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COASTAL RIVERS INVESTIGATION
INFORMATION REPORT 74-1

Some Observations on Fish Distribution in Tillamook
Bay, Oregon, with Notes on Shellfish
Temperature, and Physical Characteristics

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This work was conducted in cooperation with the National
Marine Fisheries Service under the Anadromous Fish Act
PL 89-304

April 1974

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Some Observations on Fish Distribution in Tillamook
Bay, Oregon, with Notes on Shellfish,
Temperature, and Physical Characteristics

INTRODUCTION

Fish Commission of Oregon personnel seined selected locations of Tillamook Bay, Oregon, from June to September 1972, to determine if juvenile salmon were rearing in the estuary and to get some concept of relative numbers of fish in the various parts of the bay. These data then could be compared with results of similar sampling projects in other bays and give an insight on possible management measures to preserve or enhance salmon populations. Observations of this type are also valuable in providing techniques, sample stations, and scope or need for planning of more definitive studies on the bay in the future.

Information from previous work and reports of fish distribution for other species are included with comments on physical characteristics and other facets of the bay during the summer.

DESCRIPTION OF THE AREA

Tillamook Bay is located on the north coast of Oregon 80 kilometers (50 miles) south of the Columbia River. The bay lies in a flat valley which has large lumber and dairy industries. Much of the lowlands surrounding the upper bay have been diked and converted from salt marsh to pasture land.

The bay is about 9.7 km (6 mi) long and 4.3 km (3 mi) wide with an area of 3,354 hectares or 8,289 acres (Div. of St. Lands, 1973) and is equally divided between tidelands (1,685 ha) and submerged lands (1,670 ha). Tillamook Bay ranks third in size of Oregon's estuaries, following the Columbia River estuary (37,953 ha) and Coos Bay (5,010 ha).

Major rivers entering the bay are the Miami, Kilchis, Wilson, Trask, and Tillamook (Figure 1). These streams drain $1,399 \text{ km}^2$ (540 mi^2) and annually contribute about 266 million cubic meters (216,000 acre ft) at a combined average flow of $90.56 \text{ m}^3/\text{sec}$ (3,200 cfs). The annual rate of precipitation on the watershed varies from 228.6 cm (90 in) on the coast to 381 cm (150 in) near the crest of the Coast Range Mountains.

The shore line of Tillamook Bay is rocky from the mouth to 3.2 km (mi 2). A large tideflat on the north end of the bay, known as "Garibaldi Flat," is composed of rock, sand, and mud. The tidelands across the main channel from Garibaldi are composed of sharp sand. These change gradually to a sand and mud mixture at 8.0 km (mi 5) and to mud at 12.9 km (mi 8). At 14.5 km (mi 9), the bottom is composed of silt deposited from tributary streams. Above 14.5 km the bottom changes from fine to coarser gravel as the gradient of tributary streams increase.

Eel grass beds and associated smaller plants are scattered up to about 12.9 km. Beds of eel grass are relatively small in the spring but cover large areas of the bay prior to the onset of winter storms.

About 1,214 ha (3,000 acres) of the bay are leased for commercial oyster production. Commercial fishermen harvest crabs, clams, and a variety of species for bait from the bay. Sport fishing, crabbing, clamming, hunting, and boating are popular. Garibaldi Basin is home port for a fleet of ocean-going commercial and sport boats. Boat launching facilities at the basin are used by many tourists.

Historically, several well defined channels ran generally north and south in the bay. These channels provided access for boats carrying passengers and freight between Tillamook City and points along the coast.

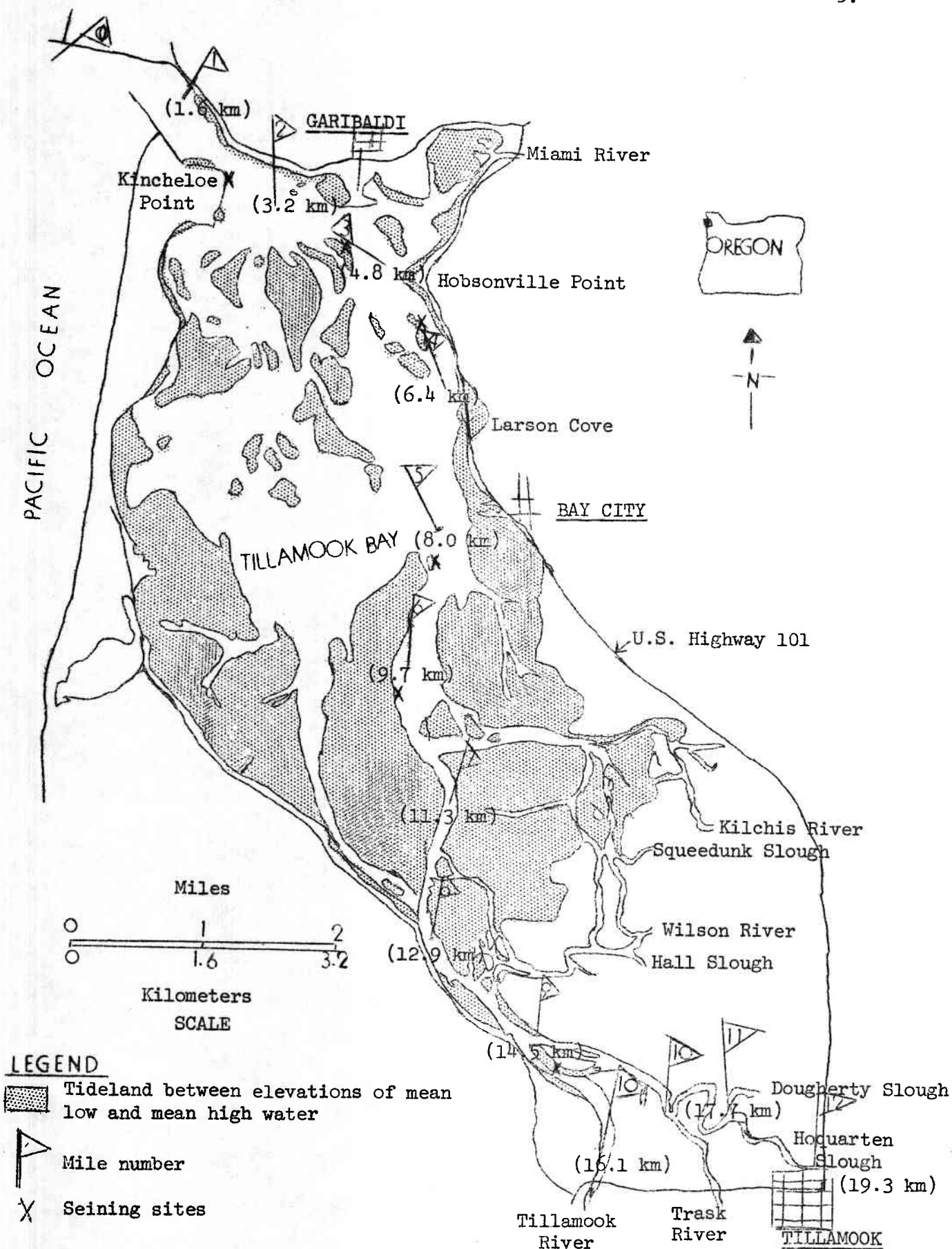


Figure 1. Map of Tillamook Bay, Oregon (Approximate tide level -1.0 ft)

