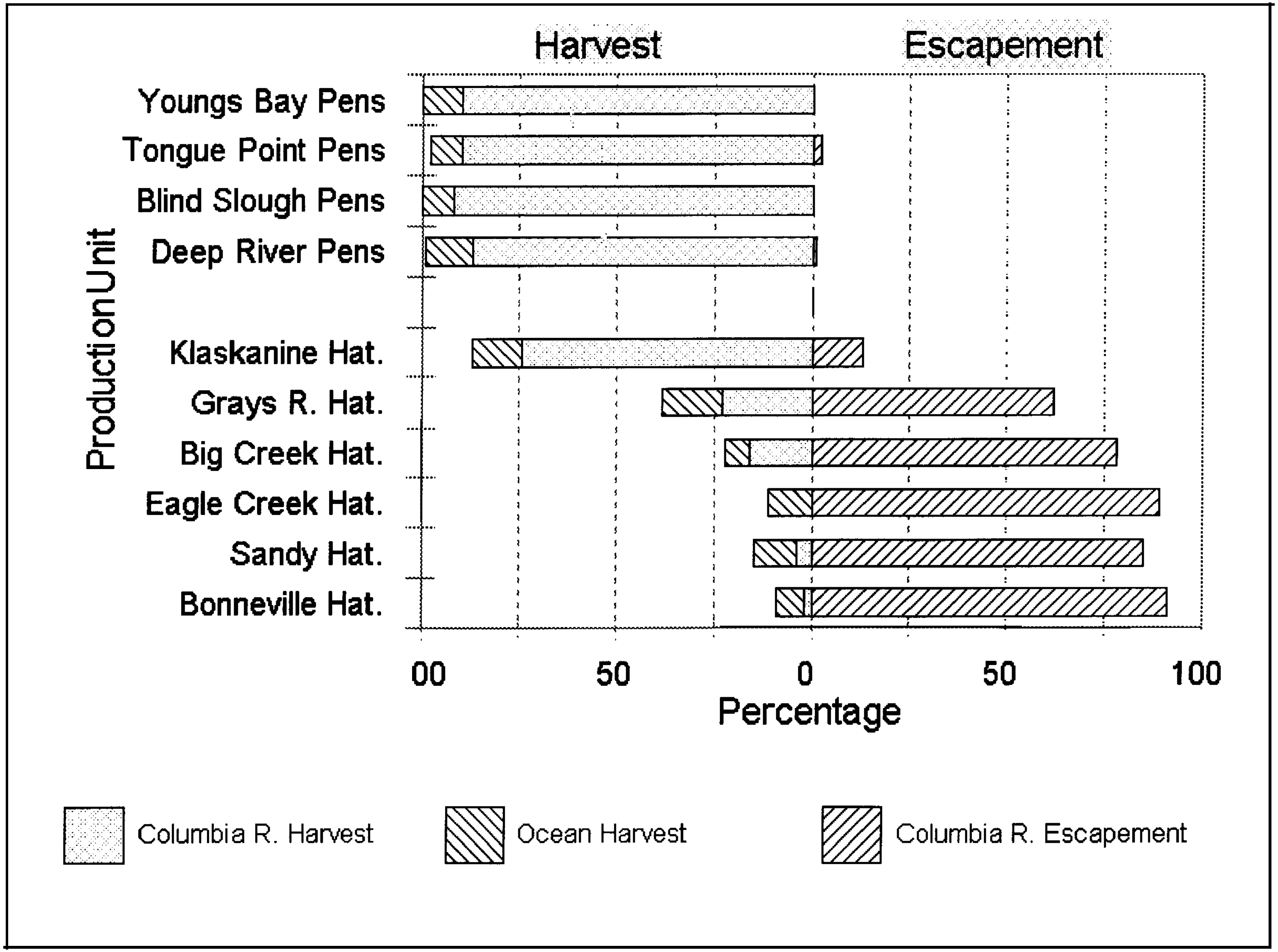

Figure 37. Accoun'ability of 1993 brood coho catch in 1996 harvest and escapement areas for select area net-pen sites and tra-itional lower Columbia River hatcheries.

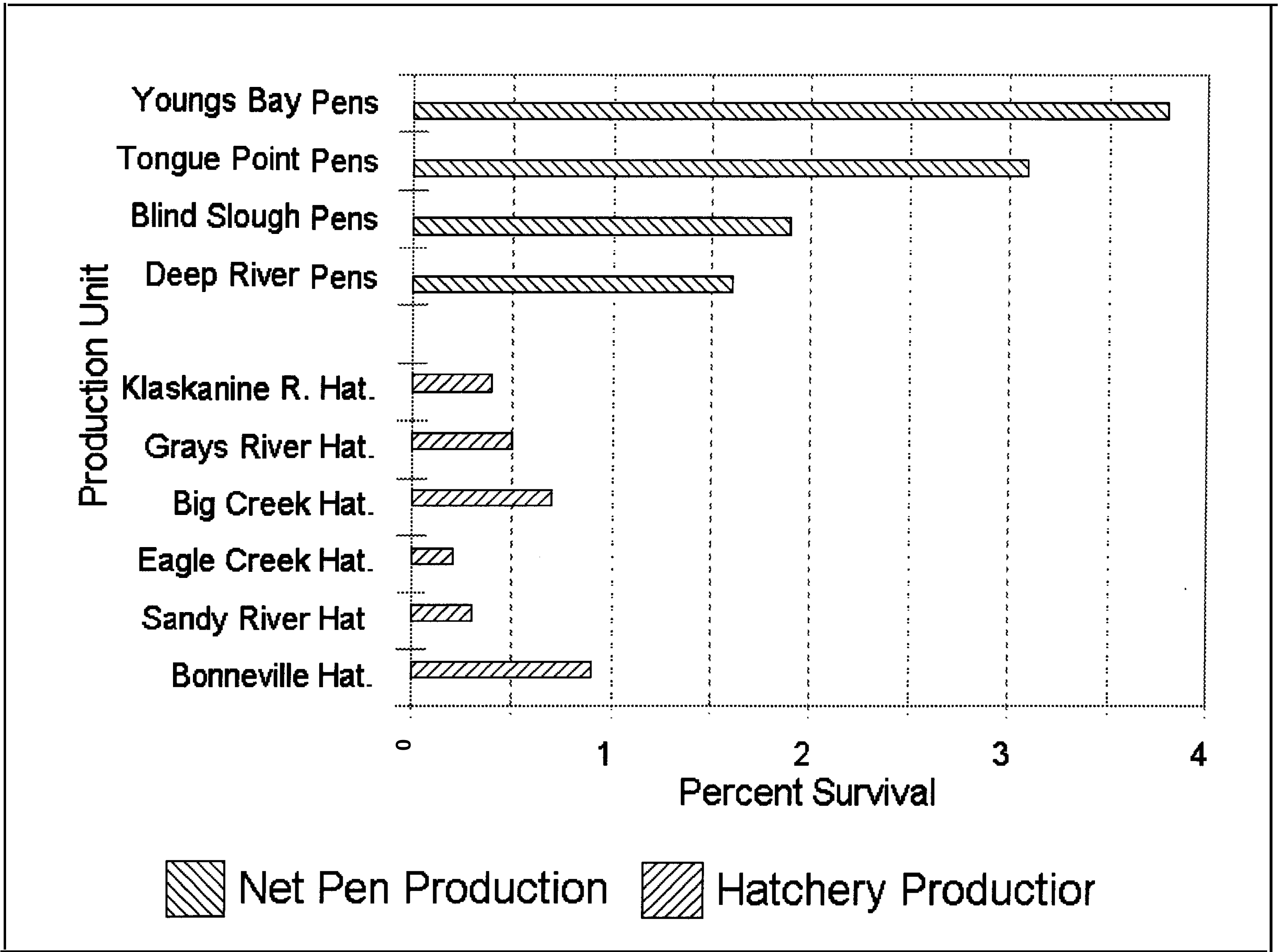

Figure 38. Comparison of adult survival rates for 1993 brood coho released from select area net-pen sites and traditional lower Columbia River hatcheries.

CHAPTER 3. CONSTRUCT NECESSARY FACILITIES TO RESEARCH AND DEVELOP SELECT AREA SALMON FISHERIES AT TONGUE POINT, OR; BLIND SLOUGH, OR; YOUNGS BAY, OR; AND DEEP RIVER, WA.

A lease agreement between the US Department of Labor and the Clatsop County Economic Development Council's Fisheries Project was consummated on April 12, 1995. The lease allows use of one of the piers in the Tongue Point basin to evaluate rearing and release of coho and chinook salmon smolts. Initially 10 pens were secured to the pier with future expansion expected. Pier improvement activities involved local fishermen and made the pier accessible by vehicles. A gate was secured across the end of the pier to control access. Through the Oregon Division of State Lands (DSL), a license was secured to utilize the submerged land associated with the Tongue Point salmon rearing activities. The City of Astoria issued a Conditional Use Permit (CUP 96-04) for the net pens at Tongue Point. A permit from the Department of Environmental Quality (DEQ) is not required until production exceeds 20,000 pounds per year.

At Blind Slough a lease arrangement between Stan and Carol Kahn and the Clatsop County Economic Development Council's Fisheries Project was consummated with expected renewal through the year 2003. The lease allows use of the premises to construct, maintain, and repair approximately 13 fish pens and adjoining walkways; to offload fish; and to raise fish. The arrangement at Blind Slough requires the land owner (Stan and Carol Kahn) to secure a DSL submerged land lease. A DEQ permit is not required until production exceeds 20,000 pounds per year. Clatsop County issued a Review Use Permit to secure 12 net pens to a wooden dock, and use is consistent with applicable goals, policies, and zoning ordinance standards for Clatsop County.

In Youngs Bay there are two locations where net pens are secured, and all associated land use and submerged land issues have been satisfied (CUP #86-PC72, ML-9967). At one site Clatsop County is the upland owner and no private/public arrangements needed to be made. At this site DSL issued a submerged land lease for the fish rearing use. At the other location a private individual relinquished his submerged land lease rights to the CEDC Fisheries Project (ML-9325), and this lease expires in the year 2017. Access to this submerged land is granted through adjoining City of Astoria property and the use of the City's pier/walkway. Also in Youngs Bay, DEQ allows production of up to 500,000 pounds of salmon smolts through a Water Pollution Control Facilities Permit (#1 01198).

All of the sites presently being evaluated for select area fisheries in Washington are within Wahkiakum County (Cathlamet), where all local permits were appropriated. The rearing of '94 brood coho in Deep River was at two separate locations, in the lower river at Steve Amala's dock (six pens), and the upper river at Walter Kato's property (six pens). After the first year all pens were moved to the Kato dock. Five pile were driven at the Kato dock to better anchor the dock structure and secure the net pens. For the first two years of rearing there were no formal leases with these landowners.

CHAPTER 4. EVALUATE SUITABILITY OF VARIOUS AVAILABLE ANADROMOUS FISH STOCKS FOR USE IN SELECT AREA FISHING SITES

Previous evaluation of biological characteristics, economic considerations, ecological impacts, political issues, and allocation issues resulted in a list of potential stocks for use in lower Columbia River select area fishery sites. From that list Columbia River early stock coho, Rogue River stock fall chinook (select area brights; SABs) and Willamette River stock spring chinook were selected to further evaluate the potential of various stocks at the Youngs Bay, Tongue Point, Blind Slough, and Deep River sites.

