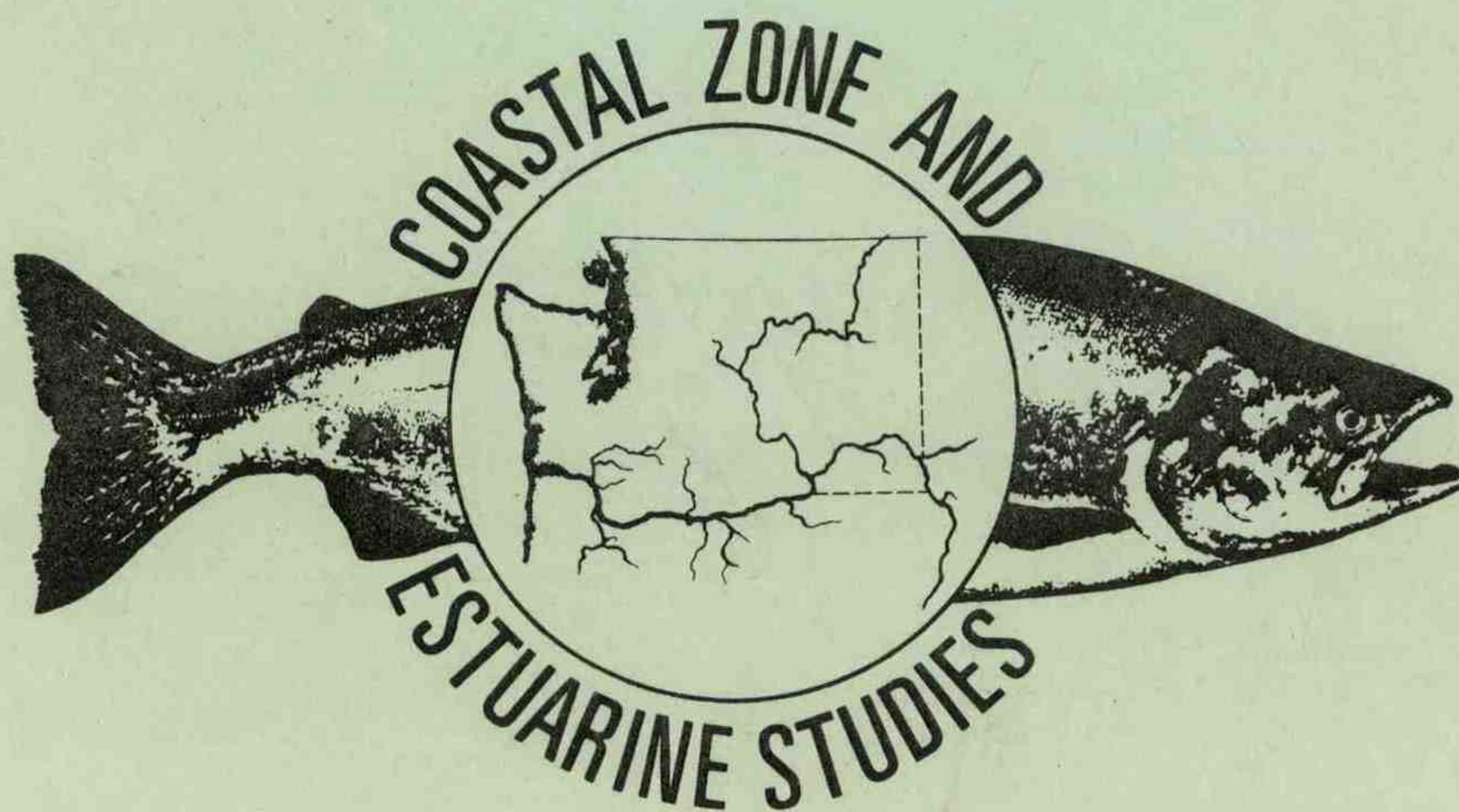


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**Juvenile Lingcod
Outer Harbor Field Survey,
Grays Harbor Navigation
Improvement Project**

by
**Travis C. Coley
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Final Report of Research
for
U.S. Army Corps of Engineers
(Contract E86-85-3308)

Coastal Zone and Estuarine Studies Division
Northwest and Alaska Fisheries Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
2725 Montlake Boulevard East
Seattle, Washington 98112

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INTRODUCTION

The Seattle District of the U.S. Army Corps of Engineers (COE) is investigating the effects of The Grays Harbor Navigation Improvement Project on fishes in Grays Harbor, Washington. The two primary areas addressed by this study are the effects of habitat alteration and the potential for dredge entrainment of juvenile lingcod, Ophiodon elongatus, and other fishes.