Most of these old channels are no longer passable at low tide, even to small skiffs. Pile dikes were placed across some in the unsuccessful attempt to maintain a single channel past Bay City on the east side of the bay. With the exception of the Garibaldi Boat Basin, channels in the bay have not been dredged for several years. The lower Wilson and Trask were dredged in the fall of 1972. Prior to this dredging, none of the river mouths were accessible to our boat at low tide.

METHODS

Seining Sites

We sampled selected sites monthly at low tide and random sites occasionally at high tide to collect fin fish throughout the summer of 1972. Site selection was governed by availability of areas firm enough to stand on while pulling a seine. We found six areas, suitable for seining at low tide, that gave reasonable coverage of the bay along the main channel. These were located 2.4, 4.0, 5.6, 8.5, 10.0, and 15.0 km above the end of the north jetty (Figure 1).

Bottom type and conformation varied with each site. The site at 2.4 km had a rock and sand bottom that dropped off into a weed bed and deep water. At 4.0 km we seined in a shallow, sandy, side channel onto a sand beach. The site at 5.6 km was a sand beach on the edge of the "ghost hole," a major holding and sport fishing area for adult salmon. At 8.5 km we seined over a weed bed and mud flat onto the end of a mud and rock mound known as "Sibley Sands." Seining at 10.0 km was through shallow water over a mud bottom onto a sandy mud beach. Soft mud and snags precluded effective seining between 10.0 km and 15.0 km. At 15.0 km we seined in a hole on the Tillamook River just below a cut-off channel from the Trask River. We sampled other areas of the bay and sloughs when they were accessible at higher tidal stages.

Equipment

Our equipment included a 125 ft (38.1 m) long, by 10-ft (3 m) deep bag seine with 3/4" (9.5 mm) mesh. It was set from a 16-ft (4.9 m) skiff powered with an outboard motor. A crew of three handled the gear and examined the catch.

Data Recorded

We recorded date, time, air and surface water temperature, and the number of each species taken in one seine haul at each location. Bad hauls were aborted and another set was made. Field identification of specimens was verified in the laboratory using an identification key. Data for fin fish species other than those seined and shellfish came from observations made during a sport use survey in 1971 and personal observations in the bay and tributaries.

RESULTS

Of the 46 fin fish species recorded for Tillamook Bay (Table 1), we captured 33. The numbers of fish and invertebrates seined at standard supplementary stations are summarized in Appendix Tables A and B. At standard sites, we found 24 fish species in the area below 4.0 km; 18 species from 4.0 km through 8.5 km; and 12 species above 10.0 km. Juveniles dominated the catch and confirmed the importance of the estuary as a spawning and rearing area.

Data collected at the seining stations and other sources provided information on the presence of fin fish within the main channel, sloughs, and lower river channels of Tillamook Bay (Figure 2).

Table 1. Names of Fish Occurring in Tillamook Bay, Oregon

Family and Common Name	Scientific Name 1/
Petromyzontidae Pacific lamprey	<i>Entosphenus tridentatus</i>
Clupeidae American shad* Pacific herring*	<i>Alosa sapidissima</i> <i>Clupea harengus pallasii</i>
Engraulidae Northern anchovy*	<i>Engraulis mordax</i>
Salmonidae Chum salmon Coho salmon* Chinook salmon* Cutthroat trout* Rainbow trout*	<i>Oncorhynchus keta</i> <i>O. kisutch</i> <i>O. tshawytscha</i> <i>Salmo clarki</i> <i>S. gairdneri</i>
Osmeridae Surf smelt*	<i>Hypomesus pretiosus</i>
Gadidae Pacific tomcod	<i>Microgadus proximus</i>
Atherinidae Topsmelt Jacksmelt	<i>Atherinops affinis</i> <i>Atherinopsis californiensis</i>
Gasterosteidae Threespine stickleback* Tube-snout*	<i>Gasterosteus aculeatus</i> <i>Aulorhynchus flavidus</i>
Embiotocidae Shiner perch* Striped seaperch* Silver surfperch* Walleye surfperch White seaperch* Pile perch Redtail surfperch*	<i>Cymatogaster aggregata</i> <i>Embiotoca lateralis</i> <i>Hyperprosopon ellipticum</i> <i>H. argenteum</i> <i>Phanerodon furcatus</i> <i>Rhacochilus vacca</i> <i>Amphistichus rhodoterus</i>
Stichaeidae Snake prickleback	<i>Lumpenus sagitta</i>
Pholidae Rockweed gunnel* Penpoint gunnel Saddleback gunnel*	<i>Xerorpes fucorum</i> <i>Apodichthys flavidus</i> <i>Pholis ornata</i>

Table 1. (cont'd)

Family and Common Name	Scientific Name 1/
Anarhichadidae Wolf-eel	<i>Anarrhichthys ocellatus</i>
Scorpaenidae Black rockfish* Blue rockfish Copper rockfish*	<i>Sebastes melanops</i> <i>S. mystinus</i> <i>S. caurinus</i>
Hexagrammidae Kelp greenling* Rock greenling* Lingcod	<i>Hexagrammos decagrammus</i> <i>H. lagocephalus</i> <i>Ophigdon elongatus</i>
Cottidae Padded sculpin* Prickly sculpin* Buffalo sculpin* Pacific staghorn sculpin* Cabezon* Brown Irish lord* Red Irish lord* Silverspotted sculpin*	<i>Artedius fenestralis</i> <i>Cottus asper</i> <i>Enophrys bison</i> <i>Leptocottus armatus</i> <i>Scorpaenichthys marmoratus</i> <i>Hemilepidotus spinosus</i> <i>H. hemilepidotus</i> <i>Blepsias cirrhosus</i>
Pleuronectidae English sole* Starry flounder* Sand sole*	<i>Parophrys vetulus</i> <i>Platichthys stellatus</i> <i>Psettichthys melanostictus</i>
Ammodytidae Pacific sand lance*	<i>Ammodytes hexapterus</i>
Syngnathidae Bay pipefish	<i>Syngnathus griseolineatus</i>

1/ From Common and Scientific Names of Fishes, AFS Pub. #6, 1970.

