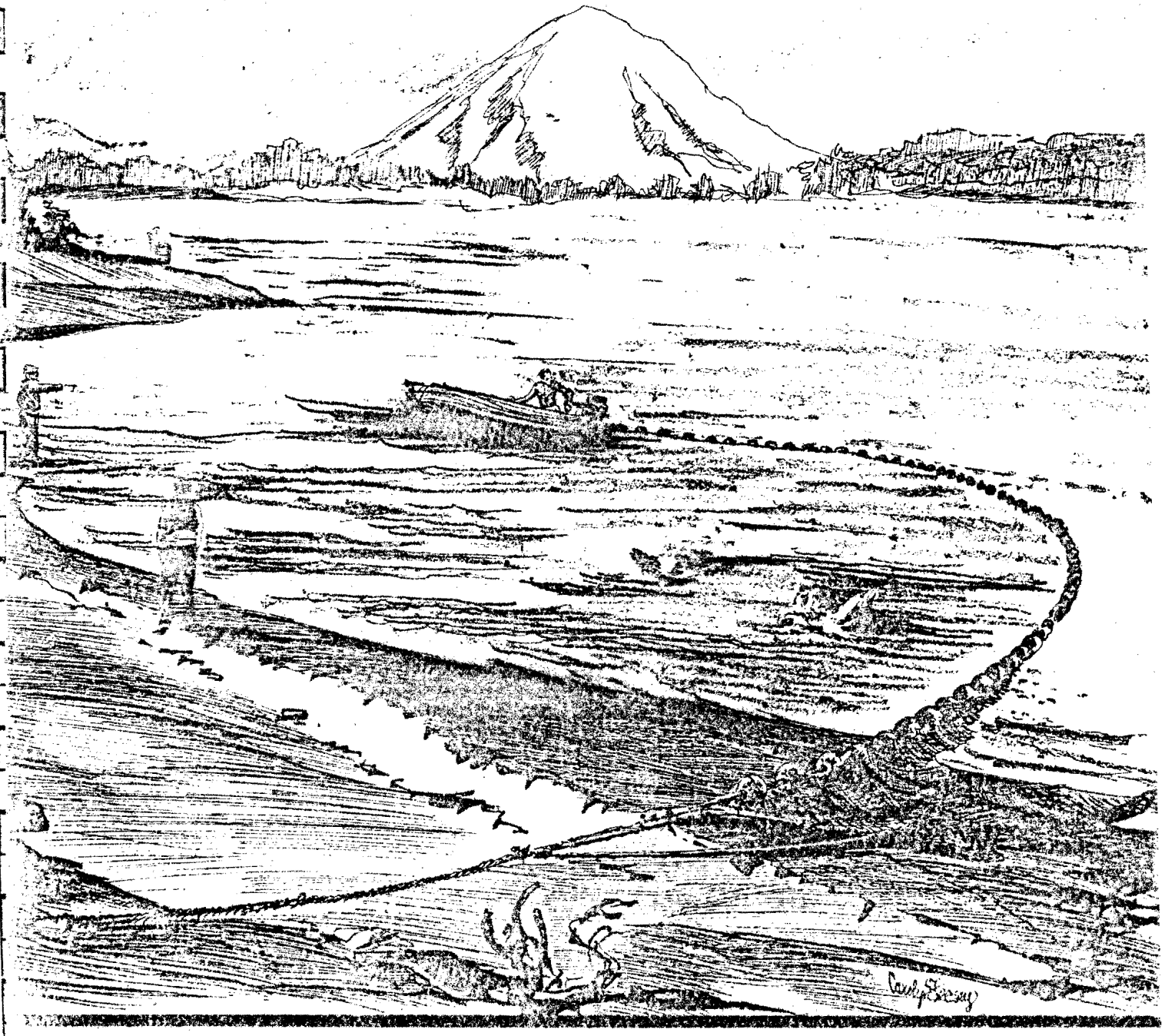
OCCURRENCE OF FISH NEAR THE KALAMA NUCLEAR POWER PLANT SITE COLUMBIA RIVER OCTOBER 1970 — OCTOBER 1973

National Marine Fisheries Service
Northwest Fisheries Center
Seattle, Washington



Prescott Field Facility
Environmental Research
Prescott, Oregon
1974

Appendix Table 1: Common and scientific names of fish mentioned in this report; from American Fisheries Society special publication N. 6, third edition, 1970.

COMMON NAME	SCIENTIFIC NAME
Rainbow trout	Salmo gairdneri Richardson
Steelhead trout 1/	Salmo gairdneri Richardson
Cutthroat trout	Salmo clarki Richardson
Chinook Salmon	Oncorhynchus tshawytscha (Walbaum)
Coho salmon	Oncorhynchus kisutch (Walbaum)
Mountain whitefish	Prosopium williamsoni (Girard)
Smelt (Eulachon)	Thaleichthys pacificus (Richardson)
Largemouth bass	Micropterus salmonides
White crappie	Pomoxis annularis
Northern squawfish	Ptychocheilus oregonensis
Largescale sucker	Catostomus macrocheilus

1/ Progeny from sea run stock

COMPLETION REPORT TO
CLARK AND COWLITZ COUNTIES
PUBLIC UTILITY DISTRICTS

OCCURRENCE OF FISH NEAR THE
KALAMA NUCLEAR POWER PLANT SITE
COLUMBIA RIVER
OCTOBER 1970--OCTOBER 1973

BY
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AND
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NATIONAL MARINE FISHERIES SERVICE
PRESCOTT ENVIRONMENTAL FACILITY
PRESCOTT, OREGON

JULY 1974

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The National Marine Fisheries Service appreciates the cooperative attitude of the public utility districts of Clark and Cowlitz Counties, Washington; special thanks to Mr. George Waters (Clark PUD) and Mr. Robert McKinney (Cowlitz PUD).

We would also like to express our appreciation to the following members of our staff: Messrs. Larry Davis, Ed Koller, Maurice Laird, and to Mrs. Deanna McDanial.

SYNOPSIS

1. Twenty-six species of fish were taken with beach seines during the 3 year study.
2. Young chinook, threespine stickleback, and American shad comprised 85% of the total catch.
3. Fish were present in the study area each month of the 36 month study.
4. Juvenile chinook were most abundant and were taken each month of the study.
5. Bimodal peak numbers occurred; non-salmonid in October and salmonid in April-May.
6. Sixty-three percent of the combined total catch occurred on the Oregon shore.

INTRODUCTION

In 1970 the National Marine Fisheries Service submitted a research proposal to the public utility districts of Clark and Cowlitz counties. The purpose of the proposed study was to gather data on the occurrence of fish, in the Columbia River, near the proposed Kalama nuclear power plant site (RM 78).[1/] The proposal was conceived subsequent to a review of the Washington State requirements for power plant siting, which outline the general biological parameters which require investigation prior to plant construction, i.e. Washington Administrative Code 463-12-035--Quality of the Environment--Natural Resources; (2) Fish and Wildlife; "(b) provide acceptable research or study plans for determining the abundance of distribution of, and project effects on wildlife, fish and other aquatic life, in the proposed project influence area." The proposal was presented to the commissioners of the public utility districts and representatives of the Washington State fisheries agencies during a meeting held at the NMFS Environmental Laboratory, Prescott, Oregon, on September 10, 1970. The proposed study was accepted, and cooperatively funded, for the period October 1970 to

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[1/]River mile (RM) refers to that distance in statue miles upstream from the end of the jettie which is located at the mouth of the Columbia River.