In September 1985, the National Marine Fisheries Service (NMFS) entered into a cooperative agreement with the COE to conduct a bottom-trawl survey for juvenile lingcod and other demersal fishes in Grays Harbor and the offshore zone within a 2-mile radius of the entrance. The 7-day study had the following primary objectives: (1) determine the distribution and relative density of juvenile lingcod in outer Grays Harbor and adjacent coastal areas during October 1985, (2) determine if young-of-the-year (0+ age) lingcod were emigrating from the estuary, and (3) determine the distributions and relative densities of other demersal fishes in outer Grays Harbor and adjacent ocean areas.

METHODS

Trawl samples were collected from 1 through 9 October 1985 at 30 stations in Grays Harbor and adjacent coastal areas (Fig. 1) using an 8-m semiballoon shrimp trawl. Overall mesh size (stretched) in the trawl was 38.1 mm; a 12.7-mm liner was inserted in the cod end to prevent escape of small fishes and crabs. The fishing width of the trawl was estimated to be 5 m (manufacturer's estimate). In the estuary, trawl efforts were generally 5 min in duration; in the ocean, they were generally 10 min in duration. Sampling was done during daylight at various stages of flood and ebb tides, including low slack; average trawling speed (ground speed) was about 4-5 km/h. The

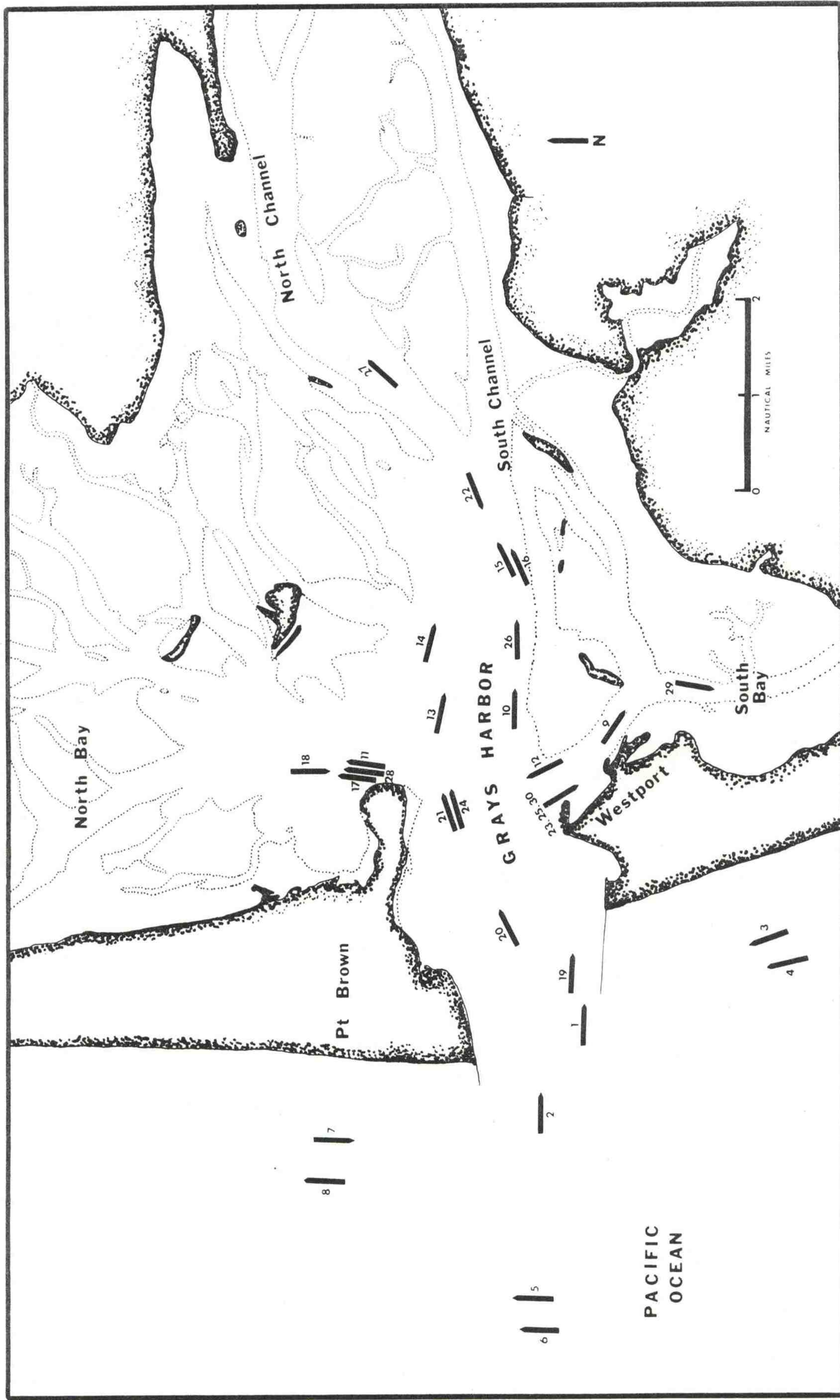


Figure 1.--Map of Grays Harbor, Washington, and adjacent coastal areas showing the areas sampled with an 8-m bottom trawl in October 1985.

distance traveled during each sampling effort was estimated using Loran-C navigational equipment. Beginning and ending Loran readings for each station are presented in Appendix A. Our greatest effort was concentrated in sandy channel areas near tidal flats where juvenile lingcod had previously been collected by the Washington Department of Fisheries.

Bottom salinities and temperatures were measured at each station using a Beckman RS5-3 salinometer and probe.^{1/} An Impulse-600 electronic depth finder was used to measure depths.