* Captured during seining operations, summer of 1972.

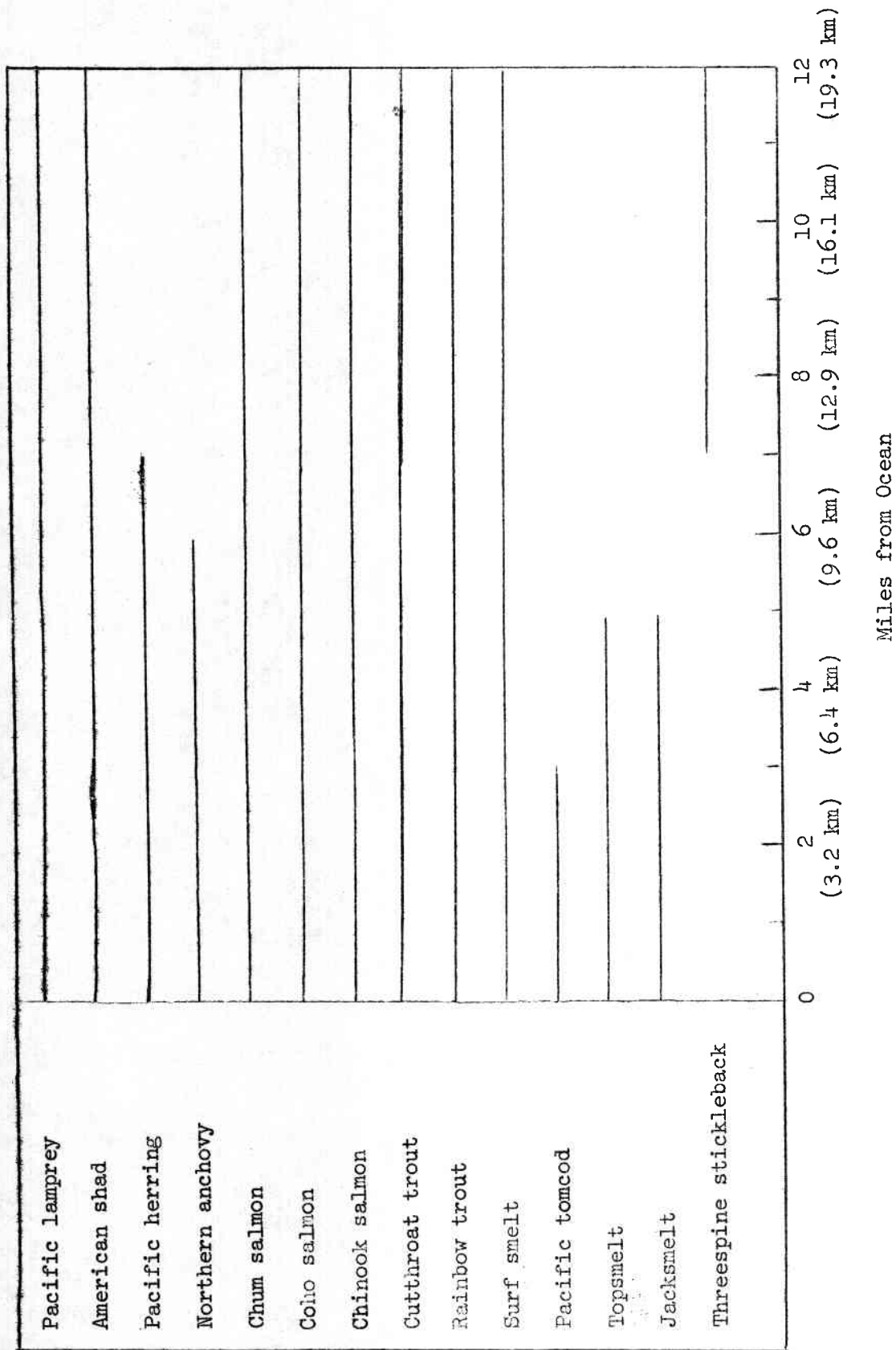


Figure 2. Presence of Fishes in the Tillamook Bay Estuary.