October 1973. This report outlines the procedures of fish collection (beach seining) and summarizes the data collected during the three year study.

BEACH SEINING PROCEDURE

Four sampling sites were established at sloping sandy beaches on both sides of the Columbia River--two upstream and two downstream from the proposed plant (Figure 1). Sampling areas 1 and 2 (RM 77) were established, during 1968-1969, coincidental to a fish occurrence study in relation to the Trojan Plant (McConnell, Snyder; 1970). Sites 3 and 4 (RM 79) were added in 1970 to bracket the proposed Kalama Plant site.

A seventeen foot power boat was used to fish the variable mesh seine used for all fish collections. The net was 500 feet long and tapered from 9 to 12 feet in depth; the net did not collect fish smaller than 1.5 inches (40 mm). All fish captured were identified, counted, examined, and released into the river.

Seining was scheduled twice weekly throughout the year; all beaches to be fished on the same day. The beaches were sampled in pairs (1-2 and 3-4) and usually all within four hours. However, due to adverse weather and/or river flow conditions, the schedule was altered on several occasions. Fishing frequency was increased during periods when concentrations

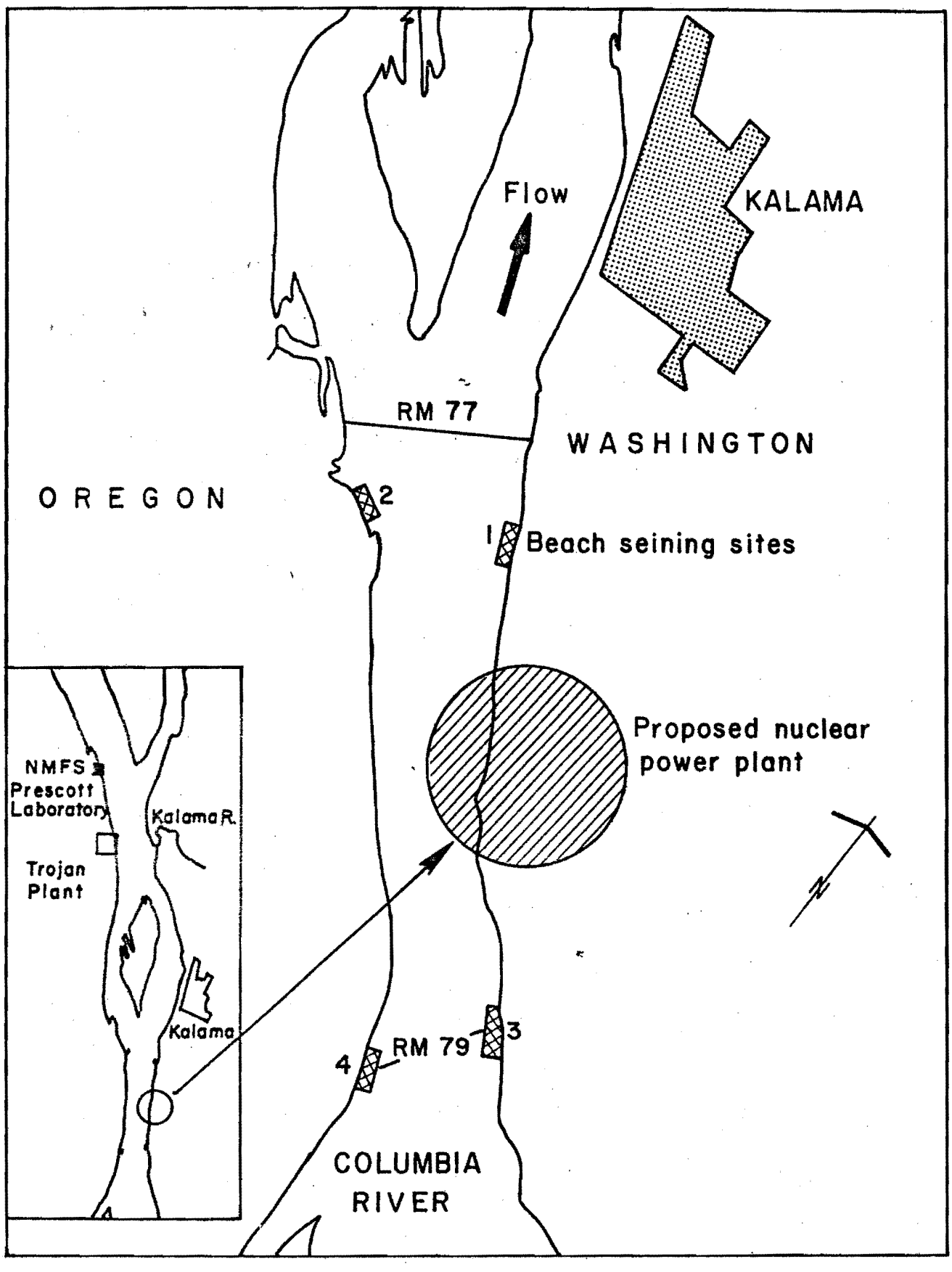

Figure 1—Location of proposed nuclear power plant and proximity of beach seining sites.

of hatchery released juvenile salmonids were moving through the lower Columbia River.

FISH OCCURRENCE

During the thirty-six month study 1044 net sets were made; 522 on each side of the Columbia River. Raw data collected during the study are compiled and attached as a separate item (data cards).

Fish found in the Columbia River between river mile 77 and 79 are predominantly freshwater and anadromous species; an exception, the juvenile starry flounder (a euryhaline fish) was common well above maximum saltwater intrusion. Twenty-six species (115,074 individual fish) were captured during the three year study. Juvenile chinook, threespine stickleback, and American shad accounted for 85% of the total catch. Table 1 is a list in descending order of occurrence of the fish captured; also included are eight additional species which have been reported to occur in the lower Willamette or lower Columbia above river mile 77.

Fish were present in the Kalama study area each month from October 1970 through September 1973. The overall peak catch occurred during the month of October; two species, threespine stickleback and American shad, account for 95% of the October peak while migrant juvenile salmonids make up the major part of the April and May catch (table 2).

Table 1 -- A list of fishes captured in the study area during 1970 to 1973, plus additional species reported in literature which may occur in the lower Columbia River.

Common Name	Scientific Name[1/]	Number Captured
Chinook salmon	*Oncorhynchus tshawytscha*	41,791
Threespine stickleback	*Gasterostus aculeatus*	38,284
American shad	*Alosa sapidissima*	17,950
Coho salmon	*Oncorhynchus kisutch*	6,928
Peamouth	*Mylocheilue caurinus*	4,247
Perch	*Perca flavescens*	1,072
Eulachon	*Thaleichthys pacificus*	946
Mountain whitefish	*Prosopium williamsoni*	581
Starry flounder	*Platichthys stellatus*	551
Carp	*Cyprinus carpio*	549
Largemouth sucker	*Catostomus macrocheilus*	515
Black crappie	*Pomoxis nigromaculatus*	410
Cutthroat trout	*Salmo clarki clarki*	253
White sturgeon	*Acipenser transmontanus*	197
Rainbow trout	*Salmo gairdneri*	176
Northern squawfish	*Ptychocheilus oregonensis*	169
Sculpin	*Cottus sp.*	152
Largemouth bass	*Micropterus salmonides*	146
Chiselmouth	*Acrocheilus alutaceus*	77
Chum salmon	*Oncorhynchus keta*	29
Sockeye salmon	*Oncorhynchus nerka*	26
Bluegill	*Lepomis macrochirus*	9
Red-sided shiner	*Richardsonius balteatus*	7
Pacific lamprey	*Entospenus tridentatus*	7
Brown bullhead	*Ictalurus nebulosus*	1
Smallmouth bass	*Micropterus dolomieui*	1
Total		115,074

Species reported in literature

Sand roller	*Percopsis transmontana*
Longfin smelt	*Spirinchus thaleichthys*
White crappie	*Pomoxis annularis*
Walleye	*Stizostedion vitreum*
Oregon chub	*Hybopsis crameri*
Tench	*Tinca tinca*
Dace sp.	*Rhinichthys sp.*
Striped bass	*Morone saxatilis*

[1/] From American Fisheries Society Special Publication No. 6, 1970.