1993 Brood Spring Chinook

Beginning with the 1993 brood, the evaluation of the effects of over-winter rearing of Willamette stock spring chinook was initiated. Approximately 500,000 fingerlings were transferred from ODFW's McKenzie hatchery to the Youngs Bay net-pen site and CEDC's South Fork Klaskanine (SFK) facility.

Table 64. Releases of 1993 brood Willamette stock spring chinook from lower Columbia select area fishery sites.

Release Date	Release Site	Release #	No. of CWTs	Tag Code	Release Size (Fish/lb.)
2/07/95	SFK Facility	86,978	51,829	070351	14.4
2/09/95	Youngs Bay	79,336	39,519	070345	12.1
3/07/95	Youngs Bay	156,519	52,446	070343	8.1
3/30/95	Youngs Bay	127,367	52,224	070344	7.4

The fingerlings were transferred the first week of November 1994 with about 88,000 ponded at the South Fork site, and about 412,000 in pens in Youngs Bay. The fish were 25 fish/lb at time of transfer. The Youngs Bay fish were ponded into three separate groups representing three different release times. The goal was to release each group at the same size but at different times (Feb 1, Mar 1, and April 1) to **determine the optimum time of release from the Youngs Bay estuarine environment.** The group reared at the South Fork site was for a typical freshwater site comparison. The fish were fed a Biodry feed ration at levels to attain the same size at release (8 fish/lb). The February release group was fed at a satiation level while the March and April groups were fed at a reduced level. Even with a maximum feed ration, the February release group did not attain 8 fish/lb. The March and April release groups reached the release size goal; 8.1 and 7.4 fish/lb respectively. Minimal mortality was experienced during the rearing period at both sites and the pre-release pathological exam resulted in 'no disease found'. Both groups looked good upon release.

1994 Brood Spring Chinook

To evaluate the effects of overwinter rearing of Willamette stock spring chinook in Blind Slough and Tongue Point, and compare to Youngs Bay, approximately 925,000 1994 brood eggs were taken at ODFW's McKenzie hatchery and reared to 25 fish/pound. During the week of October 31, 1995 through November 3, 1995 approximately 841,000 fingerlings were transferred to the three sites. Blind Slough received 199,616; Tongue Point 242,758; and Youngs Bay 398,633. Also, 76,900 fish were transferred to the SFK facility. In Youngs Bay the fingerlings were divided into three groups; each identified with a unique coded-wire tag code. The strategy was to rear each group to the same release size (target size of 8 fish/pound) and release at three different times (February 1, March 1, and April 1, 1996). In Blind Slough the strategy was to rear one group of fish with coded-wire tag representation until March 1 and release at 8 fish/pound. At Tongue Point two groups were scheduled to be reared to 8 fish/pound and released on February 1 and March 1; each release group having coded-wire tag representation.

Table 65. Releases of 1994 brood Willamette stock spring chinook from lower Columbia select area fishery sites.

Release Date	Release Site	Release #	No. of CWTs	Tag Code	Release Size (Fish/lb.)
1/31/96	SFK Facility	76,618	52,205	071119	14.7
2/05/96	Tongue Point	100,138	52,119	071238	10.1
2/29/96	Tongue Point	142,181	42,281	071236	10.8
2/29/96	Blind Slough	199,389	52,369	071237	9.9
2/05/96	Youngs Bay	142,976	53,685	071121	11.9
2/29/96	Youngs Bay	133,517	51,909	071122	10.7
3/21/96	Youngs Bay	97,945	41,085	071120	10.0

During the rearing period minimal mortality was observed, however, pre-release pathological exams revealed kidney disease pustules and acute bacterial kidney disease (BKD). The target release size was not attained and may not be realistically attainable for future broods, but the resultant sizes at each location were fairly close; ranging from 9.9 to 11.9 fish/pound. At Tongue Point and Youngs Bay for the February 29 release the sizes were basically the same; 10.8 and 10.7 fish/pound respectively

(Table 65), and should allow for a good site-to-site comparison upon adult return.

1995 Brood Spring Chinook

The same rearing strategy was employed utilizing 1995 brood Willamette River stock spring chinook. Approximately 950,000 eggs were taken from the Willamette hatchery system and reared at ODFW's Willamette and McKenzie hatcheries. From October 23, 1996 through November 1, 1996, 945,625 fingerlings at about 25 fish/pound were transferred to the Lower Columbia select area sites. Blind Slough received 171,610 fish at 26 fish/pound; Tongue Point 302,260 at 25 fish/pound and the Youngs Bay pens 392,600 at 25 fish/pound. Also, 79,150 were transferred to the South Fork Klaskanine facility. In Youngs Bay the fingerlings were divided into four groups; each identified with a unique coded-wire tag code. Three groups were to be reared to the same size (target size of 12 fish/pound) and released at three different times (February 1, March 1, and April 1, 1997). The fourth group, in collaboration with Walt Dickhoff and the National Marine Fisheries Service (NMFS), was put on a winter dormancy feeding regime. Scheduled release was April 1 with minimal feeding during December and January, and beginning in mid-February until release, a satiation ration was fed. The goal was to simulate a more natural winter situation and also simulate the springtime voracious feeding activity associated with the warming water conditions. At Tongue Point two groups each uniquely identified with coded-wire tags were scheduled to be reared to 12 fish/pound; one group to be released on March 1, and one to be released April 1, 1997. In Blind Slough one group would be reared to 12 fish/pound and released March 1, 1997.

Table 66. Releases of 1995 brood Willamette stock spring chinook from lower Columbia select area fishery sites.

Release Date	Release Site	Release #	No. of CWTs	Tag Code	Release Size (Fish/lb.)
2/01/97	Youngs Bay	100,680	49,944	091737	18.1
3/05/97	Youngs Bay	96,540	49,341	091738	15.2
4/04/97	Youngs Bay	95,396	50,208	091739	14.6
4/04/97	Youngs Bay	94,612	50,139	091740	12.7 *
3/04/97	SFK Facility	76,821	25,149	071337	15.9
3/05/97	Blind Slough	171,229	58,002	091716	15.2
3/05/97	Tongue Point	151,905	51,461	091717	16.6
4/04/97	Tongue Point	149,889	50,309	091718	14.6

* NMFS winter dormancy group

During the rearing period, minimal mortality was observed. Pre-release pathological examinations revealed BKD at all sites, with Youngs Bay having the highest level. ELISA exam resulted in 45/48 positive for BKD with 11 fish at the 0.15 level; 19 at 0.2 to 0.8 level; and 15 at 1 to 2+ level. At Tongue Point 26/60 were positive with 19 at the 0.1 level; 6 at the 0.2 to 0.5 level; and 1 at 1+ level. At Blind Slough 35/60 were positive with 27 at the 0.1 level, and 8 at the 0.2 to 0.4 level. No tests were done on the winter dormancy group in Youngs Bay, however, there were visual signs of BKD incidence as compared to the other Youngs Bay groups.

1994 Brood SAB Fall Chinook

The SAB fall chinook evaluation began with the 1994 brood. During the months of November and December 1994, approximately 799,000 eyed eggs were received from ODFW's Big Creek Hatchery and placed in incubators at the SFK facility. Beginning February 9, 1995 fry were ponded in Youngs Bay net pens, and by March 7 a total of about 772,500 fish had been ponded. During the month of May five groups of 50,000 each were coded-wire tagged and all (100%) received a left ventral fin clip. The tagging and clipping operation revealed a small hole in one of the net pens and resulted in a loss of about 199,000 fish. The remaining 545,715 were clipped. The release strategies were to release one group at 65 degree water temperature or July 15, whichever came first; one group at 70 degree water temperature or August 1, whichever came first; one group reared at 0.75 Ibs per square foot rearing area and released at 70 degrees or August 1, whichever came first; one group reared at 0.50 pounds per square foot rearing area and released at 70 degrees or August 1, whichever came first; and one reared at 0.25 pounds per square foot rearing area and released at 70 degrees or August 1, whichever came first. These rearing densities were expected at time of release using an expected fish size of 13 fish/pound. During the month of May all groups were experiencing mortality loss due to furunculosis and were fed a 16-day treatment of sulfamethazine (Romet 30) in the feed ration. The fish were also routinely vaccinated to prevent potential loss due to vibriosis. No vibriosis losses occurred.

The first group was released on June 27, 1995 when the estuary water temperature reached 65 degrees F. On July 17 the water temperature reached 70 degrees and all other groups were released. The three density study groups were fed the same feed ration; however, the less dense groups grew larger and exceeded the expected 13 fish/pound release size. Actual release densities were slightly different than expected because of the fish size at release being different than 13 fish/pound.

Table 67. Releases of 1994 brood SAB fall chinook from the Youngs Bay select area fishery sites; BPA study.

Release Date	Study Group	Release #	No. of CWTS	Tag Code	Release Size (Fish/lb.)
6/27/95	65 degree or Jul 15	107,892	49,826	070742	18.2
7/l 7/95	70 degree or Aug 1	77,100	49,657	070928	13.6
7/l 7/95	0.25 lbs/cu.ft.density	116,030	43,518	070929	10.9
7/l 7/95	0.56 lbs/cu.ft.density	127,936	44,123	070930	11.8
7/l 7/95	0.66 lbs/cu.ft.density	115,702	42,854	070931	13.8

1995 Brood SAB Fall Chinook

In 1996 the same rearing and release strategy was intended; however, due to a landowner situation and the associated inability to get all five groups coded-wire tagged, the result was fewer study groups. Eyed eggs from the 1995 brood were transferred from ODFVV's Big Creek Hatchery to CEDC's SFK incubation facility. Beginning on January 24, 1996 fry were ponded in Youngs Bay net pens, and by March 11 a total of about 787,500 fry had been ponded. Fin clipping and coded-wire tagging activities began in mid-April, and by May 21 were completed. Unfortunately only two groups of about 50,000 were coded-wire tagged. All the fish including those that were coded-wire tagged, received a left ventral fin clip. The tagging operation also revealed a hole in one of the confinement nets; probably from a boat propellor, that resulted in less fish than expected to be fin-clipped. The two tagged groups were ponded so as to compare the 0.25 and 0.75 pounds per square foot rearing density.

Table 68. Releases of 1995 brood SAB fall chinook from the Youngs Bay select area fishery sites; BPA study.

Release Date	Study Group	Release #	No. of CWTS	Tag Code	Release Size (Fish/lb.)
7/16/96		389,320	LV only		16.3
7/16/96	0.67 lbs/cu.ft.density	154,593	45,148	071341	14.5
7/16/96	0.25 lbs/cu.ft.density	64,679	57,523	071342	13.1

During the rearing period very low loss was experienced. Pre-release pathological examination of the few mortalities revealed 40% had BKD. ELISA results of live, healthy fish at release is not available. All the fish were released when the estuary temperature reached 70 degrees F. As in 1995 the less densely reared fish attained a larger size while being fed the same ration. Depending on water temperature, each group was fed the same percentage of body weight/day.