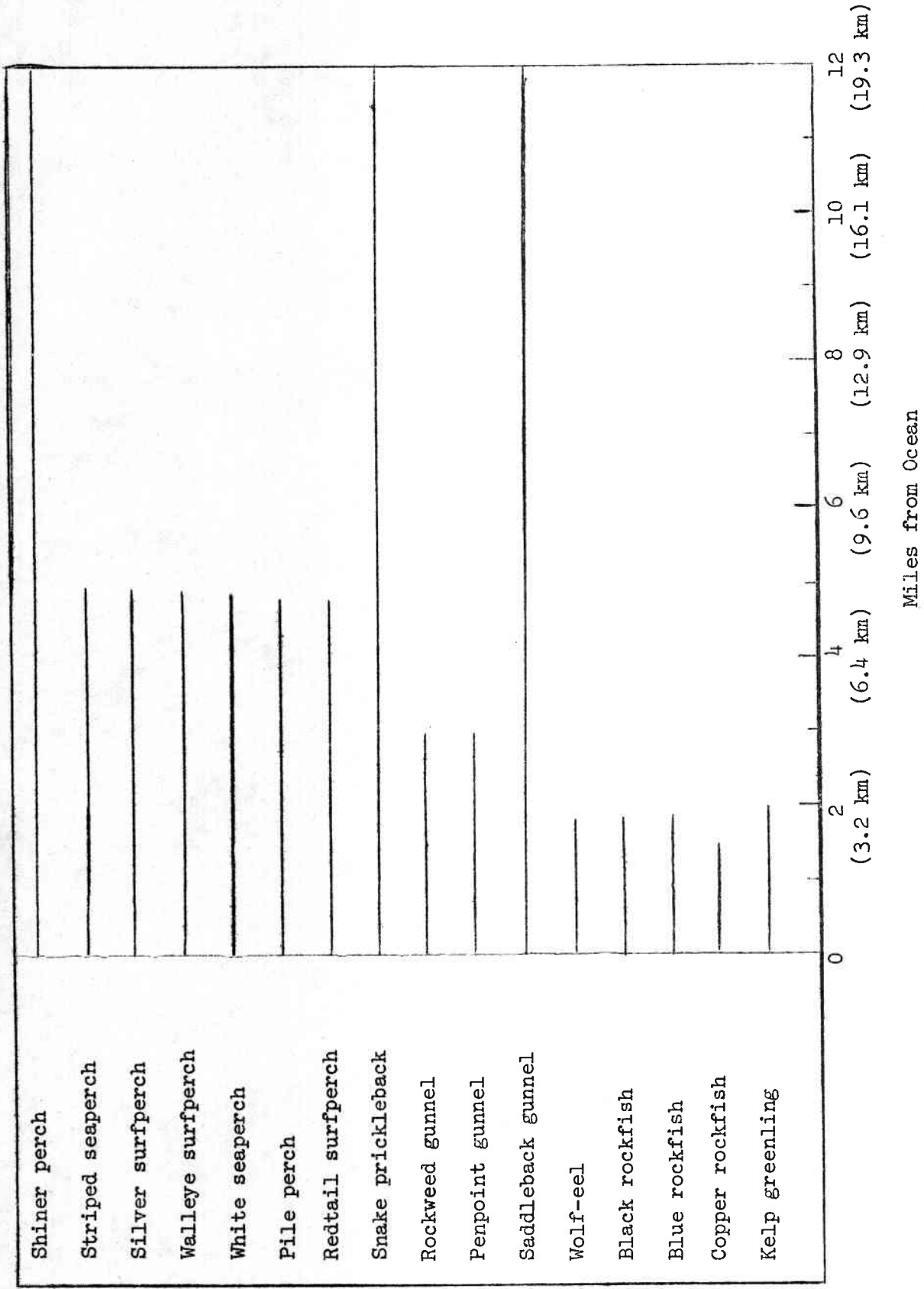


Figure 2. (cont'd)

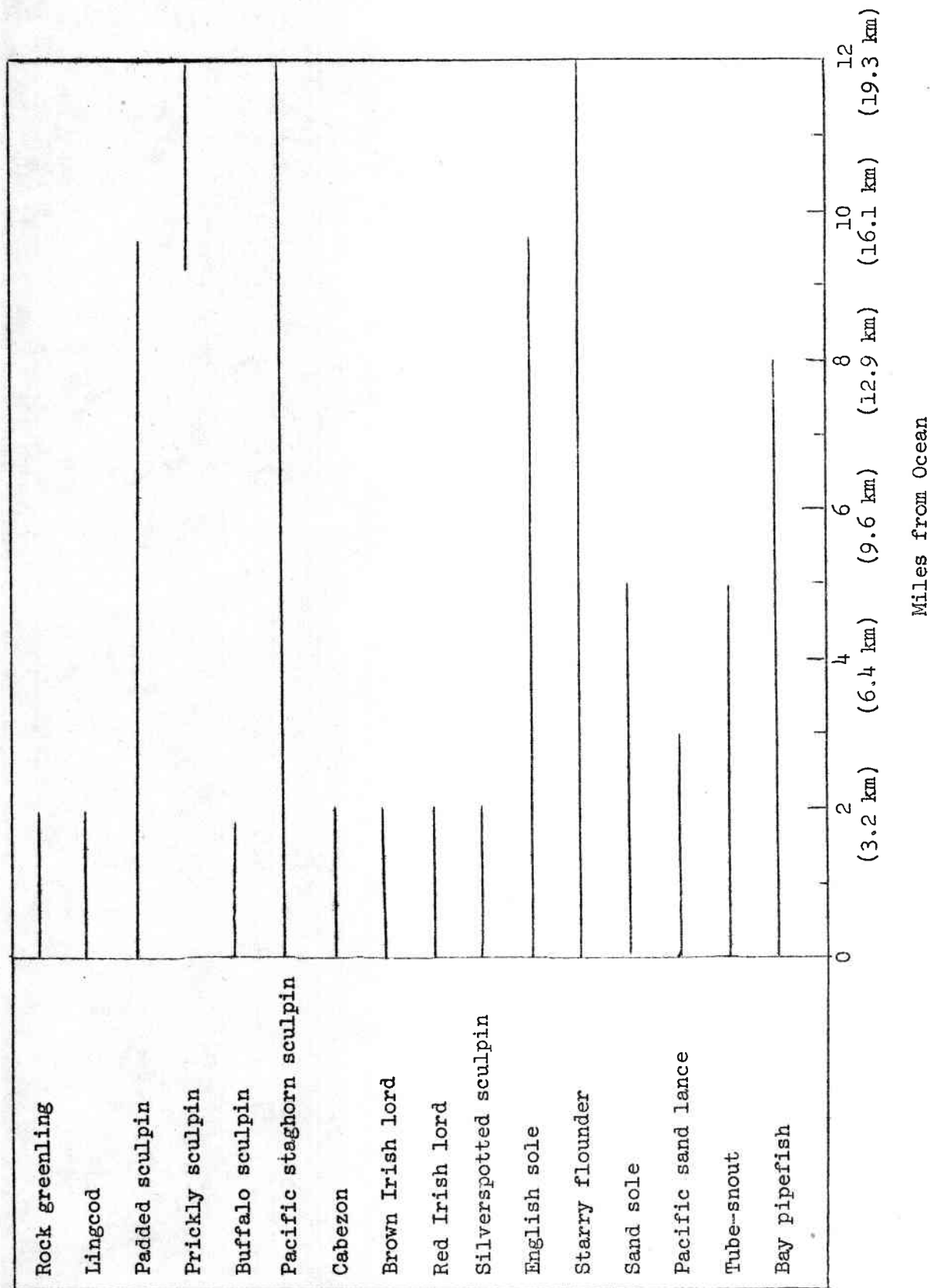


Figure 2. (cont'd)

Coho

We captured a few juvenile coho each day of seining through August 7. However, peak outmigration of yearlings probably occurred in May before seining commenced. A few fish of the year were taken in June and their proportion increased, in comparison to yearlings, as the season progressed.

Mature coho were caught by sportsmen in the upper bay and tributary streams from October to December.

Chinook

Chinook yearlings were common above 4.0 km during the summer with large numbers occasionally observed in the boat basin at Garibaldi. On August 2 and 4, 1972, 115,275 fall chinook were released from the Fish Commission's Trask River Hatchery which is located at 31.2 km (river mile 19.4). We seined the bay on August 7 and captured larger numbers of chinook than in previous sampling days. Another 52,000 fall chinook were released on September 3 and relatively large numbers were again noted while seining in the bay on September 7. In both instances, chinook were observed in the Trask River with some, but not all, migrating into the bay shortly after release.