Relative densities (expressed as number/hectare) of juvenile lingcod, other demersal fishes, and crabs were calculated for each trawling effort using catch data, the fishing width of the trawl, and the distance traveled. Also, various community structure indices were calculated for each effort. Diversity was calculated for each trawl effort using the Shannon-Weaver Diversity Index (Shannon and Weaver 1963):

$$H = - \sum_{i=1}^s P_i \log_2 P_i$$

where H = Shannon-Weaver Diversity Index

$P_i = X_a/n$ (X_a is the number of individuals of a particular species in a sample, and n is the total number of all individuals in the sample.)

s = number of species.

A second diversity index, the Simpson Diversity Value (Simpson 1949), was also calculated for each trawl:

$$SD = 1 - \sum_{i=1}^s P_i^2$$

^{1/} Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Diversity values are sensitive to two components: the number of species in a sample (species richness) and the distribution of individuals among species (evenness) (Lloyd and Ghelardi 1964). Species richness (SR) was estimated using Margalef's formula (Margalef 1958):

$$SR = \frac{(S-1)}{\ln(N)}$$

where S = number of species

N = total number of individuals at the station.

Species evenness was described using the Evenness Index (Pielou 1966):

$$J = \frac{H}{\log_2 S}$$

where J = Evenness Index

H = Shannon-Weaver Diversity Index

S = number of species.

At the beginning of the study, generally a subsample of at least 50 individuals of each species for each sampling effort was measured and weighed. The remainder was counted and weighed as a group. As the study progressed, it became apparent we would be unable to sample an adequate number of areas because of the large catches of fishes and Dungeness crabs, Cancer magister. This matter was discussed with the COE, and it was agreed that NMFS could simply identify and enumerate demersal fish species (except lingcod) when large catches were made; this compromise allowed NMFS to sample more areas. Individual lengths and weights that were taken are not included in this report, but a computer print-out is available upon request.

At the end of the survey, we attempted to collect lingcod using two set lines rigged with unbaited colored jigs. The set lines were fished for about

1 h in the vicinity of Stations 11 and 17 (an area where lingcod had been captured by trawling).