1993 Brood Coho

Beginning with the 1993 brood, evaluation of effects of various rearing regimes of lower Columbia early stock coho on survival and contribution to fisheries was initiated. During the month of March 1995 approximately 411,000 coho fingerlings were transferred from ODFW's Oxbow hatchery to the three Oregon select area sites; Blind Slough, Tongue Point, and Youngs Bay. The fish were distributed to the three sites with Blind Slough receiving about 141,000; Tongue Point about 131,000; and Youngs Bay approximately 139,000. At Deep River (Washington) approximately 201,000 Lewis River early coho were reared in two groups. About 50,000 Toutle River stock were transferred from Grays River Hatchery in February as part of a cooperative agreement between the Lower Columbia Fish Enhancement Group and WDFW, with an additional 151,000 being transferred from Lewis River Hatchery on 24 March for SAFE. Each of these groups contained a representative group of coded-wire tagged fish.

Table 69. Releases of 1993 brood lower Columbia early stock coho from lower Columbia select area fishery sites, BPA study groups.

Release Date	Release Site	Release #	No. of CWTs	Tag Code	Release Size (Fish/lb.)
5/11/95	Youngs Bay	138,371	28,995	071544	7.8
5/12/95	Blind Slough	140,267	26,258	071545	8.9
5/12/95	Tongue Point	130,623	26,426	075329	8.7
5/12/95	Deep River	201,009	30,535	635444	8.1

A pathological exam before transfer showed no visual signs of BKD, however, the fish were held in ponds below other fish where BKD was present. During the rearing period very minimal mortality was experienced and the fish were released on May 11 and 12, 1995. Release size ranged from 7.8 to 8.9 fish/pound.

1994 Brood Coho

Utilizing the 1994 brood from Eagle Creek Hatchery, approximately 622,000 coho fingerlings were transferred to the three Oregon select area sites. Beginning March 5, 1996 approximately 212,000 fingerlings were put in Blind Slough net pens; about 218,000 in Youngs Bay pens; and about 192,000 in Tongue Point pens. In Washington approximately 199,,800 coho (19.0/lb) were transferred to pens from Grays River Hatchery (Toutle River stock) on November 30. Each group was represented by a coded-wire tagged group.

Table 70. Releases of 1994 brood lower Columbia early stock coho from lower Columbia select area fishery sites, BPA study groups.

Release Date	Release Site	Release #	No. of CWTs	Tag Code	Release Size (Fish/lb.)
5/06/96	Blind Slough	209,761	24,942	075901	9.0
5/06/96	Tongue Point	190,032	23,942	071241	8.4
5/07/96	Youngs Bay	216,187	26,274	071222	9.5
5/07/96	Deep River	199,817	28,320	635739	9.7

During the rearing period mortality gradually increased to nearly 100 fish per day at each site. The fish were fed BioDry feed formulation from Bio-Oregon at a satiation level. According to pathologists the low level loss was a mysterious malady that showed no disease symptoms or biological disease agent. Release size ranged from 8.4 to 9.5 fish/pound.

1995 Brood Coho

During the month of November 1996 the third comparative release brood (1995) of coho was transferred from ODFW's Oxbow Hatchery to the Tongue Point, Blind Slough, and Youngs Bay sites. Tongue Point received about 464,000 fingerlings; Blind Slough received about 223,000, and Youngs Bay about 150,000. The fish were received at about 33 fish/pound. Rearing strategy was modified slightly from previous years. Because of cursory indication of slight benthic impacts a feeding regime of every other day, and no feeding on weekends, was employed. Monthly mortality was minimal and the fish continued to grow. During the month of March slight increases in mortality numbers occurred, and beginning the first of April a 3-week treatment of sulfamethazine (Romet 30) in the diet at all three sites was initiated to stop the loss caused by an infection of bacterial hemorhagic septicemia. Also, all groups experienced loss due to BKD. The pre-release pathological exam revealed about 50% were positive for BKD. Prior to release, losses were decreasing, but were still at about 200 fish per day at each site. On May 5, 1997 the fish at each site were released. Approximately 196,963 smolts were released from Blind Slough at 14.4 fish/pound; 430,221 were released from Tongue Point at 13.9 fish/pound, and 146,818 were released from Youngs Bay at 13.2 fish/pound. The fish did not appear very healthy at release. Washington was not able to release '95 brood coho at Deep River due to the unavailability of broodstock. In addition to each group containing a representative coded-wire tagged group, all (100%) of the fish received an adipose clip as part of the coho mass marking directive.

Table 71. Releases of 1995 brood lower Columbia early stock coho from lower Columbia select area fishery sites, BPA study groups.

Release Date	Release Site	Release #	No. of CWTs	Tag Code	Release Size (Fish/lb.)
5/05/97	Blind Slough	196,963	25,104	091818	14.4
5/05/97	Tongue Point	430,221	26,174	071336	13.9
5/05/97	Youngs Bay	146,818	27,198	070942	13.2
	Deep River	0	0	0	0

Chapter 5. Coordination of Activities Between Agencies

The Select Area Fishery Evaluation project has regularly held meetings to coordinate activities between the varying phases of the project and with other agencies and user group contacts. Meetings were held alternatively between sites at ODFW/Clackamas (OR), WDFW/Battle Ground (WA), and CEDC/Astoria (OR). Following is a list of the meetings held:

Date	Subjects Discussed
31 January 1995	Spring rearing plans, water quality sampling, spring test fishing plans, 1994 draft report progress, Youngs Bay spring season.
31 March 1995	Spring rearing progress, spring test fishing plans, fall rearing plans, 1994 draft report progress, Youngs Bay spring season.
26 May 1995	Spring rearing report, spring test fishing progress, 1994 draft report progress and scheduling, 1995 project report planning, Youngs Bay spring season progress.
7 August 1995	Spring test fishing summary, Youngs Bay spring season summary, 1994 draft report review, review of 17 July meeting with Jim Shaklee and Craig Busack, fall rearing plans, 1996 budget plans and needs.
29 September 1995	Fall test fishing progress, Youngs Bay fall season progress, fall rearing plans, 1994 annual report, 1995 progress reports, status of budget and work plan.
29 November 1995	Fall test fishing results, Youngs Bay fall season results, fall rearing plan updates, 1994 annual report, 1995 progress reports, status of budget and work plan.
2 February 1996	Youngs Bay spring season, annual BPA contract, rearing status and release schedule, RRB/Abernathy sample analysis, National Emergency Assistance Program (NEAP) fund availability, Mitchell Act facility status.
5 April 1996	Youngs Bay spring season, annual BPA contract, rearing status and release schedule, annual report writing status, test fishing plans, leases with landowners.
7 June 1996	Contract status, spring select area test fishery results, Youngs Bay fishing report, fall '96 select area fishery plans, spring '96 net-pen releases.

2 August 1996	Fall select area fishery plans, relative modifications in test fisheries, Youngs Bay situation (update), SAB fall chinook reprogramming, schedule for development of 1997 work statement, coastal select area fishery feasibility study.
4 October 1996	Youngs Bay fishery progress, new select area fishery progress, budget issues, next work statement development schedule.
6 December 1996	Youngs Bay fall fishery results, new fall select area fishery results, 1996-97 annual budget and work plan, 1995 brood year rearing plans, 1995-96 annual report schedule.

Included in the list of individuals invited to or attending some or all of these meetings are:

Agency	Individual
BPA	Debbie Docherty, Steve Smith
CEDC	Jim Hill
NMFS	Steve Smith, Bob Smith
ODFW	Paul Hirose, Steve King, Don Mclsaac, Robert Brooks
SFA	Bob Eaton, Francis Clark
WDFW	Marc Miller, Guy Norman, Dennis Austin, Jim Shaklee, Craig Busack, Mark Kaufman

Meetings held on a more irregular basis include meetings with the Astoria-Warrenton Chamber of Commerce Fisheries Committee, public informational meetings prior to season setting, regulatory Compact and staff season setting hearings, and periodic project presentations.

APPENDIX I. COLUMBIA RIVER: SELECT AREA FISHERY EVALUATION PROJECT. 1994-96 GOALS AND OBJECTIVES

PURPOSE: Determine the feasibility of creating or expanding select area, known stock fisheries in the Columbia River basin to allow harvest of strong anadromous salmonid stocks while providing greater protection of depressed fish stocks.

I. Determine suitability of the Deep River, Steamboat Slough, Cathlamet Channel, Tongue Point Basin, Blind Slough, Clifton Channel and Wallace Slough sites for rearing and release of salmon.

- A. Conduct water quality monitoring program for rearing areas for the entire year. Water column parameters, benthic sediment and organisms, and planktonic characteristics to be measured at rearing sites using established schedule.
- B. Continue to collect and analyze homing and straying information from current net-pen programs, select area bright (SAB) fall chinook and lower Columbia River hatchery programs.

II. Determine the potential for the Deep River, Steamboat Slough, Cathlamet Channel, Tongue Point Basin, Blind Slough, Clifton Channel, Wallace Slough, and Prairie Channel sites for harvest of target and non-target fish stocks.

- A. Continue and initiate (Prairie Channel and South Channel) test fishing during spring and fall periods to determine relative abundance and timing through the area of non-target fish stocks.
  1. Obtain NMFS opinion and statement via consultation under the Endangered Species Act.
  2. Contact fishermen, develop schedule, collect CWT and other biological data.
- B. Initiation and evaluation of commercial and recreational select area fisheries.
  1. Develop seasons, monitor fishery, determine harvest and collect biological data.

III. Investigate feasibility of cooperative, manageable sport fishery harvest in select area fishing areas.

- A. Meet with “sports” spokes group to consult on issues, rules, criteria, and conditions regarding fishing in select areas.
- B. Review literature pertinent to sport harvest in select off-channel location.
- C. Determine harvest potential of sport fisheries directed at various target stocks and handle of non-target stocks.
- D. Describe effect of shifting various levels of historic mainstem lower Columbia River sports fisheries to select area sites on upriver runs and other lower river tributary runs.
- E. Re-evaluation of initial list of sites in terms of sport harvest potential.

IV. Evaluate the suitability of various anadromous fish stocks for use in select area fishing sites.

A. Evaluate effects of overwinter rearing of Willamette River stock spring chinook on survival, contribution to fisheries, and straying; ‘93 - ‘95 broods.

B. Evaluate effects of various rearing regimes in Youngs Bay of SAB fall chinook on survival, contribution to fisheries, and straying; ‘94 - ‘96 broods.

C. Evaluate effects of various rearing regimes of early stock lower Columbia coho on survival and contribution to fisheries; ‘93 - ‘96 broods.

D. Evaluate the effects of various rearing regimes for spring chinook on survival and contribution to fisheries; ‘93 - ‘96 broods.

V. Coordinate activities with WDFW, ODFW, CEDC, BPA, NMFS, and SFA.

A. Coordinate all objectives, tasks, and activities undertaken jointly to ensure complementary products and minimal overlap of actions.

B. Co-host bimonthly coordination meetings of involved or interested parties to further develop work plans and report on progress.

C. Promote dialogue and participation in all projects that are affected by select area fisheries development.

VI. Begin construction activities to develop additional research capabilities at select area fishery sites.

A. Undertake initial site preparation and obtain necessary permit approvals.

1. Obtain written agreement with property owners.
2. Construct additional net-pen confinements.

Appendix 2. Raw sample data from 1995 spring test fishery, in numbers of fish and hours fished by species, site, date and time.