We were unable to differentiate between fall and spring chinook juveniles so could not determine if both were present in the bay at any given time of year. However, spring chinook have been noted to move downstream from reservoirs on the Willamette throughout the winter months (Larry Korn, pers. comm.). Good returns of adult spring chinook to Trask Hatchery from smolts released during the late fall or early winter (age 0+) suggested observations on the Willamette are applicable to coastal streams. Low catches of age 1+ chinook in early summer indicated that most of these fish

from the various races using the bay, had already emigrated to the ocean. Increasing catch rates on age 0+ chinook through the summer suggested they may spend part of their 1st year in the stream, hatchery, estuary, or a combination of these environments.

Adult spring chinook are caught in the bay and tributaries from May to September with migration through the bay during the spring. Based on body coloration, another group of chinook move into the upper bay, apparently during July and August, where they remain until September. Maturing fall chinook enter the bay in September and bright fish are caught in the bay and tributaries until January.

Herring

Adult herring are taken for bait by sportsmen and, in past years, by commercial nets from January to March. This is earlier than they appear in Yaquina, Umpqua, and Coos bays. Herring spawn on piling in the boat basin at Garibaldi, on eel grass beds up to 9.7 km, and on the rocks along the shore of the lower bay.

Juveniles were large enough to be caught in our seine by June and the number occurring in each seine haul increased as the summer progressed. Juvenile herring were caught through 8.5 km on or adjacent to weed beds over rock/sand to a mud/sand substrate.

Smelt

We found large numbers of surf smelt up to 6.4 km and a few to 19.3 km. On August 11 we landed about 1,000 smelt in a single seine haul at 2.4 km when the tide had been flooding for about 4 hours. Surf smelt appear to

adapt to a wide range of salinities but were more common in near full strength sea water than in the slightly brackish water environment of the upper sloughs.

Topsmelt and jacksmelt were found below 7.2 km in the main channels and over the mud flats at high tide.

Sole

Juvenile English sole were found up to 10.0 km with the largest number caught in June and July between 5.6 and 10.0 km. English sole were found on all bottom types from rock through sharp sand to mud but were more commonly associated with mud substrate.

Sand sole were found below 6.4 km in areas with a sharp sand bottom. No adult sole were caught during the summer.

Starry Flounder

Starry flounder were found throughout the bay over all types of bottom material. They were most abundant in the upper bay above 10.0 km where the bottom is mainly mud or mud/loam. The fish ranged in size from about 2.5 to 12.7 cm long in the upper bay and to 22.9 cm long in the lower bay. Adult starry flounder are found throughout the bay during the winter and early spring months.

Surf Perch

Seven species of perch are found in the bay at various times of the year. Shiner perch dominated our catch throughout the bay. Juveniles (2.5 cm at birth to 6 cm in September) of all species were more common than adults in our seine catches during the summer. Adult striped and white seaperch, pile perch, redbait, white, and silver surfperch were

caught by sport anglers below 8.0 km throughout the year (Unpub. data, 1971 estuary study, Fish Comm. Oreg.) with heaviest catches in the spring.

Cottids

Staghorn sculpins were found on all sites but were most common below 16.1 km where they preferred mud or mud/loam substrates to sharp sand. A few padded sculpins were found to 15.0 km where prickly sculpin began to appear. Buffalo sculpin, red Irish lord, brown Irish lord, cabezon, and silverspotted sculpin were caught among weeds along the rocky beaches through 3.2 km. These species apparently prefer a relatively high salinity.

Miscellaneous Fish Species

Species found near the mouth of the bay in high salinity, weed beds, and rocks included the snake prickleback, rockweed gunnel, penpoint gunnel, wolf-eel, black rockfish, blue rockfish, copper rockfish, kelp greenling, rock greenling, longcod juveniles, and Pacific sand lance. The saddleback gunnel seems to be tolerant of fresh water and was found to 19.3 km in some of the sloughs. Both the saddleback gunnel and snake prickleback were found in upper sloughs of Coos Bay in areas of moderate salinity, weedbeds, and rocks in 1970 (Cummings and Schwartz, 1971).

Threespine stickleback were found above 10.5 km while tube-snout and bay pipefish were generally below this point. Pacific tomcod were found below 6.4 km (Unpub. data, 1971 estuary study, Fish Comm. Oreg.)

Shellfish

During seining and other work on the bay we also noted the occurrence of clam beds. We can generally comment on species (Table 2), area, and levels of use.

Table 2. Clam Species Found in Tillamook Bay, Oregon

Common Name	Scientific Name
Gaper clam	<i>Tresus capax</i>
Cockle clam	<i>Clinocardium nuttalli</i>
Softshell clam	<i>Mya arenaria</i>
Butter clam	<i>Saxidomus giganteus</i>
Native littleneck clam	<i>Protothaca staminea</i>
Bentnose clam	<i>Macoma nasuta</i>
Sand clam	<i>Macoma secta</i>
Bodega tellen	<i>Tellina bodegensis</i>
Razor clam	<i>Siliqua patula</i>
Manila littleneck clam	<i>Tapes semidecussata</i>

There was intensive sport harvest of cockle, gaper, native littleneck, and butter clams on "Garibaldi Flat" at the north end of the bay. East from this flat to the parking area at Garibaldi Boat Basin, a soft mud flat contained bentnose, sand, cockle, and some native littleneck clams and a large population of bait shrimp. From the boat basin to Hobsonville Point, tideland composed of mud and sand produced cockle, gaper, and butter clams. This area has limited sport use near the shore. Most clam diggers prefer the sandy tide flat near the main channel.

Littleneck clams were found among the rocks at Hobsonville Point while the areas south to Bay City contained softshell clams, bentnose clams, and bait shrimp. South of Bay City to 11.3 km the mud flats supported softshell clams and bait shrimp.

Across the main channel from Garibaldi to 8.0 km is a series of small channels and islands which range from sharp sand habitat on the north to mud

on the south. This area afforded excellent digging, for those with boats, on cockle clams and bait shrimp. A few razor clams were found on the northwest islands near the mouth of the bay. Sand clams, manila littleneck, and bodega tellen were scattered in the lower bay, while bentnose clams were common throughout most of the bay.

On the west shore of the bay from Kincheloe Point south to 6.4 km, the tideflats were intensively used by clam diggers for cockle and gaper clams. Excellent beds of softshell clams were found above this area to 11.3 km. Softshell clam beds above 11.3 km are variable with densities dependent on the duration of fresh water over the tideflats during winter months. Most of these upper beds are accessible only by boat and are lightly used by clam diggers.