RESULTS AND DISCUSSION

Fifteen juvenile lingcod were captured by trawling (Appendix B); all the juveniles, which were young-of-the-year, were captured in Grays Harbor (Fig. 2). No lingcod were captured in the ocean, nor were any captured with set lines. Bottom salinities and water temperatures in the ocean and Grays Harbor were similar; mean bottom salinity and temperature in the ocean were 32.8 ppt and 11.5°C, and in Grays Harbor, 32.4 ppt and 10.2°C.

All the lingcod were collected in areas with a hard bottom, i.e., shell-cobble habitat near rocks in 9-15 m of water (Stations 11, 17, 23, 25, 30); none were captured in sandy channel areas near tidal flats. Lingcod densities at the five stations ranged from 3/ha at Station 23 to 18/ha at Station 30 (Appendix B), with a mean density (five stations) of 11.4/ha. At each of the five stations, the lingcod density represented less than 0.3% of the station's total density (fishes and crabs). Dungeness crab was the dominant species at all five stations; other numerically important species associated with lingcod included shiner perch, Cymatogaster aggregata; kelp greenling, Hexagrammos decagrammus; and English sole, Parophrys vetulus, (Appendix B). Lingcod were captured during ebb tide at Stations 23 and 30 and during flood tide at Stations 11, 17, and 25. Bottom salinities and water temperatures in the areas where lingcod were captured ranged from 31 to 33 ppt and 10° to 13°C.

In Puget Sound, it was observed that 0+ age lingcod used open sandy-bottom habitat until October, moved offshore during October, and