							Chinook								
							Lower		Upper		Sthd				
DATE	SITE	DRIFT	NET	LENGTH	Set Time	Hours	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	STGN	SHAD	Comments
427	TP	3	L	177	18.23	0.55							1		
427	TP	2	S	200	19.08	0.69									
427	TP	1	L	177	20.38	0.76		1					97		
504	TP	1	S	200	2.75	0.58									
504	TP	3	L	177	3.75	0.63							1		
504	TP	4	S	200	4.67	0.63									
511	TP	2	L	177	10.50	0.08									
511	TP	2	L	177	10.70	0.69								1	
511	TP	3	S	200	11.75	0.64									
511	TP	4	L	177	12.63	0.68									
518	TP	4	S	200	10.25	0.58							2	1	
518	TP	2	S	200	11.08	0.75									
518	TP	1	L	177	12.08	0.71									
525	TP	4	L	177	21.92	0.63	1						1		
525	TP	1	S	200	22.95	0.68									
525	TP	1	L	177	23.85	0.69							5		
530	TP	3	S	200	9.10	0.74							1	1	Seals in area
530	TP	2	L	177	10.42	0.61									
530	TP	1	S	200	11.27	0.66							1		
425	DR	3	L	120	18.50	1.13							88		
425	DR	2	S	70	20.60	0.40									
425	DR	1	S	70	21.17	0.34					1				
503	DR	4	S	100	2.87	0.58									
503	DR	2	L	120	3.83	0.64							12		
503	DR	1	L	120	4.80	0.65									
509	DR	4	S	100	8.48	0.44									
509	DR	3	S	100	9.40	0.47							2		
509	DR	1	L	125	10.13	0.49									
517	DR	3	L	125	11.77	0.58							8		
517	DR	2	L	125	12.70	0.47							2		
517	DR	1	S	140	13.47	0.42								1	
523	DR	4	L	60	21.67	0.44									
523	DR	3	S	80	22.55	0.53							11		
523	DR	2	L	120	23.33	0.54									
530	DR	3	S	85	9.78	0.56							5		
530	DR	2	L	120	10.62	0.47							3		
530	DR	1	S	85	11.35	0.53							2	1	

Cont.

Appendix 2.

DATE	SITE	DRIFT	NET	LENGTH	Set Time	Hours	Chinook Lower LIVE	Chinook Lower DEAD	Chinook Upper LIVE	Chinook Upper DEAD	Sthd LIVE	Sthd DEAD	STGN	SHAD	Comments
427	BS	2	S	100	18.78	0.98									seals
427	BS	1	L	100	20.13	0.89	1						5		seals
427	BS	3	L	50	21.60	1.04									
504	BS	1	L	100	4.03	1.03							17		
504	BS	2	L	100	5.47	1.16							4		
504	BS	3	S	60	7.03	1.16									
512	BS	3	L	50	9.00	0.51									
512	BS	2	S	100	9.92	0.83									
512	BS	1	L	100	11.08	0.83							1		
518	BS	3	S	50	10.15	0.49									
518	BS	2	L	100	11.00	1.08							1		
518	BS	1	S	100	12.63	0.93							3		
525	BS	2	S	100	23.25	0.58									
525	BS	1	L	100	24.08	0.88					1		10		1 Squawfish
525	BS	2	L	50	25.50	0.58									
530	BS	2	L	110	9.57	2.12							3		
530	BS	1	S	100	10.70	0.88							2		
530	BS	3	S	50	12.08	0.75									1 Carp
425	SS	4	L	60	20.00	0.58									
425	SS	1	S	190	21.08	0.32									
425	SS	1	S	200	21.58	0.45							1		
425	SS	1	S	190	22.08	0.51							4	3	
503	SS	3	L	60	4.37	0.58									
503	SS	4	S	60	4.53	0.67									
503	s s	1	L	200	5.75	0.52									
509	SS	3	L	60	8.75	0.51									
509	SS	1	S	200	9.63	0.55		1			1			1	seal
509	SS	1	L	200	11.08	0.55									seal
517	SS	1	S	190	15.58	0.64	1				3			20	1 STHD 1 rtpunch
517	SS	4	L	60	16.72	0.56									
517	SS	2	L	200	18.22	0.58									seals
523	SS	4	S	60	20.52	1.21									
523	SS	3	L	60	20.82	0.62									
523	SS	2	S	200	22.12	0.10									
523	SS	2	S	200	22.80	0.28									1 STHD smolt
530	s s	4	L	50	13.47	0.86									
530	SS	3	S	60	13.58	0.58									
530	SS	2	L	190	14.63	0.60									

Cont.

Appendix 2.

DATE	SITE	DRIFT	NET	LENGTH	Set Time	Hours	Chinook Lower LIVE	Chinook Lower DEAD	Chinook Upper LIVE	Chinook Upper DEAD	Sthd LIVE	Sthd DEAD	STGN	SHAD	Comments
426	CL	2	L	170	18.20	0.70							37		
426	CL	2	L	170	19.40	0.73							18		
426	CL	1	S	100	20.50	0.63			1				1	4	BF jack, STHD smolt
503	CL	2	S	100	4.08	0.71	2				1		3		seal/sea lions wlmorts
503	CL	2	L	180	5.17	0.83	1						4		seal/sea lions wlmorts
503	CL	2	L	180	6.42	0.75							10		seal/sea lions wlmorts
510	CL	2	S	100	11.28	0.60							3		
510	CL	2	L	170	12.12	1.18							12		seal
510	CL	2	L	170	13.70	0.91							4		
517	CL	2	L	175	10.27	0.67							2		
517	CL	2	L	175	11.50	0.80		1					3		seal damage, 95L9905
517	CL	1	S	100	12.68	0.50							1	10	
524	CL	2	S	100	23.30	0.63								2	
524	CL	2	L	175	24.20	0.65									
524	CL	2	L	175	25.10	0.89	1	1					10		
531	CL	2	L	170	10.20	0.70							2		
531	CL	2	L	170	11.23	0.58							1		
531	CL	1	s	100	12.12	0.70						1	5	2	
426	CC	2	L	200	20.33	0.71	4		1				5		
426	CC	3	S	200	21.50	0.67	3				2		5	3	95L4201,4202
426	CC	1	L	200	22.58	0.46							1		
504	CC	1	L	200	4.28	0.62							1		
504	c c	4	s	200	5.33	0.60	1		1						CWT -jack (95L4203)
504	CC	2	S	200	6.27	0.66									seal working net - mort
510	CC	3	L	200	8.20	0.63									
510	c c	4	L	200	9.12	0.64									
510	c c	1	s	200	10.22	0.63							1	2	
516	CC	3	S	190	11.78	0.66							4	22	
516	CC	2	S	190	12.83	0.83							20	26	
516	CC	4	L	200	14.33	0.63									
524	CC	1	L	190	21.32	0.44									
524	CC	2	L	190	22.17	0.63									
524	CC	3	S	190	23.03	0.61							1	6	1 STHD smolt
531	c c	2	L	190	14.17	0.58								1	
531	c c	4	s	200	15.17	0.68						1		2	
531	CC	1	S	200	16.33	0.67								21	

Cont.

Appendix 2.

DATE	SITE	DRIFT	NET	LENGTH	Set Time	Hours	Chinook Lower LIVE	Chinook Lower DEAD	Chinook Upper LIVE	Chinook Upper DEAD	Sthd LIVE	Sthd DEAD	STGN	SHAD	Comments
426	WA	3	L	150	19.68	0.55	2						4		1 CWT (95L9901)
426	WA	1	S	153	20.65	0.87	3	2					45	4	95L9902, 9903, 9904
426	WA	1	L	150	22.07	0.72	1	1					3		
503	WA	1	L	150	4.83	0.81	3						6	1	
503	WA	1	S	153	6.00	0.84			1				21		
503	WA	3	L	150	7.47	0.76	1		1						
510	WA	3	S	153	11.83	0.74	2						19		1 CWT (95L8901)
510	WA	1	L	150	13.17	2.19							3		Northern squawfish (NSF)
510	WA	1	S	153	14.13	0.78							26	1	1 chinook dropout
517	WA	3	S	153	11.70	0.58	1						4	7	
517	WA	3	L	150	12.58	0.62								3	
517	WA	1	L	150	13.52	0.73	1	1					6		
524	WA	3	L	150	24.17	0.67									
524	WA	1	L	150	25.25	0.80							5		
524	WA	1	S	153	26.40	0.93		2					50	5	NSF, 95L9906, 9907
531	WA	1	S	153	11.12	0.75							22	6	
531	WA	1	L	150	12.25	0.65							2		
531	WA	3	L	150	13.40	0.67							2		

Notes:

Sites
- BS = Blind Slough
- CC = Cathlamet Channel
- CL = Clifton Channel
- DR = Deep River/Grays Bay
- SS = Steamboat Slough
- TP = Tongue Point
- WA = Wallace Slough

Drifts — Numbered as in Figures l-7

Nets
- S = Small mesh (5-6”)
- L = Large mesh (7-8”)

Length — Length of net in fathoms

Time — Hour (and hundredth) that net was set based on 24-hour clock

Hours — Numbers of hours that net was fished, including half of both set and pull times.

Live/Dead — Condition of fish when pulled from net

Appendix 3. Biological sample data from spring 1995 select area test fishery, by location and species.

LOCAT.	DATE	SITE	SAMP. NO.	SPEC.	AGE	F.L.	SEX	WT.	MARK	CWT	L/D	COLOR	DAMAGE
BS	42795	1	1	CHS	41	71.4					L	w	
CAT	42695	2	1	CHS		94.0					L	B	
CAT	42695	2	2	CHS	52	88.0					L	w	
CAT	42695	2	3	CHS	42	70.0					L	w	
CAT	42695	2	4	CHS	52	80.0					L	w	
CAT	42695	2	5	CHS	52	87.0					L	w	
CAT	42695	3	6	CHS	52	70.0	F	14.2	A d	95L4201	L	W	
CAT	42695	3	7	CHS	42	68.0					L	w	
CAT	42695	3	8	CHS	32	50.0	M	4.0	A d	95L4202	L	w	
CAT	50495	4	1	CHS	42	70.0					L	w	
CAT	50495	4	2	CHS	32	52.0	M	4.3	A d	95L4203	L	B	
CLIF	42695	2	1	CHS	32	52.0					L	B	
CLIF	50395	2	1	CHS	52	81 .O	M				L	w	
CLIF	50395	2	2	CHS	52	95.0	M				L	w	
CLIF	50395	2	3	CHS	42	73.0	M				L	w	
CLIF	51795	2	1	CHS	42	71.0	M		2	95L9905	D	W	SB
CLIF	52495	2	1	CHS	41	98.3					L	w	
CLIF	52495	2	2	CHS	51	87.6	F		LV		D	W	s s
s s	50995	1	1	CHS		67.0	F	10.0			D	W	
s s	51795	1	1	CHS	52	81 .O					L	w	
TP	42795	1	1	CHS	42	81.0	F				D	W	
TP	52595	4	1	CHS	42	69.5					L	w	
WAL	42695	3	1	CHS		77.6					L	w	
WAL	42695	3	2	CHS	42	74.5	M		A d	95L9901	L	w	
WAL	42695	1	3	CHS	42	76.0					L	w	
WAL	42695	1	4	CHS	52	85.5	M		A d	95L9902	D	W	
WAL	42695	1	5	CHS	42	67.8	F		A d	95L9903	L	w	
WAL	42695	1	6	CHS	42	69.8	F		A d	95L9904	L	w	
WAL	42695	1	7	CHS	52	81.2	M				D	W	SD GN SS
WAL	42695	1	8	CHS	52	87.5					L	w	
WAL	42695	1	9	CHS		87.5	M				D	W	
WAL	50395	1	1	CHS	42	74.2					L	w	s s
WAL	50395	1	2	CHS	42	89.1					L	w	SD
WAL	50395	1	3	CHS	42	74.2					L	w	s s
WAL	50395	1	4	CHS	32	56.0					L	B	
WAL	50395	3	5	CHS	31	63.0					L	w	
WAL	50395	3	6	CHS	41	69.8					L	B	
WAL	51095	3	1	CHS	42	74.0	F		A d	95L8901	L	w	
WAL	51095	3	2	CHS	41	82.0					L	w	
WAL	51795	3	1	CHS	62	82.0					L	w	
WAL	51795	1	2	CHS	52	78.5					L	w	
WAL	51795	1	3	CHS	52	91	F				D	W	
WAL	52595	1	1	CHS	52	76.9	M		A d	95L9906	D	W	
WAL	52595	1	2	CHS		87.8	M		A d	95L9907	D	W	SB
BS	52595	1	1	STHD	1.3	85.7	M		Ad		L	1	
CAT	42695	3	1	STHD	1.2	69.0			Ad		L	SP	
CAT	42695	3	2	STHD	3.2	63.0	F				L	Wi	
CAT	53195	4	1	STHD	1.2	69.0	F	7.7	Ad		D	B	
CLIF	53195	1	1	STHD	1.2	71.9	M		Ad		D	Su	
DR	42595	1	1	STHD	R.3	84.0	F		Ad			Wi	
s s	50995	1	1	STHD	1.2	71 .o			Ad		L	Wi	
s s	51795	1	1	STHD	1.1	76.0			Ad		L	Wi	
s s	51795	1	2	STHD	1.2	69.0			Ad		L	su	
SS	51795	1	3	STHD	1.2	68.0			Ad		L	su	