Table 2 -- Monthly catch per net set of fish captured in the lower Columbia River (RM 77 to 79) during October 1970-September 1973.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Wash.	Ore.
Total net sets 1970-1973	54	76	82	134	94	64	90	104	96	84	92	74	522	522
	CATCH PER NET SET													
Chinook	2.4	4.4	7.6	99.7	135.6	66.5	54.9	19.1	11.3	10.4	10.6	6.3	34.0	46.0
Stickleback	9.9	7.0	29.3	36.1	14.6	1.8	29.6	14.7	38.9	157.9	73.9	6.9	28.0	45.3
Shad	.2	X		X	3.6	4.1	1.6	60.9	37.5	114.4	7.4	1.8	5.7	28.6
Coho	X[1/]			16.5	48.0	.5	X	X	.7	.6	X	X	6.2	7.1
Peamouth	X	X	8.2	6.7	8.4	6.2	7.4	4.3	1.5	X	X	X	3.0	5.1
Eulachon		.4	11.1[2/]	X									1.7	X
Whitefish	X	X	X	X	X	.6	1.5	1.9	.5	X	X	X	.6	.5
Starry flounder	.9	.9	.6	X	X	X	X	X	.7	1.3	.6	.5	.3	.7
Carp	X	X	1.4	.4	1.7	.4	.6	.7	.3	.2	X	.2	.2	.9
Sucker	X	X	.2	.5	1.1	.8	.4	1.5	.4	.3	.1	X	.3	.6
Crappie	.4	.1	.1	.2	.4	.1	1.2	.8	.4	X	.1	.7	.2	.6
Cutthroat	X	X	.2	.8	.4	X	X	X	.3	.3	.1	X	.3	.2
White sturgeon	X	X	X	X	.2	1.1	.3	X	.2	.3	.2		X	.4
Rainbow	X	X	.2	.3	.4	.2	X	X	X	.1	.2	.2	.2	.2
Squawfish		X	X	X	.5	.2	.2	.5	.1	X	X		.2	.1
Sculpin	.2	.3	.4	X	X	X	X	.1	.1		X	.4	.1	.2
Largemouth bass		X	X	X	X	X	.3	.8	.2	X	X	X	.1	.1
Total	15.0	14.0	62.0	165.0	218.0	83.0	101.0	76.0	94.0	286.0	95.0	18.0	82.0	139.0

1/ X represents less than .1 fish per net set.

2/ Underlined represents peak occurrence.

The monthly occurrence of fish and the peak month of capture for each species is presented in table 2. This list does not include those species which averaged less than .1 fish per net set for the three year period.

Juvenile chinook salmon were the most abundant and were present each month of the 36 month study. The largest numbers of chinook were captured in April 1971, May 1972, and May 1973, tables 3-8. In 1971 approximately 40,000,000 fall chinook were released in the lower Columbia River during the week of April 26, this explains the early peak out-migration (1971).

Young coho salmon were more abundant during May 1971, May 1972, and April 1973, tables 3-8. Coho were not present in the study area during February or March.

The small numbers of sockeye salmon, rainbow, and cutthroat trout captured by beach seines during this study is not indicative to the numbers present in the study area. For example in the 1968-1969 study (McConnell, Snyder; 1970) when both beach and purse seines were fished 97% of the sockeye, 84% of the rainbow and 80% of the cutthroat trout were captured by purse seines. This demonstrates the effect of gear selectivity for various species of fish e.g. sockeye salmon and rainbow trout can be captured more successfully with purse seines than with beach seines.

Threespine stickleback, the second most abundant species, were present in the study area during 35 of the 36 months of sampling; peak catches occurred in October.

Table 3 -- Occurrence of fishes captured on Washington beach sites (1 - 3) October 1970-September 1971.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Species Totals
Chinook	161	144	44	7	79	50	4,176	1,405	146	651	194	143	7,200
Coho	18	5	6	-	-	-	220	242	4	-	-	57	552
Sockeye	-	-	-	-	-	-	-	1	-	-	-	-	1
Rainbow	8	6	5	1	1	1	17	5	1	-	3	-	48
Cutthroat	1	1	1	-	-	-	23	3	1	-	2	10	42
Sub-total													7,843
Stickleback	188	749	128	-	6	-	15	-	2	502	1,084	1,547	4,221
Shad	346	27	-	-	-	-	-	-	-	5	43	313	734
Peamouth	2	28	1	-	11	2	22	31	17	174	99	34	421
Whitefish	1	-	-	1	2	-	45	-	1	54	73	13	190
Eulachon	-	-	-	-	26	64	1	-	-	-	-	-	91
Crappie	-	2	-	-	-	1	3	7	1	10	38	-	62
Largemouth bass	-	-	-	-	-	-	1	-	-	8	37	3	49
Perch	-	-	-	-	3	-	1	19	1	1	7	-	32
Carp	1	-	2	-	2	-	2	10	1	5	5	1	29
Flounder	9	5	2	4	5	-	1	-	-	-	1	2	29
Squawfish	-	2	-	-	-	-	1	2	-	1	13	6	25
Sucker	5	3	-	-	-	-	1	4	-	1	4	4	22
Cottus sp.	-	-	-	-	11	1	-	1	-	3	-	1	17
Chiselmouth	-	-	-	-	-	-	-	-	-	-	3	-	3
Bluegill	-	-	-	-	-	-	-	-	-	-	2	-	2
Red-sided shiner	-	-	-	-	-	-	-	-	-	-	2	-	2
Sturgeon	1	1	-	-	-	-	-	-	-	-	-	-	2
Sub-total													5,931
Grand Total	741	973	189	13	146	119	4,529	1,730	175	1,415	1,610	2,134	13,774
# Sets	12	16	14	4	12	14	24	10	9	17	18	16	166
Catch per net set	62	61	14	3	12	8	189	173	19	83	89	133	83