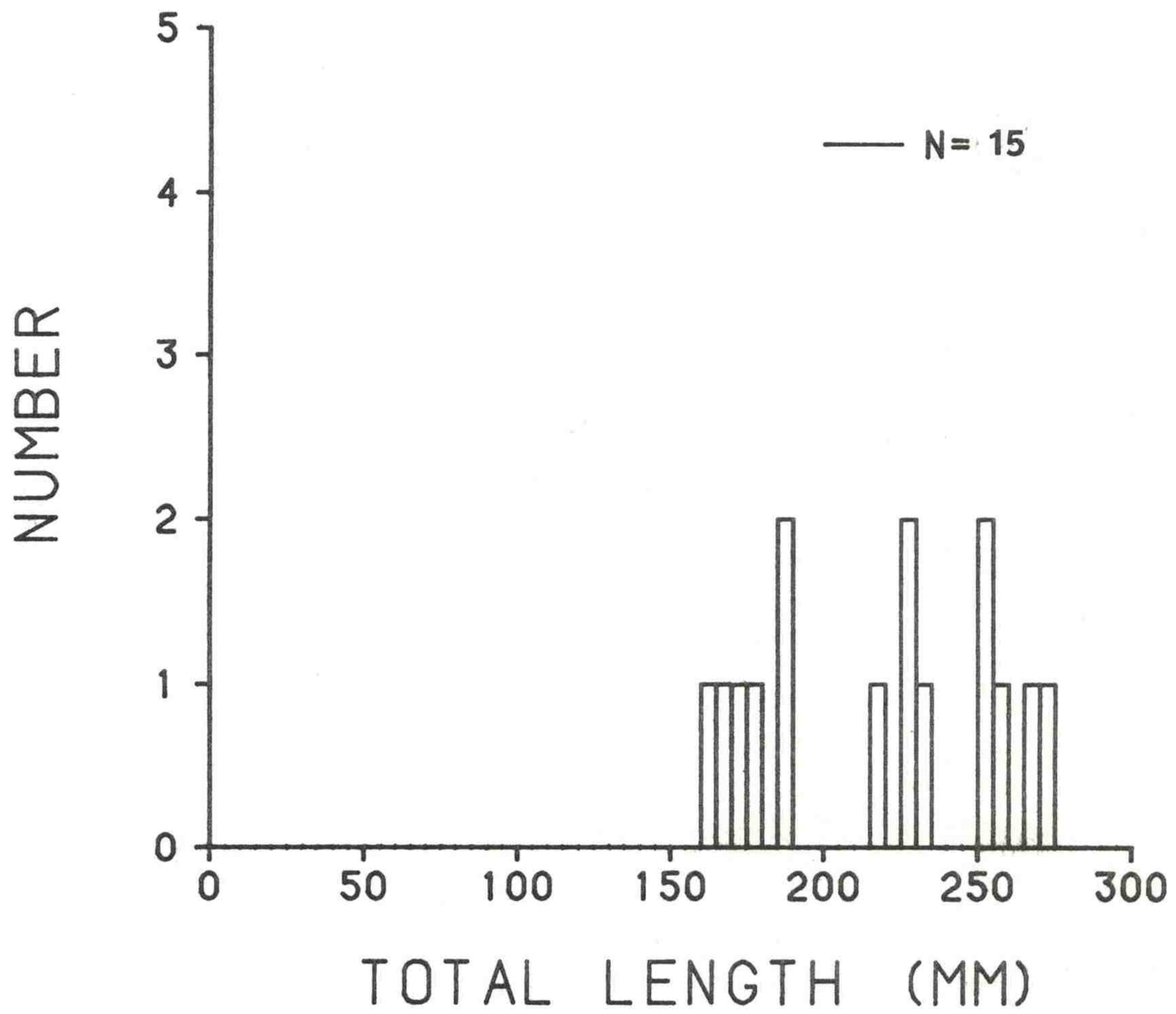


Figure 2.--Length frequency distribution of juvenile lingcod captured in Grays Harbor during October 1985.

returned the following spring to occupy nearshore rocky habitats (Buckley et al. 1984). More research would be required to determine the timing of a habitat shift for juvenile lingcod in Grays Harbor.

Twenty-eight other species of fishes and six species of crabs were captured (Table 1). Dungeness crab was the most abundant species, with estimated densities greater than 1000/ha at 14 of the 30 sampling sites. At most stations, crabs 50-115 mm (carapace width) were the most abundant size class, although crabs less than 50 mm were important at Stations 23, 24, 25, and 30. English sole were captured at 27 stations in 4-21 m of water; densities ranged from 3 to 3,478/ha. Densities of English sole were low within the entrance reach and in offshore areas north and south of the jetties. Sand sole were collected at 18 stations in water depths of 4-21 m; densities in both the ocean and Grays Harbor were relatively low and ranged from 4 to 160/ha. Shiner perch were captured at 18 stations in 4-21 m of water; densities ranged from 3 to 6,811/ha. Shiner perch were virtually absent in the ocean catches, and highest densities occurred upstream from the entrance reach.

There was variation among diversity values for the 30 trawling efforts (Table 2). Diversity tended to be lower at the mouth (entrance reach) of the estuary than in the area upstream from the mouth. The mean Shannon-Weaver Diversity Index (H) and Simpson Diversity Value (SD) for the stations at the mouth were 1.21 and 0.38, respectively; in the area upstream from the mouth, H and SD averaged 1.89 and 0.60, respectively.

Much more research is needed before the lingcod community in Grays Harbor can be adequately described. Intensive sampling throughout the year is needed to define the distribution, abundance, age-class structure, and movements of lingcod in the estuary and adjacent ocean areas.

Table 1.--Species composition of fishes and crabs captured in
Grays Harbor and near offshore areas in October 1985.