Appendix 4. Raw sample data from 1995 fall test fishery, in numbers of fish and hours by species, site, date and time.

DATE	SITE	DRIFT	NET	LEN	Begin Time	Hours	Chin LIVED	Chin DEAD	Coho LIVED	Coho DEAD	Sthd LIVED	Sthd DEAD	STGN	SHAD	Comments
921	TP	1	L	190	11.28	0.74									
921	TP	2	S	200	12.32	0.78									
921	TP	3	L	190	13.62	0.94									
928	TP	4	S	200	22.37	0.68									
928	TP	3	L	200	23.35	0.66							1		
928	TP	1	S	200	24.32	0.62									Seal damage to coho
1005	TP	2	L	200	21.50	0.82									
1005	TP	3	S	200	22.58	1.00									1 chum (male)
1005	TP	4	L	200	23.83	0.89									
1013	TP	4	S	220	10.10	0.77									
1013	TP	2	S	220	11.10	0.73									
1013	TP	1	L	200	12.03	0.59							2		
1019	TP	1	L	200	10.08	0.67									
1019	TP	1	S	220	10.95	0.77									
1019	TP	4	L	200	12.07	0.82									Seal
1026	TP	3	S	220	21.53	0.72									
1026	TP	2	L	200	22.48	0.73							2		
1026	TP	1	S	220	23.43	0.74									
921	DR	4	L	50	12.60	0.58									
921	DR	3	L	65	13.52	0.66							5		
921	DR	1	S	125	14.47	0.66				1					2 Gn. Stgn., Seal
927	DR	2	L	70	23.50	0.58							12		
927	DR	2	S	80	24.43	0.50	1						4		
927	DR	1	S	80	25.27	0.48			1				6		
1004	DR	4	S	50	22.25	0.57									
1004	DR	3	L	125	23.25	0.83							22		
1004	DR	2	L	125	24.50	0.68							5		
1013	DR	2	L	125	11.17	0.59							2		
1013	DR	2	S	140	11.98	0.63									Seal
1013	DR	1	S	140	12.85	0.58									Seal
1018	DR	4	L	50	10.30	0.59									
1018	DR	3	S	135	11.23	0.63							1		
1018	DR	2	L	120	12.10	0.60									
1026	DR	1	S	135	22.40	0.63									
1026	DR	1	L	125	23.33	0.58							1		
1026	DR	2	S	135	24.20	0.65							3		

Cont.

Appendix4.

DATE	SITE	DEPTH	INLET	LEN	Begin Time	Hours	Chin LIVE	Chin DEAD	Coho LIVE	Coho DEAD	WSthd LIVE	WSthd DEAD	STGN	SHAD	Comments
921	BS	2	S	100	10.75	0.82									
921	BS	1	L	100	12.25	0.87							1		
921	BS	3	L	50	13.50	0.83									
928	BS	3	S	50	21.08	1.18	1								
928	BS	2	L	100	22.63	1.43	1							1	
928	BS	1	S	100	24.58	0.93				2			5		
1005	BS	3	L	50	21.27	1.06									
1005	BS	2	S	100	22.67	1.11			1						
1005	BS	1	L	100	24.12	0.86			1				2		
1013	BS	1	S	100	11.33	0.83									
1013	BS	2	L	100	12.47	0.63									
1013	BS	3	S	50	13.52	0.76									
1020	BS	2	L	100	10.33	0.63									1 Crawfish
1020	BS	1	S	100	11.33	1.21							1		1 Crawfish
1020	BS	3	L	50	13.08	0.80									1 Crawfish
1026	BS	3	S	50	20.75	1.15									
1026	BS	2	L	100	22.25	0.80									
1026	BS	1	S	100	23.37	1.05									
920	SS	3	S	60	11.42	0.67									
920	SS	5	L	60	11.67	0.80				1	1				95L8606 (STHD)
920	SS	4	S	60	12.28	0.63									
928	SS	5	S	60	0.37	0.58	1								
928	SS	1	S	200	1.42	0.83	2			1					
928	SS	2	L	200	2.83	0.61							1		
1004	SS	5	L	60	23.17	0.58									
1004	SS	4	S	60	23.32	0.85									
1011	SS	4	S	60	11.60	0.58									
1011	SS	5	L	60	11.82	0.67									
1011	SS	2	S	200	12.92	0.67									
1011	SS	3	L	150	14.15	0.62									Seals (2+)
1018	SS	4	L	60	9.90	0.59									
1018	SS	3	S	60	10.05	0.63									2 Seals
1018	SS	2	L	150	11.00	0.58									
1025	SS	4	S	60	23.62	0.61									
1025	SS	5	L	60	23.80	0.73									
1025	SS	5	S	60	24.40	0.59									
1025	SS	4	L	60	24.75	0.58									

Cont.

Appendix4.

DATE	SITE	DRIFT	NET	LEN	Begin Time	Hours	Chin LIVE	Chin DEAD	Coho LIVE	Coho DEAD	Sthd LIVE	Sthd DEAD	W STGN	SHAD	Comments
920	CL	2	S	100	11.80	1.35		1					6		
920	CL	1	L	160	13.50	1.15							1		
920	CL	1	L	160	15.20	0.89							3		
927	CL	2	L	170	10.50	0.69	1						2		
927	CL	2	L	170	11.55	0.71	1						1		
927	CL	1	S	100	12.70	0.65									
1004	CL	2	S	100	23.15	0.32							2		
1004	CL	2	S	100	23.58	0.47							6		
1004	CL	2	L	170	24.37	0.68									
1004	CL	2	L	170	25.38	0.67									
1011	CL	2	L	175	9.83	0.69							3		
1011	CL	2	L	175	10.83	0.71							2		
1011	CL	1	S	100	12.00	0.67									
1018	CL	2	S	100	10.30	0.70							3		Seals
1018	CL	2	L	175	12.33	0.71							2		Seals
1018	CL	2	L	180	13.37	0.67									Seals
1025	CL	2	L	170	21.83	0.64							3		
1025	CL	2	L	170	22.73	0.74	2						1		
1025	CL	1	S	100	24.00	0.60									
921	CC	1	L	190	11.83	0.63							2		
921	CC	2	L	190	12.87	0.64				1			2		Seal, SD
921	CC	3	S	200	14.00	0.67							1		
927	cc	3	s	200	0.13	0.70	1		5				8		
927	cc	2	s	200	1.10	0.75			2	1			10		
1003	CC	1	S	200	21.98	0.71							7		
1003	CC	4	L	190	23.30	0.63							4		Seal Obs. & seal damage
1003	CC	3	L	190	24.20	0.61									
1010	CC	2	S	200	11.25	0.63			1				1		
1010	CC	4	L	150	12.22	0.65							3		
1010	CC	3	S	200	13.15	0.61			1	1	1				Seal/seal dam. to STHD
1017	CC	1	L	150	9.33	0.63									Seals
1017	CC	2	L	150	10.17	0.64									Seals
1017	CC	3	S	200	11.08	0.67			1				2		Seals, SD
1024	CC	2	L	150	22.42	0.67									
1024	CC	4	S	200	23.58	0.65			1		1				
1024	CC	1	S	200	24.62	0.68				1			2		

Cont.

Appendix 4.

DATE	SITE	DRIFT	NET	LEN	Begin Time	Hours	Chin LIVE	Chin DEAD	Coho LIVE	Coho DEAD	Sthd LIVE	Sthd DEAD	STGN	SHAD	Comments
920	WA	2	S	55	13.00	0.51									
920	WA	3	L	150	13.83	0.75	1								95L8902
920	WA	1	S	150	15.08	1.08						1	15		
927	WA	3	L	135	22.67	0.77	1						1		
927	WA	1	L	150	23.92	0.67		2					1		
927	WA	1	S	150	24.92	1.01	1		1				7		
1004	WA	3	S	150	23.33	0.64							5		
1004	WA	2	L	60	24.47	0.67							1		
1004	WA	1	L	150	25.37	0.72							1		
1011	WA	3	S	150	9.53	0.68	1						4		
1011	WA	1	L	150	10.63	0.66									
1011	WA	1	S	150	11.52	0.71							4		
1018	WA	2	S	60	11.40	0.60							2		
1018	WA	3	L	150	12.23	0.63									
1018	WA	1	S	150	13.27	0.68							3		
1025	WA	3	L	150	21.93	0.67									
1025	WA	1	L	150	23.03	0.91		1					1		Live SAB
Total							15	4	27	9	4	1	198	1	

Notes:

Sites
- BS = Blind Slough
- CC = Cathlamet Channel
- CL = Clifton Channel
- DR = Deep River/Grays Bay
- SS = Steamboat Slough
- TP = Tongue Point
- WA = Wallace Slough

Drifts — Numbered as in Figures l-7.

Nets — S = Small mesh (5-6"), L = Large mesh (7-8").

Length — Length of net in fathoms.

Time — Hour (and houndredth) that net was set based on 24-hour clock.

Hours — Numbers of hours that net was fished, including half of both set and pull times.

Live/Dead — Condition of fish when pulled from net.

Appendix 5. Biological sample data from fall 1995 select area test fishery, by location and species.