We found juvenile Dungeness crabs (*Cancer magister*) throughout the bay in nearly every seine haul. The largest catches were taken over mud substrate. There was an intensive crab fishery by both sport and commercial gear through the channels south of Garibaldi from 2.4 to 6.4 km. A few commercial fishermen set gear in the bay all year while others bring their pots in from the ocean in the fall when the ocean gets rough. We counted over 200 and estimated a total of 300 pieces of crab gear set in the bay on September 7, 1972. Sportsmen fish for crabs all year with the greatest pressure in summer months.

Oysters (*Crassostrea gigas*) are farmed on about 1,214 ha of tide flats in Tillamook Bay. The oyster beds are mainly located from 6.4 to 11.2 km on the west side of the bay. A small oyster plat in Miami Cove was rendered useless by log storage in past years. About 90% of Oregon's oyster production comes from Tillamook Bay. Sport harvest of oysters is illegal in Oregon. However, public clam digging is allowed by law on tideland leased for oyster production.

Temperature

Surface water temperatures are subject to the influence of changes in air temperature and wind action but can give a general trend of subsurface temperatures. The water at 2.4 km ranged from 12.8 to 15.0 C (Table 3) similar to the temperature of the nearby ocean during the same period. The water was progressively warmer at sites further up the bay, reflecting the influence of the tributary streams and upper tide areas which have a relatively poor exchange rate with cool ocean water. A high surface temperature of 21.1 C was recorded at 15.0 km in August, but temperatures declined throughout the bay by September.

Table 3. Surface Water Temperature (C) at Six Seining Sites in Tillamook Bay, 1972

Date	Bay Kilometer					
	2.4	4.0	5.6	8.5	10.0	15.0
6-27	13.3	14.4	15.0	16.1	16.7	--
7-10	15.0	15.6	15.6	16.7	17.2	18.3
8-7	14.4	14.4	16.1	18.9	20.0	21.1
9-7	12.8	13.3	14.4	15.6	16.7	16.7

Daily air temperatures ranged to the high 20's in August and decreased to below 20 C in early September. We did not observe any relationship between water or air temperature and the number or species of fish caught at a particular seining site.

DISCUSSION

A larger variety of fish species was found near the ocean than further up the bay. Rockfish, greenling, lingcod, and other species of fish commonly found in the ocean near rocks and weed beds were seined at 2.4 km but not

at 5.2 km, an area similar in all respects except for the unmeasured factor, salinity. Herring, smelt and surf perch tolerate lower salinity and were common to 10.0 km over substrates ranging from rock to mud and sand. Prickly sculpin and threespine stickleback, associated with brackish and fresh water, were found above 10.0 km.

We recorded 46 species of fish in Tillamook Bay while Cummings and Schwartz (1971) recorded 66 species in Coos Bay. The number of fish we caught in each seine haul was smaller than was caught from Coos Bay. Coos Bay, in contrast to Tillamook Bay, has deep water channels and extensive sloughs. Comparison of apparent greater diversity of fin fish in Coos Bay with that of Tillamook Bay indicates a need for better understanding of limiting factors controlling estuarine production. Planned and present studies should provide part of this information.

Factors contributing to an increase in tideland in Tillamook Bay include poorly placed pile dikes (across channels) in the late 1800's; major forest fires in the watershed since 1933; logging and road building; and a break in the south end of the spit between the bay and the ocean in 1952. Deep water channels have not been maintained above Garibaldi. The upper salt marshes and some sloughs have been filled or diked. Heavy winter runoff from the five tributary streams contributes sediment and fresh water which is intolerable to marine species.

Various alterations of the bay have been made through the years and more are proposed to improve transportation and aid in flood control. Projects that increase the tidal prism may improve the fish rearing potential of the bay. Benefits to be derived from Tillamook Bay can be increased through planning and implementation of multiple resource programs.

ACKNOWLEDGMENTS

Personnel from OWC and FCO Otter Trawl Investigation each assisted in 1 day's seining. Bob Cruse, a Neighborhood Youth Corps enrollee, also worked on the project.

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APPENDIX A

(Tables A-1 through A-6)

Numbers of Fish and Invertebrates Seined
at Standard Stations in Tillamook
Bay, Oregon, 1972

Appendix Table A-1. Station 2.4 km. Point Below Crab Harbor,
Tillamook Bay, 1972

Species	Number of Species by Month and Day						Total	
	6/27	1/	7/10	7/11	2/	8/7		9/7
<u>Fish</u>								
American shad	0		2	3		0	0	5
Pacific herring	150	3/	1	≈ 750	3/	222	3/ 414	3/ 1,537
Northern Anchovy	17		0	4		1	0	22
Coho salmon	0		2	4		0	0	6
Chinook salmon	0		0	0		6	38	44
Cutthroat trout	0		0	0		0	0	0
Surf smelt	≈ 950		2	≈ 1,000		6	58	2,016
Threespine stickleback	0		0	0		0	0	0
Tube-snout	0		0	0		0	0	0
Shiner perch	4		63	1		24	12	104
Striped seaperch	0		0	0		8	5	13
Silver surfperch	0		0	0		0	0	0
White seaperch	0		0	0		1	0	1
Redtail surfperch	0		0	1		0	0	1
Rockweek gunnel	0		3	0		6	0	9
Saddleback gunnel	0		5	0		1	0	6
Black rockfish	0		66	2		5	11	84
Copper rockfish	0		0	0		1	0	1
Kelp greenling	0		18	0		3	3	24
Rock greenling	0		1	0		1	0	2
Padded sculpin	0		0	0		0	0	0
Prickly sculpin	0		0	0		0	0	0
Buffalo sculpin	0		6	0		0	1	7
Pacific staghorn sculpin	0		7	0		11	2	20
Cabezon	0		10	0		3	5	18
Brown Irish lord	0		0	0		6	2	8
Red Irish lord	13		0	0		5	3	21
Silverspotted sculpin	1		0	0		0	0	1
English sole	0		2	0		1	6	9
Starry flounder	0		2	0		1	2	5
Sand sole	0		0	0		0	0	0
Pacific sand lance	0		0	0		0	0	0
<hr/>								
<u>Invertebrates</u>								
Ghost shrimp	0		0	0		0	0	0
Shrimp (<i>Crago</i> sp.)	0		13	0		7	8	28
Dungeness crab	0		13	0		0	0	13
Red rock crab	0		0	0		0	0	0
Shore crab	0		0	0		0	0	0

1/ Low tide +3 hours

2/ Low tide +4 hours

3/ Juveniles

Appendix Table A-2. Station 4.0 km. Point Opposite Garibaldi
Office Building, Tillamook Bay, 1972.