<u>Common name</u>	<u>Scientific name</u>	<u>Total number</u>
Spiny dogfish	<u>Squalus acanthias</u>	439
Big skate	<u>Raja binoculata</u>	4
Pacific herring	<u>Clupea harengus pallasii</u>	107
Northern anchovy	<u>Engraulis mordax</u>	699
Whitebait smelt	<u>Allosmerus elongatus</u>	87
Night smelt	<u>Spirinchus starski</u>	339
Longfin smelt	<u>Spirinchus thaleichthys</u>	14
Larval smelt	<u>Osmeridae</u>	606
Pacific tomcod	<u>Microgadus proximus</u>	2272
Bay pipefish	<u>Syngnathus leptorhynchus</u>	128
Shiner perch	<u>Cymatogaster aggregata</u>	2857
Spotfin surfperch	<u>Hyperprosopon anale</u>	67
Walleye surfperch	<u>Hyperprosopon argenteum</u>	55
Snake pricklyback	<u>Lumpenus sagitta</u>	43
Saddleback gunnel	<u>Pholis ornata</u>	54
Pacific sand lance	<u>Ammodytes hexapterus</u>	1286
Black rockfish	<u>Sebastes melanops</u>	1
Kelp greenling	<u>Hexagrammos decagrammus</u>	810
Lingcod	<u>Ophiodon elongatus</u>	15
Buffalo sculpin	<u>Enophrys bison</u>	295
Red Irish lord	<u>Hemilepidotus hemilepidotus</u>	57
Pacific staghorn sculpin	<u>Leptocottus armatus</u>	325
Cabezon	<u>Scorpaenichthys marmoratus</u>	2
Unidentified sculpin	<u>Cottidae</u>	68
Pricklebreast poacher	<u>Stellerina xyosterna</u>	5
Speckled sanddab	<u>Citharichthys stigmaeus</u>	469
Butter sole	<u>Isopsetta isolepis</u>	129
English sole	<u>Parophrys vetulus</u>	2930
Starry flounder	<u>Platichthys stellatus</u>	2
C-0 sole	<u>Pleuronichthys coenosus</u>	2
Sand sole	<u>Psettichthys melanostictus</u>	105
Dungeness crab	<u>Cancer magister</u>	9948
<u>Cancer oregonensis</u>	<u>Cancer oregonensis</u>	1
Red rock crab	<u>Cancer productus</u>	52
<u>Cancer gracilis</u>	<u>Cancer gracilis</u>	1
Purple shore crab	<u>Hemigrapsus nudus</u>	1
Kelp crab	<u>Pugettia producta</u>	1
TOTAL		24276

Table 2.--Diversity indices for 30 trawling efforts done in Grays Harbor and near offshore areas in October 1985; the Shannon-Weaver Diversity Index (H) and the Simpson Diversity Value (SD) are shown for each effort.

<u>Station</u>	<u>Location</u>	<u>H</u>	<u>SD</u>
1	Mouth of estuary	0.10	0.02
2	Mouth of estuary	1.82	0.61
19	Mouth of estuary	1.27	0.41
20	Mouth of estuary	1.40	0.42
21	Mouth of estuary	1.59	0.50
24	Mouth of estuary	1.08	0.32
3	Ocean	2.37	0.68
4	Ocean	3.23	0.86
5	Ocean	1.16	0.36
6	Ocean	1.96	0.65
7	Ocean	2.46	0.70
8	Ocean	0.00	0.00
9	Upstream from mouth	2.14	0.70
10	Upstream from mouth	2.28	0.72
11	Upstream from mouth	2.63	0.75
12	Upstream from mouth	2.05	0.69
13	Upstream from mouth	2.05	0.64
14	Upstream from mouth	2.17	0.71
15	Upstream from mouth	2.01	0.67
16	Upstream from mouth	1.16	0.35
17	Upstream from mouth	1.99	0.57
18	Upstream from mouth	1.49	0.54
22	Upstream from mouth	2.27	0.72
23	Upstream from mouth	1.72	0.57
25	Upstream from mouth	1.85	0.63
26	Upstream from mouth	0.88	0.27
27	Upstream from mouth	1.74	0.53
28	Upstream from mouth	2.49	0.80
29	Upstream from mouth	1.30	0.43
30	Upstream from mouth	1.80	0.55

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APPENDIX A

Loran-C Navigational Values

Appendix A.--Loran C navigational values for the 30 sampling stations (October 1985) in Grays Harbor and adjacent ocean waters.