Table 4 -- Occurrence of fishes captured on Oregon beach sites (2 - 4) October 1970-September 1971.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Species Totals
Chinook	141	141	110	63	67	132	4,214	1,361	877	1,354	420	170	9,050
Coho	1	3	-	-	-	-	852	459	11	3	-	8	1,337
Sockeye	-	-	1	-	2	3	2	-	1	1	-	-	10
Chum	-	-	-	-	-	-	1	-	-	-	-	-	1
Rainbow	-	10	5	2	4	6	17	9	3	1	-	1	58
Cutthroat	2	-	1	-	1	-	18	5	1	1	-	5	34
Sub-total													10,490
Shad	1,516	313	122	8	7	-	-	-	3	54	1,644	1,820	5,487
Stickleback	268	781	164	14	10	2	57	3	-	1,523	218	202	3,242
Peamouth	2	4	13	1	7	177	265	97	70	232	157	45	1,070
Perch	-	-	-	1	5	47	278	70	1	80	28	41	551
Crappie	-	3	28	12	5	6	11	3	-	80	32	28	208
Whitefish	-	3	1	-	-	-	-	-	30	67	87	20	208
Carp	3	2	3	-	4	2	23	46	7	14	32	14	150
Sucker	-	2	1	1	-	1	4	4	3	12	55	10	93
Flounder	5	12	19	9	4	3	-	2	2	10	1	5	72
Eulachon	-	-	-	-	6	34	-	-	-	-	-	-	40
Squawfish	2	-	-	-	2	5	3	2	-	6	15	4	39
Largemouth bass	2	1	1	-	-	-	1	-	1	6	14	7	33
Chiselmouth	-	1	-	-	-	-	4	-	1	3	11	-	20
Sturgeon	9	2	-	-	-	-	-	-	-	-	-	6	17
Cottus sp.	-	1	-	-	7	3	-	-	-	1	-	1	13
Bluegill	-	-	-	-	-	-	-	2	2	1	-	-	5
Lamprey	-	-	-	1	-	-	1	1	-	-	-	-	3
Red-sided shiner	-	1	-	-	-	-	-	-	-	2	-	-	3
Bullhead	-	-	1	-	-	-	-	-	-	-	-	-	1
Smallmouth bass	1	-	-	-	-	-	-	-	-	-	-	-	1
Sub-total													11,256
Grand Total	1,952	1,280	470	112	131	421	5,751	2,064	1,013	3,451	2,714	2,387	21,746
# Sets	12	16	14	4	12	14	24	10	9	17	18	16	166
Catch per net set	163	80	34	28	11	30	240	206	112	203	151	149	107

Table 5 -- Occurrence of fishes captured on Washington beach sites (1 - 3) October 1971-September 1972.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Species Totals
Chinook	69	90	100	9	27	23	1,015	2,459	146	356	243	155	4,692
Coho	5	4	4	-	-	-	481	1,587	-	1	-	1	2,083
Sockeye	-	-	-	-	-	-	-	1	-	-	-	-	1
Rainbow	-	2	-	-	-	1	2	5	-	2	-	1	13
Cutthroat	4	4	2	-	1	1	31	17	-	2	1	9	72
Sub-total													6,861
Stickleback	699	1,154	3	34	40	21	85	46	-	373	101	1,044	3,600
Shad	761	-	-	-	-	-	-	-	1	2	67	34	865
Eulachon	-	-	-	-	-	812	-	-	-	-	-	-	812
Peamouth	31	14	2	-	1	119	89	204	146	80	88	32	806
Sucker	4	-	-	-	-	-	7	48	2	4	33	1	99
Perch	-	-	-	-	4	13	15	3	-	50	3	2	90
Whitefish	1	3	2	-	1	6	1	1	-	7	30	9	61
Chiselmouth	-	-	-	-	-	-	-	-	-	54	-	-	54
Carp	3	-	-	-	-	2	3	16	4	6	4	2	40
Cottus sp.	-	-	-	-	2	18	-	2	2	-	7	6	37
Squawfish	-	-	-	-	-	-	-	2	-	4	22	3	31
Crappie	-	-	1	-	2	-	4	4	1	1	4	1	18
Largemouth bass	-	2	-	-	-	-	-	1	-	2	9	1	15
Flounder	5	1	-	2	-	-	-	-	-	-	-	4	12
Bluegill	-	-	-	-	-	-	-	-	-	-	-	1	1
Sub-total													6,541
Grand Total	1,582	1,274	114	45	78	1,016	1,733	4,396	302	944	612	1,306	13,402
# Sets	12	14	14	6	12	9	25	19	7	10	18	16	162
Catch per net set	132	91	8	8	6	113	69	220	43	94	34	82	83

Table 6 -- Occurrence of fishes captured on Oregon beach sites (2 - 4) October 1971-September 1972.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Species Totals
Chinook	209	140	93	11	78	83	1,637	2,804	236	973	643	348	7,255
Coho	21	-	1	1	-	-	186	1,979	1	-	-	1	2,190
Sockeye	-	1	-	-	-	1	2	3	1	-	-	-	8
Rainbow	1	2	1	-	-	4	2	4	2	1	1	1	19
Cutthroat	3	1	-	1	-	1	11	13	-	-	4	7	41
Sub-total													9,513
Stickleback	3,110	1,961	124	34	19	8	1,049	66	3	261	125	939	7,699
Shad	2,187	5	9	1	-	-	-	-	3	21	1,221	1,111	4,558
Peamouth	11	3	-	-	4	346	192	274	41	31	84	16	1,002
Perch	12	1	3	-	20	79	79	40	-	12	36	8	290
Carp	4	4	1	-	1	106	12	48	11	12	27	8	234
Sucker	4	-	-	-	-	6	6	24	11	6	55	19	131
Crappie	2	6	14	1	1	2	8	16	2	12	6	5	75
Cottus sp.	-	2	8	1	4	8	4	1	-	2	7	2	39
Largemouth bass	1	1	-	-	1	1	-	4	1	10	8	8	35
Whitefish	7	-	4	3	-	2	1	1	-	1	12	2	33
Flounder	7	5	4	1	1	1	-	1	-	-	1	4	25
Sturgeon	1	2	-	-	-	-	-	-	-	-	5	17	25
Squawfish	2	1	-	-	-	-	-	5	-	2	5	1	16
Eulachon	-	-	-	-	-	3	-	-	-	-	-	-	3
Lamprey	-	-	-	-	-	-	-	1	-	-	-	-	1
Sub-total													14,166
Grand Total	5,582	2,135	262	54	129	651	3,189	5,284	312	1,344	2,240	2,497	23,679
# Sets	12	14	14	6	12	9	25	19	7	10	18	16	162
Catch per net set	465	148	19	9	11	72	128	278	44	134	124	156	146

Table 7 -- Occurrence of fishes captured on Washington beach sites (1 - 3) October 1972-September 1973.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Species Totals
Chinook	126	235	63	16	37	207	803	2,250	1,056	620	305	138	5,856
Coho	1	1	1	1	-	-	414	167	15	1	1	2	604
Sockeye	-	-	-	-	-	2	1	1	1	-	-	-	5
Chum	-	-	-	-	-	-	-	7	1	-	-	-	8
Rainbow	-	1	-	-	-	1	3	11	5	2	-	-	23
Cutthroat	10	2	1	3	1	10	9	4	-	-	-	1	41
Sub-total													6,537
Stickleback	2,392	786	28	256	179	1,194	1,454	466	53	2	-	-	6,810
Shad	1,084	5	-	-	-	-	-	163	100	28	9	8	1,397
Peamouth	18	16	10	1	2	7	67	91	65	60	12	14	363
Flounder	10	10	1	13	21	10	24	7	4	7	6	9	122
Sucker	6	4	1	1	1	1	6	5	21	3	4	3	56
Whitefish	11	10	8	4	5	3	1	-	9	2	1	1	55
Squawfish	2	-	-	-	-	-	-	27	4	2	2	-	37
Carp	1*	-	-	-	-	-	1	7	-	2	1	3	15
Crappie	-	-	1	4	-	-	1	2	-	1	-	-	9
Cottus sp.	-	-	2	1	-	2	-	-	-	1	-	-	6
Perch	-	-	1	-	-	-	3	-	1	-	-	-	5
Largemouth bass	1	-	1	-	-	1	-	1	1	-	-	-	5
Sturgeon	-	-	-	1	-	1	-	-	-	-	-	-	2
Bluegill	-	-	1	-	-	-	-	-	-	-	-	-	1
Sub-total													8,883
Grand Total	3,662	1,070	119	301	246	1,439	2,787	3,209	1,336	731	341	179	15,420
# Sets	18	16	9	17	14	18	18	18	16	18	16	16	194
Catch per net set	203	67	13	18	18	80	155	178	84	41	21	11	80