LOCAT.	DATE	SITE	SAMP. NO.	SPEC.	AGE	F.L.	SEX	WT.	MARK	CWT	L/D	COLOR	DAMAGE
BS	92895	3	1	CHF	41	94.5	M				L	3	
BS	92895	2	2	CHF	0	93.6					L	2	
CAT	92795	3	3	CHF	0	68.0					L	B	
CLIF	92095	2	1	CHF	51	84.3	M				D	1	
CLIF	92795	2	1	CHF	31	75.4	F		unk		L	1	
CLIF	92795	2	2	CHF	51	90.1	F		unk		L	1	
CLIF	102595	2	1	CHF	51	89.5					L	1	
CLIF	102595	2	2	CHF	51	87.3					L	1	
DR	92795	2	1	CHF	51	97.0	F				L	B	
ss	92895	5	1	CHF	0	88.0					L		
ss	92895	1	2	CHF	0	77.0					L		
ss	92895	1	3	CHF	61	91 .o					L		
WAL	92095	3	1	CHF	31	72.1	M				L	2	
WAL	92795	3	1	CHF	41	75.0					L	1	Old SB
WAL	92795	1	2	CHF	31	80.0	M				D	1	
WAL	92795	1	3	CHF	51	89.6	F				D	1	
WAL	92795	1	4	CHF	41	80.4					L	1	
WAL	101195	3	1	CHF	51	84.8	F				L	1	
WAL	102595	1	1	CHF	31	59.6	F		LV		L	3	
BS	92895	1	3	c o		60.3	M				D		
BS	92895	1	4	c o		66.6	F				D		
CAT	92195	2	1	c o							D	B	Snout left by sea lion
CAT	92795	3	1	c o		75.0					L	B	
CAT	92795	3	2	c o		55.0					L	B	
CAT	92795	3	4	c o		56.0					L	D	
CAT	92795	3	5	c o		74.0					L	D	
CAT	92795	3	8	c o		57.0					L	B	
CAT	92795	2	7	c o		76.0					L	B	
CAT	92795	2	8	c o		78.0	F	11.4			D	B	
CAT	92795	2	9	c o		34.0					L	B	
CAT	101095	2	1	c o		65.0	F				L	B	
CAT	101095	3	2	c o		71.0	M	10.0			D	B	
CAT	101095	3	3	c o		55.0	M				L	B	
CAT	101795	3	1	c o							L		Snout left by sea lion
CAT	102495	4	1	c o	32	72.0	M				L	D	
CAT	102495	1	2	c o	32	59.0	F				D	B	
DR	92195	1	1	c o		82.0	M	13.5			D	B	Seal damage
DR	92795	1	1	c o		72.0	F				L	B	
ss	92095	5	1	c o		76.0	M				D	D	
ss	92895	1	4	c o		77.0	F	13.1			D		
ss	100495	5	1	c o		70.0	M				L	E	
ss	101195	2	1	c o		65.0					L	B	
WAL	92795	1	5	c o		72.8					L		
CAT	101095	3	1	STHD		75.0		10.0			D	B	Seal damage
CAT	102495	4	1	STHD	1.2	78.0			Ad		L	B	
ss	92095	5	1	STHD	R.3	82.0	M		AdLV	94L8606	L	B	
WAL	92095	3	1	STHD	1.2	79.2	M		24	95L8902	D		
WAL	101195	1	1	STHD	1.1	63.8			Ad		L		

Appendix 6. Raw sample data from 1996 spring test fishery, in numbers of fish and hours fished by species, site, date and time.

DATE	SITE	DRIFT	NET	LEN	FISH BEGIN TIME	TIME (HRS.)	Chinook Lower LIVE	Chinook Lower DEAD	Chinook Upper LIVE	Chinook Upper DEAD	Sthd LIVE	Sthd DEAD	STGN	SHAD	COMMENTS
425	TP	1	L	210	6.33	1.08							5		
425	TP	2	S	220	7.75	1.15									
425	TP	3	L	210	9.20	1.18									
502	TP	4	s	210	6.23	1.14			1					1	
502	TP	3	L	210	7.67	1.09	3						9		
502	TP	1	s	210	9.18	0.97					1				Ad STHD
509	TP	2	L	220	6.20	1.05									
509	TP	3	S	220	7.53	1.19									
509	TP	4	L	220	8.95	0.99									Snagged last 15 fm
516	TP	2	S	200	6.70	0.90									
516	TP	1	L	200	7.85	0.98									
516	TP	4	s	200	9.10	1.02									
523	TP	1	L	200	11.80	0.93									
523	TP	1	s	200	12.92	1.02									
523	TP	4	L	200	14.18	0.87							1		
528	TP	1	s	220	9.93	1.13									
528	TP	2	L	200	11.32	1.04									
528	TP	3	S	220	12.58	1.36					1			1	Ad STHD
426	SC	1	s	200	7.32	0.92									
426	SC	2	L	112	8.63	0.90							1		
426	SC	3	s	200	9.93	0.67							4		
503	SC	1	L	210	7.77	0.84							1		Seals present
503	SC	2	L	210	9.05	0.87							1		
503	SC	3	s	210	10.37	0.73	1	1					4	4	Lost 1 salmon
510	SC	1	L	110	7.50	0.78							2		
510	SC	2	s	100	8.58	0.81									Hung up
510	SC	3	s	210	9.62	1.00	1						1	2	
517	SC	1	L	110	7.93	0.64							2		
517	SC	2	L	110	8.88	0.71									
517	SC	3	L	215	10.07	0.83	1		1				3		
524	SC	1	L	110	12.33	0.73							1		Heavy flows
524	SC	2	L	110	13.28	0.81							1		Heavy flows
524	SC	3	S	200	14.38	0.83								5	Heavy flows
531	SC	1	L	110	10.50	0.82							3		6" Starry Flounder
531	SC	2	L	110	11.58	0.61							2		
531	SC	3	S	200	12.63	0.75					1			1	Ad STHD

Cont.

Appendix 6.

DATE	SITE	DRIFT	NET	LEN	FISH BEGIN TIME	TIME (HRS.)	Chinook Lower LIVE	Chinook Lower DEAD	Chinook Upper LIVE	Chinook Upper DEAD	Sthd LIVE	Sthd DEAD	STGN	SHAD	COMMENTS
425	DR	4	L	50	6.87	0.63									
425	DR	3	L	125	7.83	0.83							7		
425	DR	1	S	140	9.10	0.84							3		
501	DR	2	L	125	7.83	1.07							14		1 Seal
501	DR	2	S	145	9.47	0.63							2	1	1 Carp
501	DR	1	S	145	10.42	0.63									
511	DR	4	S	60	7.92	0.75									
511	DR	3	L	160	8.97	0.63							4		
511	DR	2	L	160	9.85	0.66	1						1		
515	DR	2	L	65	7.85	0.60									
515	DR	2	S	125	8.58	0.77									
515	DR	1	S	125	9.58	0.70							1		
523	DR	2	S	125	12.77	0.69									
523	DR	1	S	125	13.75	0.54									
523	DR	1	L	160	14.57	0.59									
529	DR	4	L	50	11.75	0.73									1 Carp, 1 Crawfish
529	DR	3	S	125	12.78	0.61							11		
529	DR	2	L	135	13.73	0.59									Rip net, Ad STHD
425	BS	1	S	100	6.37	0.73							4		
425	BS	2	L	100	7.42	1.13							4		
425	BS	3	S	70	8.80	1.00									
501	BS	2	L	100	7.12	0.84							1		
501	BS	1	S	100	8.23	1.38							3		
501	BS	3	S	70	10.02	1.03									6 Carp
509	BS	1	L	100	6.25	1.00							11		
509	BS	2	S	100	7.50	1.01							4		
509	BS	3	L	70	8.70	1.09							1		
516	BS	3	S	70	7.17	0.98									
516	BS	2	L	100	8.37	0.87							34		
516	BS	1	S	100	9.57	0.98							11		
523	BS	3	L	70	12.67	0.85									
523	BS	2	S	100	13.75	0.96							13		
523	BS	1	L	100	14.93	0.83									
530	BS	1	S	100	13.13	0.82							4		
530	BS	2	L	100	14.25	0.78							1		
530	BS	3	S	60	15.27	0.74							4		

Cont.

Appendix 6.

DATE	SITE	DRIFT	NET	LEN	FISH BEGIN TIME	TIME (HRS.)	Chinook Lower LIVE	Chinook Lower DEAD	Chinook Upper LIVE	Chinook Upper DEAD	Sthd LIVE	Sthd DEAD	STGN	SHAD	COMMENTS
424	PC	3	S	100	6.03	0.44							4		
424	PC	2	L	100	6.98	0.68	2						15		2 H.S.s, Ad (96L 701)
424	PC	1	L	100	7.93	0.86	1 ,		2				8		2 H.S.s
503	PC	2	L	100	8.23	0.63							32		1 H.S.
503	PC	1	L	100	9.32	0.80	2		2				77		1 H.S., Ad (96L 604)
503	PC	3	L	100	10.98	0.72	1						4		Ad (96L 605)
510	PC	3	L	100	7.28	0.96							19		1 H.S.
510	PC	2	s	100	8.78	0.88							25		1 H.S.
510	PC	1	L	100	9.97	0.86							66		1 H.S.
517	PC	2	L	100	8.92	0.71	1					1	32	2	Ad STHD
517	PC	1	s	100	10.00	0.65							8		
517	PC	3	s	100	11.12	0.68							4		1 salmon dropped
524	PC	2	L	100	13.40	0.54							31		
524	PC	1	L	100	14.30	0.61							93	1	
524	PC	3	L	100	15.83	0.58							1		
531	PC	1	L	100	10.98	0.53	1						4		1 H.S. mort
531	PC	2	L	100	11.83	0.71							27		
531	PC	3	s	100	13.08	0.65							16		
501	SS	4	S	60	10.72	0.53									1 Carp
501	SS	3	L	60	11.53	0.64						1			Ad STHD
501	SS	5	L	60	12.38	0.53									
508	SS	5	S	60	5.30	0.52							1		
508	SS	4	L	60	5.47	0.53									
508	SS	3	L	60	6.17	0.52									Considerable debris
515	SS	4	S	60	10.78	0.51									
515	SS	5	L	60	11.45	0.56							2		
515	ss	2	s	150	12.48	0.35								2	
522	SS	4	S	60	17.20	0.56									High water, no stoptide
522	SS	5	L	60	17.40	0.49									High water, no stoptide
522	SS	3	S	60	18.07	0.59									High water, no stoptide
529	SS	3	S	60	10.55	0.58	1								1 Seal in area
529	SS	5	L	60	11.35	0.61									
529	ss	4	s	60	11.48	0.63									

Cont.

Appendix 6.