<u>Station</u>	<u>Beginning of trawl</u>		<u>End of trawl</u>	
1	11834.3	28055.6	11833.6	28056.2
2	11833.9	28054.9	11833.5	28053.3*
3	11840.8	28057.9	11839.3	28057.7
4	11842.8	28057.2	11840.9	28057.3
5	11840.4	28050.7	11838.9	28050.7
6	11841.5	28049.9	11839.5	28050.4
7	11820.6	28056.4	11822.3	28056.1
8	11823.9	28054.9	11821.8	28055.3
9	11824.3	28063.0	11824.7	28063.1
10	11817.8	28064.1	11817.4	28064.5
11	11811.8	28063.8	11810.8	28063.9
12	11822.0	28062.8	11821.7	28062.5
13	11813.8	28064.6	11813.8	28064.5*
14	11810.0	28066.7	11810.1	28066.7*
15	11813.2	28067.3	11812.4	28067.5
16	11814.0	28067.1	11813.1	28067.5
17	11811.6	28063.9	11810.5	28064.0
18	11807.7	28064.5	11808.9	28064.3
19	11830.7	28057.8	11830.5	28058.0
20	11823.9	28059.9	11823.2	28060.0
21	11817.5	28062.4	11817.2	28062.6
22	11807.4	28069.5	11808.6	28069.0
23	11824.3	28062.1	11824.9	28062.4
24	11822.3	28060.9	11821.0	28061.8*
25	11824.4	28062.0	11825.0	28062.3
26	11815.8	28065.7	11815.2	28066.1
27	11799.1	28072.4	11797.9	28072.7
28	11812.8	28064.0	11811.9	28063.8
29	11827.4	28063.8	11828.5	28063.5
30	11824.2	28062.9	11824.9	28062.2

* - questionable Loran readings for this station

APPENDIX B

Physical and Biological Data

Physical and biological data for 30 stations sampled in Grays Harbor and near offshore areas in October 1985. Four community structure indices are also included for each station; see Methods for a brief description of the indices.

STATION: 1
Gear: 8-m trawl
Date: 1 Oct 1985
Depth: 13.7 m
Bottom salinity: 33.4 ppt
Bottom temperature: 8.9 C
Distance traveled: 556 m

Species	Number Captured	No. Per Hectare
Pacific sand lance	1183	4255
Kelp greenling	1	4
Speckled sanddab	1	4
Dunsmuir crab	12	43
TOTALS	1197	4306

H=0.10 J=0.05 SD=0.02 SR=0.42

STATION: 2

Gear: 8-m trawl

Date: 1 Oct 1985

Depth: 15.8 m

Bottom salinity: 33.4 ppt

Bottom temperature: 8.5 C

Distance traveled: 648 m

Species	Number Captured	No. Per Hectare
Pacific herrings	1	3
Bay pipefish	1	3
Pacific sand lance	46	142
Pacific staghorn sculpin	3	9
Unidentified sculpin	2	6
Speckled sanddab	16	49
English sole	3	9
C-O sole	1	3
Sand sole	3	9
Dunseness crab	93	287
TOTALS	169	520

H=1.82 J=0.55 SD=0.61 SR=1.75

STATION: 3

Gear: 8-m trawl

Date: 2 Oct 1985

Depth: 8.2 m

Bottom salinity: 32.5 ppt

Bottom temperature: 12.6 C

Distance traveled: 796 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	2	5
Pacific herring	1	3
Northern anchovy	1	3
Whitebait smelt	2	5
Spotfin surfperch	4	10
Pacific sand lance	1	3
Pacific staghorn sculpin	2	5
Speckled sanddab	20	50
Sand sole	3	8
Dunsmuir crab	1	3
TOTALS	37	95

H=2.37 J=0.71 SD=0.68 SR=2.49

STATION: 4

Gear: 8-m trawl

Date: 2 Oct 1985

Depth: 11.0 m

Bottom salinity: 32.9 ppt

Bottom temperature: 12.3 C

Distance traveled: 685 m

Species	Number Captured	No. Per Hectare
Spiny dosfish	1	3
Pacific herring	6	18
Northern anchovy	6	18
Night smelt	10	29
Whitebait smelt	1	3
Pacific tomcod	1	3
Bay pipefish	1	3
Spotfin surfperch	11	32
Pacific staghorn sculpin	2	6
Unidentified sculpin	3	9
Speckled sanddab	25	73
English sole	2	6
Starry flounder	1	3
Sand sole	8	23
Dunsmuir crab	9	26
TOTALS	87	255