Table 8 -- Occurrence of fishes captured on Oregon beach sites (2 - 4) October 1972-September 1973.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Species Totals
Chinook	168	227	59	26	45	132	1,513	2,472	1,793	989	180	134	7,738
Coho	1	6	2	-	-	-	43	107	-	2	-	1	162
Sockeye	-	-	-	-	-	-	-	-	-	1	-	-	1
Chum	-	-	-	-	-	-	-	20	-	-	-	-	20
Rainbow	-	-	1	2	1	4	4	1	2	-	-	-	15
Cutthroat	2	5	-	-	1	3	10	-	-	-	1	1	23
Sub-total													7,959
Stickleback	6,580	1,373	63	198	279	1,179	2,177	795	60	7	-	1	12,712
Shad	3,720	327	-	-	-	-	3	173	154	38	183	311	4,909
Peamouth	8	3	16	6	3	21	267	93	60	93	11	4	585
Flounder	20	19	12	19	37	35	26	21	22	18	19	43	291
Sturgeon	13	12	-	-	1	7	2	21	68	27	-	-	151
Sucker	5	5	4	-	3	13	45	29	11	6	2	1	114
Perch	1	-	10	2	-	4	56	23	5	2	-	1	104
Carp	9	1	9	3	-	6	12	20	5	11	3	2	81
Cottus sp.	-	1	22	11	1	1	-	-	4	-	-	-	40
Crappie	1	-	8	4	-	-	6	9	3	5	2	-	38
Whitefish	7	12	1	6	1	2	1	-	2	2	-	-	34
Squawfish	1	-	-	-	-	-	2	9	9	-	-	-	21
Largemouth bass	3	-	3	-	-	-	-	-	-	-	2	1	9
Lamprey	-	-	1	-	-	-	-	1	-	1	-	-	3
Red-sided shiner	-	-	-	-	-	-	-	2	-	-	-	-	2
Sub-total													19,094
Grand Total	10,539	1,991	211	277	372	1,407	4,167	3,786	2,198	1,202	403	500	27,053
# Sets	18	16	9	17	14	18	18	18	16	18	16	16	194
Catch per net set	586	124	23	16	27	78	232	210	137	67	25	31	139

Juvenile American shad were most abundant during October and the third most common species in the area.

Eulachon (Columbia River Smelt) did not occur in the study area each year; they were captured in 1971 and 1972 and were absent during 1973. They occur during February, March, and April; with peak catch occurring in March.

RELATIVE DISTRIBUTION--OREGON TO WASHINGTON SHORES

Sixty-three percent of the combined catch occurred on the Oregon side of the Columbia River; this did not vary significantly from year to year and corresponds with earlier data collected in 1968 and 1969 (McConnell, Snyder; 1970). Table 9 shows the percent of fish, by species, which were captured each year on the Oregon side of the river. (Species not captured in numbers large enough to establish a pattern are deleted from the table). Species demonstrating a strong preference for the Oregon side were white sturgeon, yellow perch, carp, and American shad; for the Washington side, cutthroat trout, and eulachon. Figure 2 shows the relative distribution of fish on the Oregon and Washington side of the river during each sample year, and also the combined three year catch.

RELATED WATER QUALITY PARAMETERS

Environmental parameters taken concurrently with the collection of fish at the Kalama site, were water temperature,

Table 9--Percent of fish captured on the Oregon side of the Columbia River during a three year study, 1970-1973.

YEAR	1971	1972	1973	Three Years Combined
SPECIES		PERCENT		
Chinook	56	61	57	58
Stickleback	*44	68	65	62
Shad	88	84	78	83
Coho	71	51	*31	54
Peamouth	72	56	62	63
Perch	95	76	95	88
Eulachon	*30	*1		*5
Whitefish	52	*35	*38	*47
Starry flounder	71	68	70	70
Carp	84	85	84	85
Sucker	81	57	67	66
Crappie	77	81	81	78
Cutthroat	*45	*36	*36	*39
White sturgeon	89	100	99	98
Rainbow	55	59	*39	52
Squawfish	61	*34	*36	*45
Sculpin	*43	51	87	60
Largemouth bass	*40	70	64	53
Percent Total Catch	61	64	64	63

*Species more abundant on the Washington beaches.