Species	Number of Species by Month and Day				Total
	6/27	7/10	8/7	9/7	
<u>Fish</u>					
American shad	5	0	0	0	5
Pacific herring	13	0	0	295 <u>1/</u>	308 <u>1/</u>
Northern anchovy	1	0	1	2	4
Coho salmon	1	14	11	0	26
Chinook salmon	1	1	49	120	171
Cutthroat trout	0	0	0	0	0
Surf smelt	72	14	1	1	88
Threespine stickleback	0	0	0	0	0
Tube-snout	0	0	0	0	0
Shiner perch	8	1	0	4	13
Striped seaperch	0	0	0	0	0
Silver surfperch	0	0	0	0	0
White seaperch	0	0	0	0	0
Redtail surfperch	0	0	0	0	0
Rockweed gunnel	0	1	0	0	1
Saddleback gunnel	0	0	0	0	0
Black rockfish	0	0	0	0	0
Copper rockfish	0	0	0	0	0
Kelp greenling	0	0	0	0	0
Rock greenling	0	0	0	0	0
Padded sculpin	0	0	0	0	0
Prickly sculpin	0	0	0	0	0
Buffalo sculpin	0	0	0	0	0
Pacific staghorn sculpin	1	0	0	0	1
Cabezon	0	0	0	0	0
Brown Irish lord	0	0	0	0	0
Red Irish lord	0	0	0	0	0
Silverspotted sculpin	0	0	0	0	0
English sole	34	6	0	0	40
Starry flounder	0	0	0	0	0
Sand sole	0	0	2	1	3
Pacific sand lance	0	2	0	0	2

<u>Invertebrates</u>					
Ghost shrimp	0	0	0	0	0
Shrimp (<i>Crago</i> sp.)	2	7	1	3	13
Dungeness crab	0	1	0	0	1
Red rock crab	0	0	0	0	0
Shore crab	0	0	0	0	0

1/ Juveniles

Appendix Table A-3. Station 5.6 km. Bay Side of Ghost Hole,
Tillamook Bay, 1972

Species	Number of Species by Month and Day				Total
	6/27	7/10	8/7	9/7	
<u>Fish</u>					
American shad	3	0	0	0	3
Pacific herring	0	3	0	1 <u>1/</u>	4
Northern anchovy	0	0	1	0	1
Coho salmon	6	5	1	0	12
Chinook salmon	5	1	27	90	123
Cutthroat trout	1	0	1	0	2
Surf smelt	0	0	0	2	2
Threespine stickleback	0	0	0	0	0
Tube-snout	1	2	0	0	3
Shiner perch	13	21	4	10	48
Striped seaperch	0	0	0	0	0
Silver surfperch	0	0	0	0	0
White seaperch	0	0	0	0	0
Redtail surfperch	0	0	0	0	0
Rockweed gunnel	0	0	0	0	0
Saddleback gunnel	0	0	0	0	0
Black rockfish	0	0	0	0	0
Copper rockfish	0	0	0	0	0
Kelp greenling	0	0	0	0	0
Rock greenling	0	0	0	0	0
Padded sculpin	0	0	0	0	0
Prickly sculpin	0	0	0	0	0
Buffalo sculpin	0	0	0	0	0
Pacific staghorn sculpin	1	0	0	0	1
Cabezon	0	0	0	0	0
Brown Irish lord	0	0	0	0	0
Red Irish lord	0	0	0	0	0
Silverspotted sculpin	0	0	0	0	0
English sole	29	23	12	24	88
Starry flounder	0	0	0	1	1
Sand sole	0	0	0	3	3
Pacific sand lance	0	0	0	0	0

<u>Invertebrates</u>					
Ghost shrimp	0	0	0	0	0
Shrimp (<i>Crago</i> sp.)	14	6	2	33	55
Dungeness crab	12	0	4	9	25
Red rock crab	0	0	0	0	0
Shore crab	0	0	0	0	0

^{1/} Juveniles

Appendix Table A-4. Station 8.5 km. Sibley Sands, Tillamook Bay, 1972

Species	Number of Species by Month and Day				Total
	6/27	7/10	8/7	9/7	
<u>Fish</u>					
American shad	0	2	0	0	2
Pacific herring	3	0	31	113 <u>1/</u>	147
Northern anchovy	0	0	2	0	2
Coho salmon	1	6	3	1	11
Chinook salmon	4	5	12	3	24
Cutthroat trout	0	0	0	1	1
Surf smelt	0	0	0	0	0
Threespine stickleback	0	0	0	0	0
Tube-snout	0	0	0	0	0
Shiner perch	17	11	7	14	49
Striped seaperch	0	0	0	0	0
Silver surfperch	1	0	0	0	1
White seaperch	0	0	0	0	0
Redtail surfperch	0	0	0	0	0
Rockweed gunnel	0	0	0	0	0
Saddleback gunnel	1	3	1	0	5
Black rockfish	0	0	0	0	0
Copper rockfish	0	0	0	0	0
Kelp greenling	0	0	0	0	0
Rock greenling	0	0	0	0	0
Padded sculpin	0	0	0	0	0
Prickly sculpin	0	1	0	0	1
Buffalo sculpin	0	0	0	0	0
Pacific staghorn sculpin	13	5	1	0	19
Cabezon	0	0	0	0	0
Brown Irish lord	0	0	0	0	0
Red Irish lord	0	0	0	0	0
Silverspotted sculpin	0	0	0	0	0
English sole	6	1	1	2	10
Starry flounder	0	0	4	0	4
Sand sole	0	0	0	0	0
Pacific sand lance	0	0	0	0	0
<hr/>					
<u>Invertebrates</u>					
Ghost shrimp	1	0	0	0	1
Shrimp (<i>Crango</i> sp.)	6	0	40	2	48
Dungeness crab	0	1	1	3	5
Red rock crab	0	0	0	0	0
Shore crab	0	0	0	0	0

^{1/} Primarily juveniles

Appendix Table A-5. Station 10.0 km. Kilchis Point Upbay from
Submerged Piling, Tillamook Bay, 1972