DATE	SITE	DRIFT	NET	LEN	FISH BEGIN TIME	TIME (HRS.)	Chinook Lower LIVE	Chinook Lower DEAD	Chinook Upper LIVE	Chinook Upper DEAD	Sthd LIVE	Sthd DEAD	STGN	SHAD	COMMENTS
424	CL	2	S	100	6.25	0.70							22		
424	CL	2	L	170	7.37	1.34	3	1		1			99		Ad (96L 501)
502	CL	2	L	175	7.00	1.16	2	1	1				153		
502	CL	2	L	170	9.90	0.64	3		3				62		3 AD (96L 703, 704, 705)
502	CL	1	s	100	11.18	0.44	2				1		3	3	Ad STHD,
508	CL	2	s	100	5.83	0.88							13		Ad CHS (96L 706)
508	CL	2	L	170	7.13	0.86	1		1				21		Ad (96L 707), debris hangup
508	CL	2	L	170	8.37	0.93	2						35		
515	CL	2	L	170	7.17	0.78	1						19		
515	CL	2	L	170	8.23	0.88							9		
515	CL	1	s	100	9.33	0.78	1						5	5	Ad (96L 708)
522	CL	2	L	175	11.72	0.62	2						16		Lost salmon
522	CL	2	L	175	12.83	0.67							23		
522	CL	1	s	100	14.03	0.38							2	8	
529	CL	2	s	100	12.00	0.66	1	1					11	2	
529	CL	2	L	170	12.97	0.81							10		Net snagged
529	CL	2	L	170	14.25	0.61							9		
430	CA	3	S	150	10.87	0.68							9		
430	CA	3	L	150	11.92	0.62	3		1				1		Ad (96L6601)
430	CA	3	L	150	12.83	0.58	3						7		1 Carp, Ad (96L6602)
507	CA	3	L	150	17.25	0.61	1								
507	CA	1	S	150	18.10	0.58							6	1	
507	CA	4	L	150	18.98	0.57							1		
514	CA	3	S	150	9.50	0.60		1						9	
514	CA	2	S	150	10.28	0.68	1						4	6	
514	CA	4	L	150	11.25	0.58							3		
521	CA	3	S	150	16.12	0.63								4	
521	CA	2	L	150	17.02	0.64									
521	CA	1	L	150	17.88	0.60									
528	CA	4	S	150	10.05	0.71						1		13	
528	CA	1	L	150	11.00	0.61		1							
528	CA	2	L	150	11.83	0.58							1		

Cont.

Appendix 6.

DATE	SITE	DRIFT	NET	LEN	FISH BEGIN TIME	TIME (HRS.)	Chinook Lower LIVE	Chinook Lower DEAD	Chinook Upper LIVE	Chinook Upper DEAD	Sthd LIVE	Sthd DEAD	STGN	SHAD	COMMENTS
424	WA	1	S	150	7.13	0.73	1		1		1		1		
424	WA	1	L	150	8.20	0.66	1						1		
424	WA	3	L	150	9.50	0.63	7		5						3 Ad (96L 601,602,603)
501	WA	3	L	150	9.52	0.59	1								1 Carp
501	WA	1	L	150	10.48	0.71	5		2				1		
501	WA	1	S	150	11.50	0.93	3	3	1	1	1		1	3	Ad STHD, Ad (96L 0702)
508	WA	1	L	150	6.72	1.21	6						2		Ad (96L 502)
508	WA	1	L	150	8.38	0.78	3	1					1		
508	WA	3	S	150	9.97	0.56	4		1		1			2	AdSTHD, Ads(503,504)
515	WA	1	L	150	8.20	0.66	1	1			1		1	3	Ad STHD, Ad (96L0505)
515	WA	1	S	150	9.28	0.68	3						4	1	
515	WA	3	S	150	10.73	0.78		1					2		
522	WA	1	L	150	12.75	0.58								1	Heavy running water
522	WA	1	S	150	13.67	0.78								3	Heavy running water
522	WA	3	s	150	14.92	0.72								6	Heavy running water
529	WA	3	L	150	13.17	0.63			1						
529	WA	1	L	150	14.18	0.74	1		1						
529	WA	1	S	150	15.20	0.68		1					2	23	
Total							78	13	24	2	9	3	1208	113	

Notes:

Sites:
- BS = Blind Slough
- CC = Cathlamet Slough
- CL = Clifton Channel
- DR = Deep River
- SS = Steamboat Slough
- TP = Tongue Point
- WA = Wallace Slough
- SC = South Channel
- PC = Prairie Channel

Drifts: Numbered as in Figures l-7.

Nets:
- S = Small mesh (5-6")
- L = Large mesh (7-8")

Length: Length of net in fathoms.

Time: Hour (and hundredth) that net was set based on 24-hour clock.

Hours: Numbers of hours that net was fished, including half of both set and pull times.

Live/Dead: Condition of fish when pulled from net.

Appendix 7. Biological sample data from spring 1996 select area test fishery, by location and species.

SITE	DATE	DRIFT	SAMP NO	SPEC	AGE	F.L.	SEX	WT.	MARK	CWT	L/D	COLOR	DAMAGE
TP	50296	4	1	CHS	42	74.0					L	B	NS
TP	50296	3	2	CHS	42	77.0					L	W	SS
TP	50296	3	3	CHS	42	79.0					L	W	NS
TP	50296	3	4	CHS	42	81 .O					L	W	NS
SC	50396	3	1	CHS	52	78.0					L	W	
SC	50396	3	2	CHS	42	71 .o	M				D	W	
SC	51096	3	1	CHS	42	70.4					L	W	
SC	51796	3	1	CHS	42	79.6					L	B	
SC	51796	3	2	CHS	52	85.5					L	W	
DR	51196	2	1	CHS	52	80.0					L	W	
PC	42496	2	1	CHS	52	83.0					L	W	
PC	42496	2	2	CHS	42	75.2	M		2	96L0701	L	W	
PC	42496	1	3	CHS	52	96.0					L	W	
PC	42496	1	4	CHS	42	75.0					L	B	GA
PC	42496	1	5	CHS	42	71.0					L	B	
PC	50396	1	1	CHS	42	75.5					L	B	
PC	50398	1	2	CHS	42	77.5					L	W	
PC	50396	1	3	CHS	42	74.0	M		2	96L0604	L	B	
PC	50396	1	4	CHS	42	73.8					L	W	
PC	50396	3	5	CHS	42	74.2	M		2	96L0605	L	W	
PC	51796	2	1	CHS	42	74.0					L	W	s s
PC	53196	1	1	CHS	52	88.0					L	W	
s s	52996	3	1	CHS	42	71.0					L	W	
CL	42496	2	1	CHS	42	82.3					L	W	Scar
CL	42496	2	2	CHS	52	87.0					L	W	
CL	42496	2	3	CHS	42	76.8					L	W	
CL	42496	2	4	CHS	42	78.5	M				D	B	
CL	42496	2	5	CHS	42	78.4	M		2	96L0501	D	W	SB
CL	50296	2	1	CHS	42	78.2					L	B	SB
CL	50296	2	2	CHS	42	80.4					L	W	
CL	50296	2	3	CHS	52	84.8					L	W	
CL	50296	2	4	CHS	42	76.5	M				D	W	
CL	50296	2	5	CHS	42	81.5					L	B	SB
CL	50296	2	6	CHS	42	75.0					L	B	
CL	50296	2	7	CHS	42	76.2					L	W	
CL	50296	2	8	CHS	42	77.5	M		2	96L0703	L	W	
CL	50296	2	9	CHS	42	86.6	F		2	96L0704	L	W	
CL	50296	2	10	CHS	42	71.6	F		2	96L0705	L	B	
CL	50296	1	11	CHS	42	70.4					L	W	
CL	50296	1	12	CHS	42	81.2	F		2	96L0706	L	W	
CL	50896	2	1	CHS	42	78.2					L	B	s s
CL	50896	2	2	CHS		88.8			2	96L0707	L	W	
CL	50896	2	3	CHS	52	89.7					L	W	TS
CL	50896	2	4	CHS	41	79.4					L	W	
CL	51596	2	1	CHS		93.3					L	W	s s
CL	51596	1	2	CHS	42	74.5	M		2	96L0708	L	W	
CL	52296	2	1	CHS		76.0					L	W	
CL	52296	2	2	CHS	52	87.0					L	W	
CL	52996	2	1	CHS	42	76.6					L	W	SB
CL	52996	2	2	CHS	42	83.9					D	W	

Cont.

Appendix 7.

SITE	DATE	DRIFT	SAMP NO	SPEC	AGE	F.L.	SEX	WT.	MARK	CWT	L/D	COLOR	DAMAGE
CA	43096	3	1	CHS		74.0					L	B	
CA	43096	3	2	CHS	42	83.0					L	W	
CA	43096	3	3	CHS	52	85.0					L	W	
CA	43096	3	4	CHS	42	82.0			Ad	96L6601	L	W	
CA	43096	3	5	CHS	52	83.0					L	W	
CA	43096	3	6	CHS		73.0					L	W	
CA	43096	3	7	CHS	42	82.0			Ad	96L6602	L	W	
CA	50796	3	1	CHS	52	92.0					L	W	
CA	51496	3	1	CHS	42	66.0					D	W	
CA	51496	2	2	CHS	42	76.0					L	W	
CA	52896	2	1	CHS	41	83.0		16.0			D	W	
WA	42496	1	1	CHS	42	74.6					L	W	GA SS
WA	42496	1	2	CHS	42	66.0					L	B	OM
WA	42496	1	3	CHS	42	81.4					L	W	GA SS
WA	42496	3	4	CHS	52	84.6					L	W	GA SS
WA	42496	3	5	CHS	42	80.2					L	W	GA
WA	42496	3	6	CHS	42	71.7					L	W	
WA	42496	3	7	CHS	42	77.0					L	B	
WA	42496	3	8	CHS	52	80.4					L	W	
WA	42496	3	9	CHS	42	73.8					L	W	
WA	42496	3	10	CHS		72.5					L	B	
WA	42496	3	11	CHS	42	70.2					L	W	GA
WA	42496	3	12	CHS	42	70.7					L	W	OM
WA	42496	3	13	CHS	42	74.0	F		2	96L0601	L	B	GA SD
WA	42496	3	14	CHS	42	81.0	F		2	96L0602	L	B	GA SS
WA	42496	3	15	CHS	42	75.0	F		2	96L0603	L	B	
WA	50196	3	1	CHS	52	86.4					L	W	
WA	50196	1	2	CHS	42	80.0					L	B	
WA	50196	1	3	CHS	42	76.0					L	W	
WA	50196	1	4	CHS	42	76.0					L	W	
WA	50196	1	5	CHS	62	85.0					L	W	
WA	50196	1	6	CHS		76.0					L	B	
WA	50196	1	7	CHS	52	90.5					L	W	
WA	50196	1	8	CHS	52	74.0					L	W	
WA	50196	1	9	CHS		78.4	M				D	W	
WA	50196	1	10	CHS		72.0					L	B	GA
WA	50196	1	11	CHS	42	80.0					L	W	
WA	50196	1	12	CHS	52	79.5					L	W	
WA	50196	1	13	CHS	52	84.0	M				D	W	
WA	50196	1	14	CHS	42	83.8	M				D	W	
WA	50196	1	15	CHS	42	69.3	M		2	96L0702	D	B	GA
WA	50196	1	16	CHS	52	76.2					L	w	

Cont.

Appendix 7.