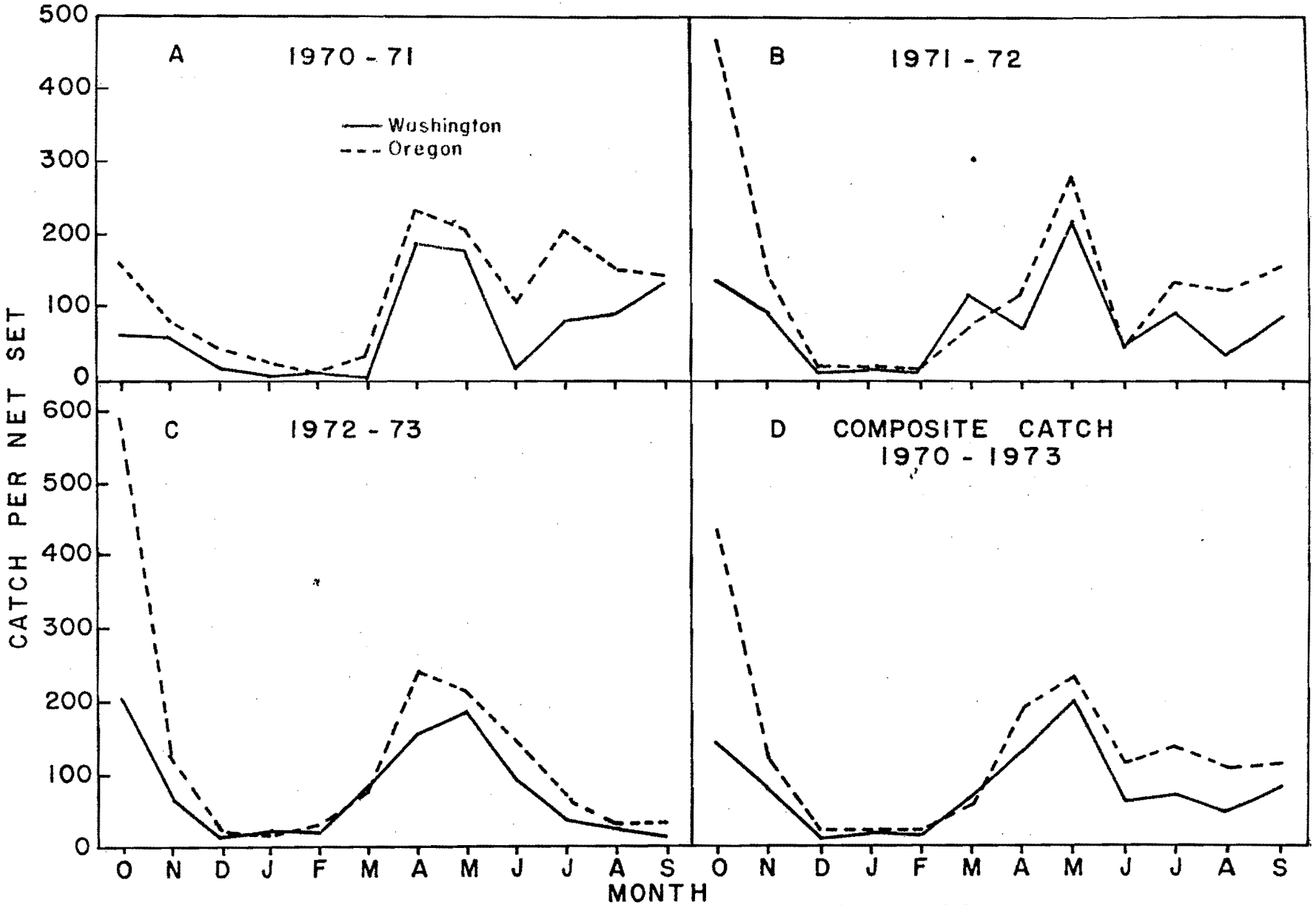

Figure 2—Monthly catch per net set of fish captured on Washington and Oregon beaches of the Columbia River near the proposed site for a nuclear power plant (River mile 78). The data was collected during a three year study, 1970-1973.

depth visibility, and dissolved gases. Although it is indicated that slight differences in water temperature, depth visibility, and gas saturation exist between the Washington and Oregon sides of the river it is doubtful that they are of the magnitude that would effect fish distribution.

Water temperatures were recorded at the conclusion of each net set. A comparison of the monthly average temperatures by site during the three years shows that water temperatures are generally warmer on the Oregon side of the river (table 10).

Depth Visibility, or the amount of light which penetrates the water mass, can influence fish distribution and the efficiency of capturing devices. A Secchi Disk was used as the index of visibility during each net set, the average depth of light penetration is presented in table 10 and indicates that visibility is greater on the Washington side during most months.

Dissolved gas concentrations and river flow influence the survival and occurrence of fish in the Kalama area. These two variables are generally related in the lower Columbia River. When the weekly average spillway discharge at Bonneville Dam is at least 150,000 cubic feet per second the dissolved gas concentrations in the study area exceed the state standards of 110% (McConnell, Blahm, Davis; 1973).

Table 10 -- Low, high, and average monthly temperatures and depth visibility at sample sites (figure 1) used during the fish occurrence study.

Date	Site	Temperature °C			Visibility Feet		
		Low	High	Ave.	Low	High	Ave.
1970							
Oct.	1	13.0	16.0	14.2	5.5	7.0	6.2
	3	13.0	16.0	14.1	5.5	6.5	6.0
	2	12.0	17.5	14.2	3.5	5.0	4.3
	4	12.0	17.0	14.1	4.0	5.0	4.3
Nov.	1	7.5	13.0	10.9	3.5	7.0	5.6
	3	8.0	13.0	10.9	4.5	7.5	6.0
	2	7.5	13.0	10.5	1.0	4.7	3.7
	4	8.0	13.0	10.6	1.0	5.0	3.6
Dec.	1	5.5	8.0	6.9	1.5	5.5	3.9
	3	5.5	7.5	6.8	3.5	6.0	4.7
	2	6.0	8.0	7.0	1.0	4.5	2.1
	4	5.5	8.0	6.9	1.5	3.0	1.7
1971							
Jan.	1	4.5	5.0	4.8	3.4	3.5	3.5
	3	4.5	5.0	4.7	3.2	3.5	3.4
	2	5.0	5.0	5.0	1.0	2.4	1.7
	4	4.5	5.5	5.0	1.0	1.0	1.0
Feb.	1	6.0	6.5	6.3	0.7	3.0	1.8
	3	5.5	6.5	6.0	0.7	3.0	1.7
	2	6.5	8.0	7.1	0.8	1.8	1.0
	4	6.5	9.0	7.6	0.8	2.5	1.6
March	1	5.0	7.0	5.9	2.2	4.0	3.1
	3	4.5	7.0	5.4	2.0	3.5	2.9
	2	6.5	8.5	7.6	1.0	2.2	1.8
	4	6.5	9.0	7.6	1.0	2.5	1.9
April	1	7.5	11.0	9.8	1.7	3.0	2.3
	3	8.0	11.0	9.4	2.0	2.8	2.2
	2	8.5	12.5	10.7	1.5	3.0	2.4
	4	9.0	14.0	10.7	1.8	2.8	2.2
May	1	-	-	-	-	-	-
	3	12.0	14.5	13.3	1.7	2.8	2.1
	2	-	-	-	-	-	-
	4	11.2	16.0	13.9	2.2	2.7	2.4
June	1	13.5	16.0	14.5	2.0	5.0	2.3
	3	-	-	-	-	-	-
	2	14.0	17.0	15.3	2.2	2.8	2.5
	4	-	-	-	-	-	-

Table 10 -- Continued

Date	Site	Temperature °C			Visibility Feet		
		Low	High	Ave.	Low	High	Ave.
1971							
July	1	16.0	22.0	18.7	2.5	4.2	3.2
	3	16.5	22.0	19.0	2.8	4.8	3.2
	2	17.0	21.5	19.0	2.0	3.2	2.5
	4	17.5	23.0	20.3	1.8	2.8	2.8
Aug.	1	20.0	23.0	22.1	3.8	6.0	4.7
	3	20.0	23.5	22.3	3.2	5.8	4.7
	2	20.0	23.5	22.2	2.0	4.0	2.9
	4	20.0	24.0	22.6	1.5	3.0	2.5
Sept.	1	17.0	20.5	19.1	4.8	5.5	5.4
	3	17.5	20.5	19.3	4.8	5.5	5.2
	2	17.0	20.0	19.0	1.2	3.8	3.1
	4	17.0	21.0	19.4	1.0	4.0	2.5
Oct.	1	12.5	17.0	15.3	4.5	6.0	5.2
	3	12.5	17.0	15.1	4.0	6.0	5.6
	2	12.0	17.0	15.2	3.2	5.0	3.7
	4	12.0	17.5	15.2	2.8	4.0	3.4
Nov.	1	8.0	11.0	9.6	3.0	6.5	5.6
	3	8.0	12.0	9.7	3.2	6.0	5.5
	2	9.0	11.5	9.5	1.2	4.0	2.8
	4	8.0	11.5	9.5	1.7	4.0	2.8
Dec.	1	4.5	8.0	6.7	2.5	3.8	3.1
	3	4.5	8.0	6.6	2.5	3.5	3.1
	2	4.0	8.0	6.4	0.8	3.0	1.1
	4	4.5	8.0	6.4	0.8	2.0	1.5
1972							
Jan.	1	5.0	5.0	5.0	2.5	3.8	3.2
	3	5.0	5.0	5.0	2.5	3.8	3.2
	2	5.0	5.5	5.3	1.2	2.8	1.8
	4	5.0	5.5	5.3	1.0	2.5	1.7
Feb.	1	3.5	6.0	4.8	1.0	2.0	1.5
	3	3.0	6.0	4.4	1.0	2.0	1.5
	2	4.5	7.5	6.5	1.0	1.8	1.2
	4	5.0	8.0	6.7	1.0	1.7	1.1
March	1	5.0	9.0	7.2	0.8	1.0	1.0
	3	-	-	-	-	-	-
	2	7.0	11.5	9.4	0.5	1.2	0.9
	4	-	-	-	-	-	-