Species	Number of Species by Month and Day				Total
	6/27	7/10	8/7	9/7	
<u>Fish</u>					
American shad	0	0	0	0	0
Pacific herring	0	0	0	0	0
Northern anchovy	0	0	0	0	0
Coho salmon	8	16	0	0	24
Chinook salmon	2	2	0	12	16
Cutthroat trout	0	0	0	0	0
Surf smelt	0	0	0	2	2
Threespine stickleback	1	0	0	0	1
Tube-snout	0	0	0	0	0
Shiner perch	25	469	1	4	499
Striped seaperch	0	0	0	0	0
Silver surfperch	0	0	0	0	0
White seaperch	0	0	0	0	0
Redtail surfperch	0	0	0	0	0
Rockweed gunnel	0	0	0	0	0
Saddleback gunnel	0	0	1	0	1
Black rockfish	0	0	0	0	0
Copper rockfish	0	0	0	0	0
Kelp greenling	0	0	0	0	0
Rock greenling	0	0	0	0	0
Padded sculpin	0	0	0	0	0
Prickly sculpin	0	0	0	0	0
Buffalo sculpin	0	0	0	0	0
Pacific staghorn sculpin	6	4	3	3	16
Cabezon	0	0	0	0	0
Brown Irish lord	0	0	0	0	0
Red Irish lord	0	0	0	0	0
Silverspotted sculpin	0	0	0	0	0
English sole	69	111	4	14	198
Starry flounder	11	10	11	23	55
Sand sole	0	0	0	0	0
Pacific sand lance	0	0	0	0	0
<hr/>					
<u>Invertebrates</u>					
Ghost shrimp	0	0	0	0	0
Shrimp (<i>Crango</i> sp.)	8	4	4	32	48
Dungeness crab	11	52	1	42	106
Red rock crab	0	0	0	0	0
Shore crab	0	0	1	0	1

^{1/} Primarily juveniles

Appendix Table A-6. Station 15.0 km. Tomlinson Slough at Confluence of Trask and Tillamook Rivers, Tillamook Bay, 1972

Species	Number of Species by Month and Day				Total
	6/13	7/10	8/7	9/7	
<u>Fish</u>					
American shad	6	0	0	0	6
Pacific herring	0	0	0	0	0
Northern anchovy	0	0	0	0	0
Coho salmon	6	7	7	0	20
Chinook salmon	3	0	12	4	19
Cutthroat trout	0	0	0	0	0
Surf smelt	0	0	0	0	0
Threespine stickleback	0	0	0	0	0
Tube-snout	0	0	0	0	0
Shiner perch	32	46	7	3	88
Striped seaperch	0	0	0	0	0
Silver surfperch	0	0	0	0	0
White seaperch	0	0	0	0	0
Redtail surfperch	0	0	0	0	0
Rockweed gunnel	0	0	0	0	0
Saddleback gunnel	0	1	0	4	5
Black rockfish	0	0	0	0	0
Copper rockfish	0	0	0	0	0
Kelp greenling	0	0	0	0	0
Rock greenling	0	0	0	0	0
Padded sculpin	1	0	0	0	1
Prickly sculpin	1	0	0	0	1
Buffalo sculpin	0	0	0	0	0
Pacific staghorn sculpin	11	6	10	7	34
Cabazon	0	0	0	0	0
Brown Irish lord	0	0	0	0	0
Red Irish lord	0	0	0	0	0
Silverspotted sculpin	0	0	0	0	0
English sole	0	0	6	2	8
Starry flounder	5	8	12	22	47
Sand sole	0	0	0	0	0
Pacific sand lance	0	0	0	0	0

<u>Invertebrates</u>					
Ghost shrimp	0	0	0	0	0
Shrimp (<i>Crango</i> sp.)	1	0	2	20	23
Dungeness crab	0	0	0	7	7
Red rock crab	0	0	0	1	1
Shore crab	0	0	0	0	0

1/ Primarily juveniles

APPENDIX B

(Tables B-1 and B-2)

Numbers of Fish and Invertebrates Seined
at Supplemental Stations in Tillamook
Bay, Oregon, 1972

Appendix Table B-1. Supplemental Seining Stations in
Tillamook Bay, 1972

Species	Number of Species by Area, Month, and Day				
	Submerged	Dick		Crab	Hobsonville
	Dike	Point	Midbay	Harbor	Point
	6/13 (8.8 km)	6/13 (12.7 km)	7/11 (5.6 km)	7/11 (1.9 km)	7/11 (5.0 km)
<u>Fish</u>					
American shad	0	0	0	4	0
Pacific herring	0	0	0	26	0
Northern anchovy	0	0	0	1	0
Coho salmon	7	2	8	9	9
Chinook salmon	6	2	0	2	0
Cutthroat trout	0	0	0	0	1
Rainbow trout	0	0	0	0	0
Surf smelt	1	0	230	11	21
Threespine stickleback	1	2	0	0	0
Shiner perch	12	24	27	5	0
White seaperch	0	0	2	0	0
Snake prickleback	0	0	0	3	0
Saddleback gunnel	0	0	0	1	0
Prickly sculpin	0	0	0	0	0
Pacific staghorn sculpin	3	5	0	1	0
English sole	9	1	7	25	1
Starry flounder	1	9	0	0	0
Sand sole	0	0	1	0	0

<u>Invertebrates</u>					
Shrimp (<i>Crango</i> sp.)	2	1	1	16	0
Dungeness crab	1	0	2	0	3

Appendix Table B-2. Supplemental Seining Station in
Sloughs of Tillamook Bay, 1972

Species	Number of Species by Area, Month, and Day					
	Hoquarten Slough		Dougherty Dry Stock- Slough		Wilson R. Sl.	
	9/18	9/18	9/18	9/18	9/20	
	(19.0 km)	(16.9 km)	(18.5 km)	(15.3 km)	(2.6 km)	(1.9 km)
<u>Fish</u>						
American shad	0	0	0	0	0	0
Pacific herring	0	0	0	0	0	0
Northern anchovy	0	0	0	0	0	0
Coho salmon	0	1 <u>1/</u>	0	0	0	0
Chinook salmon	0	2 <u>2/</u>	3	3	0	2
Cutthroat trout	0	0	0	0	1	0
Rainbow trout	0	0	0	0	1	0
Surf smelt	0	0	1	2	0	0
Threespine stickleback	46	1	0	0	0	0
Shiner perch	65	46	10	83	370	37
White seaperch	0	0	0	0	0	0
Snake prickleback	0	0	0	0	0	0
Saddleback gunnel	1	6	0	1	5	0
Prickly sculpin	42	0	1	2	0	0
Pacific staghorn sculpin	7	4	0	2	6	0
English sole	0	0	0	0	0	0
Starry flounder	17	5	2	1	0	2
Sand sole	0	0	0	0	0	0

<u>Invertebrates</u>						
Shrimp (<i>Crango</i> sp.)	32	4	2	5	0	0
Dungeness crab	0	0	0	2	0	0

1/ Adult

2/ One jack and one juvenile