SITE	DATE	DRIFT	SAMP NO	SPEC	AGE	F.L.	SEX	WT.	MARK	CWT	L/D	COLOR	DAMAGE
WA	50896	1	1	CHS		76.8					L	W	ss
WA	50896	1	2	CHS	42	74.8					L	W	
WA	50896	1	3	CHS	42	78.2					L	W	SS
WA	50896	1	4	CHS	52	77.1					L	W	
WA	50896	1	5	CHS	42	75.3					L	W	SS
WA	50896	1	6	CHS	42	75.8	M		2	96L0502	L	W	SS
WA	50896	1	7	CHS	42	70.8					L	W	SS
WA	50896	1	8	CHS	42	70.4					L	W	SS
WA	50896	1	9	CHS	42	70.4					L	W	
WA	50896	1	10	CHS	52	86.9	F				D	W	HS
WA	50896	3	11	CHS	52	80.2					L	W	s s
WA	50896	3	12	CHS	52	87.4					L	W	SB
WA	50896	3	13	CHS	31	58.2					L	W	
WA	50896	3	14	CHS	32	48.4			2	96L0504	L	B	
WA	50896	3	15	CHS	32	55.8			2	96L0503	L	W	
WA	51596	1	1	CHS	41	81.9	F				D	W	
WA	51596	1	2	CHS	42	66.9	M		2	96L0505	L	W	
WA	51596	1	3	CHS	42	71.2					L	W	
WA	51596	1	4	CHS	31	60.2					L	W	
WA	51596	1	5	CHS		71.0					L	W	
WA	51596	3	6	CHS	42	69.0	M				D	W	
WA	52996	3	1	CHS	42	74.0					L	B	
WA	52996	1	2	CHS	42	69.0					L	B	
WA	52996	1	3	CHS	42	77.0					L	W	
WA	52996	1	4	CHS	41	80.0					D	W	
TP	50296	1	1	STHD	1.2	66.0			2		L	STS	
TP	52896	3	1	STHD	1.2	77.9	M		2		L	STS	
SC	53196	3	1	STHD	1.3	77.3			2		L	SUM	
DR	52996	2	1	STHD	1.3	85.0	M		2		L	Kelt	
PC	51796	2	1	STHD	1.2	71.0	F		2		D	SUM	
SS	50196	3	1	STHD	1.3	77.0	F	11.5	2		D		
CL	50296	1	1	STHD	R.3	74.5			2		L	SUM	
CA	52896	4	1	STHD	4.4	85.0	F	14.0			D	B	
WA	42496	1	1	STHD	3.1	75.7					L	WIN	
WA	50196	1	1	STHD	1.2	71.0			2		L	SUM	
WA	50896	3	1	STHD	1.2	78.4			2		L		SB
WA	51596	1	1	STHD	1.2	69.0			2		L	Kelt	

Appendix 8. Raw sample data from 1996 fall test fishery, in numbers of fish and hours by species, site, date and time.

DATE	SITE	DRFT	NET	LEN	FISH BEGIN TIME	TIME (HRS)	CHIN L	CHIN D	COHO L	COHO D	STHD L	STHD D	STGN	SHAD	COMMENTS
1031	YB	TP	XS	165	10.00	1.52						1			1 St.Fl.; Sthd subadult w/o fin clips.
1011	TP	1	XL	220	7.67	1.40							3		
1011	TP	2	XL	220	9.58	1.25									
1011	TP	3	XL	220	11.50	0.96									
1016	TP	1	XL	180	10.42	1.46							3		
1016	TP	1	XL	220	10.75	0.91							6		
1016	TP	3	XL	180	12.10	1.10									
1023	TP	1	XL	185	11.00	1.46									
1023	TP	1	XL	225	11.35	0.80							1		
1023	TP	2	XL	185	12.77	1.07									
1023	TP	3	XL	225	13.10	1.18							1		
1023	TP	4	XL	185	14.13	1.15							1		
1029	TP	n.a.	XS	165	7.75	0.84									Boat Ramp
1029	TP	n.a.	XS	165	8.78	0.94									Mill Creek
1029	TP	n.a.	XS	165	9.93	1.16									Pier adjacent to pens
926	SC	1	S	65	13.00	0.87			2						
926	SC	2	L	110	14.07	1.15							2		
926	SC	3	S	200	15.62	0.86									
923	DR	4	L	50	11.37	0.69			6						
923	DR	3	S	100	12.50	0.53									
923	DR	1	L	75	13.37	0.67									1 G. STGN.
1010	DR	2	S	85	19.62	0.64							4		
1010	DR	2	S	85	20.50	0.56									
1010	DR	1	S	85	21.45	0.56									
1015	DR	4	s	50	15.10	0.51			14						4 CWT (6501-6504)
1015	DR	4	S	50	15.80	0.62			7						2 CWT (6505-6506)
1015	DR	2	S	85	16.80	0.71			1						
1030	DR	4	S	50	14.47	0.38									
1030	DR	4	xs	35	15.00	0.49									
1030	DR	4	XS	35	15.83	0.54									
1030	DR	4	S	50	16.82	0.49									
925	PC	3	S	100	12.67	0.86							5		
925	PC	1	L	100	14.00	0.85							6		
925	PC	2	L	100	15.13	0.89							10		
1031	BS	n.a.	XS	100	17.12	2.94									Near upper deadline
925	ss	5	S	60	12.60	0.65									5 1/4" Mesh
925	ss	4	L	60	12.92	0.59									6 1/4" Mesh
925	ss	3	L	60	13.68	0.49									6 1/4" Mesh
1003	ss	4	S	60	3.02	0.60			1						
1003	ss	5	L	60	3.23	0.69			1						
1003	ss	2	L	150	4.08	0.59									
1009	ss	4	S	60	8.23	0.64									
1009	ss	5	L	60	8.68	0.55									
1009	ss	2	L	150	9.92	0.63									2 Harbor seals
1017	ss	5	S	60	6.65	0.59			1						
1017	ss	4	L	60	6.82	0.58									3 Carp
1017	ss	2	L	150	7.68	0.58									
1023	SS	4	L	60	21.15	0.59									
1023	SS	5	S	60	21.38	0.61									
1023	SS	2	L	150	22.17	0.59									
1030	ss	5	S	60	15.62	0.67					1				Seal
1030	ss	3	S	200	16.70	0.53									Seal
1030	SS	4	L	60	16.83	0.5									

Cont.

Appendix 8.

DATE	SITE	DRFT	NET	LEN	FISH BEGIN TIME	TIME (HRS)	CHIN		COHO		STHD		STGN	SHAD	COMMENTS
							L	D	L	D	L	D			
926	CL	2	S	100	13.88	0.96									
926	CL	2	L	160	15.38	0.94									
926	CL	2	L	160	16.62	0.59									
924	CA	3	S	170	12.42	0.63	2		1						
924	CA	4	S	170	13.28	0.80									1 Seal
924	CA	1	L	150	14.33	0.41									1 Seal
1002	CA	3	s	150	1.75	0.56									
1002	CA	2	L	150	2.83	0.64									
1002	CA	1	S	150	3.83	0.69			4						
1008	CA	3	L	150	7.73	0.60									
1008	CA	1	L	150	8.55	0.58							1		1 Seal
1008	CA	2	S	200	9.38	0.68									
1015	CA	2	L	150	5.13	0.62									
1015	CA	1	L	150	5.98	0.57				1					
1015	CA	4	S	200	6.90	0.60				1					1 Chin. lost
1022	CA	2	s	175	19.23	0.60				1			1		
1022	CA	3	S	175	20.05	0.69			1	1		1			
1022	CA	1	L	175	21.25	0.50							7		
1029	CA	3	s	200	15.10	0.69			2				2		1 Chum
1029	CA	4	s	200	16.18	0.55									Seals
1029	CA	2	L	150	17.02	0.59									Seals
925	WA	2	S	100	14.58	0.76									
925	WA	3	L	150	15.67	0.65							1		
925	WA	1	S	100	16.78	0.64							5		

Notes:

Sites:
YB = Youngs Bay
TP = Tongue Point Basin
SC = South Channel
DR = Deep River
PC = Prairie Channel
BS = Blind Slough
SS = Steamboat Slough
CL = Clifton Channel
CA = Cathlamet Channel
WA = Wallace Slough

Drifts: Numbered as in Figures 22 - 31.

Nets:
XS = Jack mesh (3 5/8 - 4 1/8 inch)
XL = Sturgeon mesh (9 inch)
S = Small mesh (5 - 6 inch)
L = Large mesh (7 - 8 inch)

Length: Length of net in fathoms.

Time: Hour (and hundredth) that net was set based on 24-hour clock.

Hours: Numbers of hours that net was fished, including half of both set and pull times.

Live/Dead: Condition of fish when pulled from net.

Appendix 9. Biological sample data from fall 1996 select area test fishery, by location and species.

LOCAT.	DATE	SITE	SAMP. NO.	SPEC.	AGE	F.L.	SEX	WT.	MARK	CWT	L/D	COLOR	DAMAGE
CAT	92496	4	1	CHF	42	67.0					L	BF	
CAT	92496	1	2	CHF	41	87.0					L	BF	
CAT	92496	3	1	CO		55.5					L		
CAT	100296	1	1	CO		69.0	F				L	B	
CAT	100296	1	2	CO		63.0	M				L	B	
CAT	100296	1	3	CO		61.0	F				D	B	
CAT	100296	1	4	CO		67.0	F				L	B	
CAT	101596	1	1	CO		73.0	M				D	D	
CAT	101596	4	2	CO		65.0	M				D	B	
CAT	102296	2	1	CO		79.0	M	13.5			D	B	
CAT	102296	3	2	CO		71.0	F	9.0			D	B	
CAT	102296	3	3	CO		66.0		8.0			L	B	
CAT	102996	3	1	CO		76.0	F				L		
CAT	102996	3	2	CO		59.0	F				L		
DR	92396	4	1	CO		74.0	M				L	B	
DR	92396	4	2	CO		72.0	F				L	B	
DR	92396	4	3	CO		68.0	F				L	B	
DR	92396	4	4	CO		78.0	M				L	B	
DR	92396	4	5	CO		73.0	M				L	B	
DR	92396	4	6	CO		73.0	M				L	B	
DR	101596	4	1	CO		67.3	F	8.7			L		
DR	101596	4	2	CO		71.5	F	9.3			L		
DR	101596	4	3	CO		70.0	F	8.5			L		
DR	101596	4	4	CO		70.8	M	8.4	Ad	6501	L	R	
DR	101596	4	5	CO		62.4	F	6.8			L		
DR	101596	4	6	CO		64.0	F	6.8	Ad	6502	L		
DR	101596	4	7	CO		64.8	F	7.1			L		
DR	101596	4	8	CO		60.6	F	5.6			L		
DR	101596	4	9	CO		62.4	F	6.7	Ad	6503	L		
DR	101596	4	10	CO		65.2	F	7.3			L		
DR	101596	4	11	CO		77.6	M	11.2			L	R	
DR	101596	4	12	CO		79.1	M	13.0			L	R	
DR	101596	4	13	CO		75.1	M	11.6			L	R	
DR	101596	4	14	CO		69.8	M	8.8	Ad	6504	L	R	
DR	101596	4	15	CO		64.1	F	7.0	Ad	6505	L		
DR	101596	4	16	CO		70.1	M	8.1			L		
DR	101596	4	17	CO		73.9	M	10.1			L	R	
DR	101596	4	18	CO		66.6	F	8.0	Ad	6506	L		
DR	101596	4	19	CO		69.1	F	8.8			L		
DR	101596	4	20	CO		61.8		6.8			L		
DR	101596	4	21	CO		65.0	F	7.5			L		
DR	101596	2	22	CO		71.6	M	8.7			L	R	
ss	100396	4	1	CO		58.0	F				L	B	
ss	100396	5	2	CO		63.0	M				L	B	
ss	101796	5	1	CO		66.0	M				L	D	
CAT	102996	3	20	CHUM		71.0	F				L		
CAT	102296	3	1	ST	R.2	80.0	F	10.5			D	WF	
SS	103096	5	1	ST	R.2	80.0	F	12.0			B	WF	