Table 10 -- Continued

Date	Site	Temperature °C			Visibility Feet		
1972		Low	High	Ave.	Low	High	Ave.
April	1	7.5	11.0	8.7	1.8	2.2	2.0
	3	8.0	10.0	9.2	2.0	2.5	2.2
	2	9.0	12.5	10.5	1.7	2.5	2.1
	4	9.5	12.0	10.7	1.4	2.5	2.0
May	1	11.5	14.5	12.8	2.0	2.5	2.2
	3	11.0	13.5	12.0	2.2	2.5	2.3
	2	12.0	15.5	13.8	2.0	3.0	2.5
	4	12.5	16.0	13.6	2.2	2.8	2.5
June	1	13.0	16.5	15.0	1.2	2.0	1.5
	3	-	-	-	-	-	-
	2	14.0	17.5	16.0	1.5	2.0	1.8
	4	-	-	-	-	-	-
July	1	17.0	21.0	18.7	-	-	-
	3	17.0	20.0	19.2	-	-	-
	2	18.0	20.0	18.9	-	-	-
	4	18.0	21.0	19.7	-	-	-
Aug.	1	16.0	24.0	20.6	2.8	5.0	3.5
	3	20.0	21.5	20.7	2.3	5.0	3.9
	2	20.0	22.2	21.3	1.5	3.0	2.7
	4	20.5	22.5	21.6	2.0	3.0	2.3
Sept.	1	15.5	20.5	18.8	4.0	6.8	5.4
	3	16.0	20.5	18.5	4.5	6.2	5.7
	2	15.5	21.0	18.5	3.3	4.5	3.6
	4	15.0	21.0	18.8	2.8	4.0	3.5
Oct.	1	12.5	16.5	14.8	5.0	6.5	5.7
	3	12.5	17.5	14.7	4.5	6.0	5.5
	2	12.5	16.5	14.5	3.0	5.0	4.1
	4	12.5	17.0	14.8	3.2	4.2	3.9
Nov.	1	9.5	12.5	10.9	5.0	6.8	6.1
	3	9.5	12.5	11.0	4.8	6.2	5.7
	2	9.5	12.0	10.5	3.8	4.8	4.3
	4	9.0	12.0	10.4	3.5	4.5	4.2
Dec.	1	3.0	8.5	5.6	1.5	6.0	3.6
	3	3.5	8.5	5.8	2.5	7.0	4.4
	2	3.0	8.0	6.5	1.0	3.2	2.0
	4	3.0	8.0	5.2	1.0	3.2	2.1

Table 10 -- Continued

Date	Site	Temperature °C			Visibility Feet		
1973		Low	High	Ave.	Low	High	Ave.
Jan.	1	2.0	5.6	3.7	1.5	4.2	1.7
	3	2.0	5.0	3.5	1.5	4.5	3.5
	2	2.0	7.0	4.3	1.2	2.5	1.8
	4	1.5	5.5	4.2	1.2	2.5	2.1
Feb.	1	3.5	6.0	4.4	1.5	4.0	2.9
	3	3.5	5.0	4.2	1.5	4.2	3.0
	2	4.5	7.5	5.7	1.8	3.0	2.4
	4	5.0	6.5	5.9	1.5	2.8	2.3
March	1	5.3	8.0	7.2	3.5	4.5	5.2
	3	6.0	8.0	6.7	4.0	5.8	4.4
	2	7.0	9.0	7.9	2.2	4.0	2.8
	4	7.0	9.0	8.0	2.5	4.5	4.4
April	1	9.0	11.0	10.0	4.0	4.5	4.1
	3	10.0	10.5	10.2	4.0	4.5	4.1
	2	9.0	11.0	10.5	2.5	4.0	3.3
	4	10.0	12.0	10.8	2.5	4.0	3.3
May	1	10.4	17.0	14.3	3.5	4.0	3.7
	3	10.0	17.5	14.0	3.0	4.0	3.7
	2	10.5	18.0	14.7	3.0	3.5	3.3
	4	10.5	18.5	14.9	3.0	3.5	3.3
June	1	16.5	19.0	17.0	3.5	4.5	3.7
	3	16.0	18.5	17.1	3.0	4.5	3.9
	2	17.0	20.0	18.1	2.5	3.5	3.1
	4	17.0	19.5	18.2	2.5	3.0	2.9
July	1	18.5	22.0	20.4	3.5	7.5	5.1
	3	19.0	22.0	20.9	3.5	6.5	3.9
	2	18.5	25.0	21.4	3.0	5.0	3.7
	4	19.0	24.5	21.6	3.0	4.0	3.4
Aug.	1	19.5	22.5	20.8	5.0	6.5	5.8
	3	19.5	22.5	20.8	5.0	6.0	5.8
	2	19.5	22.5	20.8	3.5	4.0	3.8
	4	19.5	22.5	21.4	3.5	4.5	3.2
Sept.	1	17.5	20.0	18.8	5.0	7.0	5.7
	3	18.0	20.0	19.0	5.0	6.5	5.7
	2	17.5	21.0	19.3	3.5	4.5	3.9
	4	17.5	21.5	19.5	3.5	4.5	3.7

During the years 1971, 1972, and 1973 the nitrogen gas concentrations reached "highs" of 133.3%, 131.6%, and 107.0% respectively. Table 11 is a compilation of the gas saturation levels and associated water temperatures taken at Prescott, Oregon during the study.

During periods of gas supersaturation, fish captured in the Kalama area were examined for symptoms of gas bubble disease. All species of fish captured showed external gas bubble disease symptoms: coho salmon having as high as 34.5% incidence.

Transectional samples taken from the river at Prescott and in the Kalama study area show higher gas levels on the Washington side of the river. Although the reason for these shore to shore differences has not been determined, it may be due to the proximity of the ship channel.

OTHER AQUATIC ORGANISMS

The National Marine Fisheries Service has conducted some studies related to the secondary organisms found in the Prescott-Kalama area of the Columbia River. Zooplankton has been collected near Kalama since 1967: Clark S.M., and G.R. Snyder (1970), Craddock, et all (1973), and Misitano (1973). In 1968-69 a study was conducted by Craddock, Blahm, and Parente (MS, 1973) to determine the utilization of zooplankton and insects by juvenile chinook in the study area.

Table 11 -- Percent oxygen and nitrogen gas saturation plus related water temperatures in the Washington and Oregon portions of the Columbia River at Prescott, Oregon (seven miles downstream from Kalama, Washington.

Date	Oregon			Washington		
	Temp.	% O_2	% N_2	Temp.	% O_2	% N_2
1971						
March 18	6.1	104.9	109.6	5.3	108.0	110.6
April 27	9.9	104.4	113.1	9.7	108.8	115.8
May 11	12.7	114.2	122.6	12.8	120.9	133.3
21	11.8	111.9	121.5	11.5	113.4	122.7
27	12.8	112.1	120.5	12.5	119.3	125.5
June 7	12.9	114.3	123.4	13.1	120.2	128.7
14	13.9	112.5	121.2	13.6	116.0	127.4
21	15.1	119.7	123.9	15.1	122.3	130.4
28	15.4	114.1	120.9	15.0	120.8	127.0
July 12	16.1	112.4	117.0	15.6	116.4	121.0
20	19.1	116.1	119.4	18.7	118.4	120.3
30	21.0	107.0	109.7	20.7	107.9	110.0
Aug. 10	22.0	107.0	107.1	21.9	105.9	107.0
1972						
Jan. 25	6.5	105.3	116.1	4.8	99.3	106.2
31	2.6	106.3	112.4	2.0	98.1	102.4
Feb. 8	2.9	98.7	105.2	2.2	94.5	100.6
17	5.3	103.3	107.7	4.0	99.8	103.6
23	5.4	105.9	111.3	3.9	103.7	109.6
March 7	7.2	110.9	118.2	5.4	111.1	113.9
13	7.5	111.3	117.8	6.0	110.8	116.4
22	8.6	112.3	119.8	8.8	119.0	126.2
31	7.6	113.0	118.5	7.4	115.5	124.2
April 7	7.9	106.2	114.4	6.8	106.7	112.9
15	8.5	105.0	114.4	8.2	116.2	116.8
20	8.8	106.3	115.7	8.2	113.4	118.9
26	9.3	105.4	105.4	8.6	107.0	108.1
28	9.8	107.8	110.0	9.5	109.4	107.8
30	9.6	106.2	109.2	9.3	110.6	110.9
May 7	11.8	108.2	112.7	11.0	112.5	112.0
15	13.1	117.7	119.0	12.3	118.3	118.5

Table 11 -- Continued

Date	Oregon Temp.	Oregon % O_2	Oregon % N_2	Washington Temp.	Washington % O_2	Washington % N_2
May 22	12.3	107.6	119.9	11.8	112.9	124.9
30	13.6	120.4	125.3	13.4	126.6	131.2
June 6	15.0	116.2	125.1	14.6	119.1	128.6
15	14.4	112.7	127.7	14.0	117.6	131.4
23	14.8	111.8	126.1	14.4	116.7	127.7
30	15.5	117.5	121.1	15.2	122.3	124.9
July 7	16.6	119.0	123.0	16.2	116.2	123.6
14	17.5	110.4	115.2	17.1	114.6	114.2
21	18.7	112.7	112.7	18.6	115.8	112.5
Aug. 2	18.9	106.7	109.1	18.6	108.3	110.9
16	19.8	102.1	105.3	19.2	104.7	106.9
23	20.3	100.9	103.0	20.5	101.3	103.7
Sept. 6	20.0	103.6	102.6	19.8	109.8	105.3
13	19.4	101.7	102.0	19.2	101.2	105.0
20	17.4	95.9	99.9	17.4	100.8	99.0
27	15.6	94.0	100.6	15.2	95.2	99.8
Oct. 4	15.2	101.8	101.5	15.2	101.8	100.9
17	13.8	95.2	97.9	13.8	95.8	99.2
25	13.0	94.3	95.9	13.0	95.3	99.2
Nov. 1	11.4	93.9	101.9	11.6	103.0	105.3
15	9.9	95.0	100.2	9.8	98.9	99.1
28	9.0	95.2	99.0	9.0	97.0	99.5
Dec. 15	2.8	97.8	101.1	2.8	98.1	104.2
22	5.6	100.1	104.7	5.2	98.9	102.5
1973						
Jan. 4	4.8	99.4	104.1	4.2	98.3	101.4
10	2.0	98.4	100.0	1.8	97.1	99.4
17	5.6	99.1	105.8	4.4	99.2	101.9
24	4.0	101.7	103.5	3.0	99.0	98.9
31	3.6	100.4	103.5	2.8	97.7	102.8
Feb. 7	3.6	93.4	100.4	3.4	93.9	100.3
14	3.8	94.2	99.5	3.2	94.4	98.1
21	4.6	98.2	103.4	4.0	99.6	101.0
28	5.4	99.7	102.3	4.8	100.2	100.1
March 7	6.0	105.5	104.5	5.8	107.2	103.4
14	7.0	102.0	103.1	6.4	105.4	105.3
21	6.9	98.3	100.2	6.6	101.2	99.4

Table 11 -- Continued

Date	Oregon			Washington		
	Temp.	% O_2	% N_2	Temp.	% O_2	% N_2
1973						
March 28	7.8	101.7	104.0	7.2	102.9	102.1
April 4	8.4	108.4	104.3	8.0	109.0	107.0
11	9.4	104.5	103.4	9.2	106.5	102.2
18	9.6	102.1	102.5	9.2	101.6	101.6
25	10.4	103.8	100.9	10.2	107.8	99.8
May 2	11.6	109.2	102.2	11.4	103.6	92.0
9	12.0	102.2	102.3	11.8	100.8	103.3
16	15.0	105.3	99.0	14.8	104.8	98.7
23	15.0	105.3	99.8	14.8	112.8	105.3
30	15.8	105.4	98.3	15.6	106.6	104.7
June 6	16.0	105.4	104.1	15.8	106.0	104.4
13	16.8	94.5	98.0	16.5	93.3	98.9
27	17.5	90.9	101.9	17.6	94.4	100.2
July 5	18.7	92.5	103.9	18.4	93.9	104.1
10	19.4	95.4	102.5	19.0	97.2	106.9
26	20.4	95.3	104.1	20.2	98.9	101.8

Sanborn (1973) did a limited study to determine the benthic organisms (the animals living in or on the bottom substrate) and epibenthic animals (highly motile species living on or just above the bottom substrate) in the lower Columbia River. Table 12 is a list, from the above references, of the secondary organisms captured in the Columbia River between river mile 72 and 95.

A synopsis of the available data shows that the major zooplankters were *Daphnia* and *Bosmia* and that their peak abundance coincides with either the peak or the rise and fall of the temperature cycle. The stomach contents of 207 juvenile chinook salmon, randomly selected from the study area, revealed that during August through October zooplankters were the major items of the diet while insects provided the major portion of the diet for the remainder of the year (Craddock, et all 1973).

Table 12 -- List of secondary production organisms captured in the Columbia River between River Mile 72 and 95 since 1967.

ORGANISMS

Hydrozoa:
- *Hydra sp.*

Cladocera:
- *Alona quadrangularis*
- *Bosmina longirostris*
- *Ceriodaphnia pulchella*
- *Chydorus globosus*
- *Daphnia longispina*
- *Daphnia pulex*
- *Diaphanosoma brachyurum*
- *Eurycercus lamellatus*
- *Ilyocryptus sp.*
- *Leptodora kindtii*
- *Leydigia sp.*
- *Macrothrix sp.*
- *Moina brachiata*
- *Monospilus dispar*
- *Pleuroxus sp.*
- *Scapholeberis mucronata*
- *Sida crystallina*
- *Simocephalis serrulatus*

Copepoda:
- *Canthocamptidae*
- *Copepod nauplius*
- *Cyclops vernalis*
- *Diaptomus sp.*
- *Epischura nevadensis*

Oligocheata:
- *Enchytraeus sp.*

Hydracarina:
(Water-mite)

Mysidacea:
- *Neomysis awatchensis*

Amphipoda:
- *Corophium salmonis*
- *Gammarus sp.*

Decopoda:
- *Pacifastacus leniusculus*

Pelecypoda:
- *Corbicual fluminca*

Odonata:
- *Gomphus olivaceous*

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