H=3.23 J=0.83 SD=0.86 SR=3.13

STATION: 5

Gear: 3-m trawl

Date: 4 Oct 1985

Depth: 14.3 m

Bottom salinity: 32.8 ppt

Bottom temperature: 11.2 C

Distance traveled: 630 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	1	3
Night smelt	5	16
Pacific tomcod	36	114
Spotfin surfperch	7	22
Pacific staghorn sculpin	3	10
Unidentified sculpin	1	3
Speckled sanddab	47	149
Butter sole	2	6
English sole	137	435
Starry flounder	1	3
Sand sole	19	60
Dunsmuir crab	999	3171
TOTALS	1258	3992

H=1.16 J=0.32 SD=0.36 SR=1.54

STATION: 6

Gear: 8-m trawl

Date: 2 Oct 1985

Depth: 21.3 m

Bottom salinity: **** ppt

Bottom temperature: **** C

Distance traveled: 556 m

Species	Number Captured	No. Per Hectare
Spiny dosfish	1	4
Bis skate	3	11
Pacific herring	10	36
Northern anchovy	3	11
Night smelt	125	450
Whitebait smelt	23	83
Pacific tomcod	1421	5112
Bay pipefish	3	11
Shiner perch	12	43
Pacific staghorn sculpin	26	94
Pricklebreast poacher	5	18
Speckled sanddab	13	47
Butter sole	122	439
English sole	967	3478
C-O sole	1	4
Sand sole	1	4
Dungeness crab	221	795
TOTALS	2957	10640

H=1.96 J=0.48 SD=0.65 SR=2.00

STATION: 7

Gear: 8-m trawl

Date: 2 Oct 1985

Depth: 7.9 m

Bottom salinity: 32.9 ppt

Bottom temperature: 10.7 C

Distance traveled: 500 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	4	16
Northern anchovy	85	340
Night smelt	198	792
Larval smelt	606	2424
Whitebait smelt	54	216
Pacific tomcod	58	232
Bay pipefish	2	8
Spotfin surfperch	30	120
Buffalo sculpin	1	4
Pacific staghorn sculpin	20	80
Unidentified sculpin	1	4
Speckled sanddab	25	100
Butter sole	5	20
English sole	37	148
Sand sole	14	56
Dunseness crab	41	164
TOTALS	1181	4724

H=2.46 J=0.62 SD=0.70 SR=2.12

STATION: 8

Gear: 8-m trawl

Date: 2 Oct 1985

Depth: 9.1 m

Bottom salinity: 32.9 ppt

Bottom temperature: 10.9 C

Distance traveled: 611 m

Species	Number Captured	No. Per Hectare
English sole	1	3
TOTALS	1	3

H=0.00 J=0.00 SD=0.00 SR=0.00

STATION: 9

Gear: 8-m trawl

Date: 3 Oct 1985

Depth: 7.9 m

Bottom salinity: 31.2 ppt

Bottom temperature: 12.5 C

Distance traveled: 259 m

Species	Number Captured	No. Per Hectare
Pacific tomcod	5	39
Bay pipefish	7	54
Shiner perch	66	510
Snake prickleback	7	54
Pacific staghorn sculpin	29	224
Speckled sanddab	29	224
English sole	130	1004
Sand sole	1	8
Dungeness crab	225	1737
TOTALS	499	3854

H=2.14 J=0.68 SD=0.70 SR=1.29

STATION: 10

Gear: 8-m trawl

Date: 3 Oct 1985

Depth: 10.1 m

Bottom salinity: 31.4 ppt

Bottom temperature: 12.4 C

Distance traveled: 389 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	20	103
Pacific herrings	28	144
Northern anchovy	157	807
Pacific tomcod	3	15
Shiner perch	5	26
Kelp greenling	1	5
Pacific staghorn sculpin	7	36
Speckled sanddab	18	93
English sole	30	154
Dungeness crab	131	674
TOTALS	400	2057

H=2.28 J=0.69 SD=0.72 SR=1.50

STATION: 11

Gear: 8-m trawl

Date: 3 Oct 1985

Depth: 14.9 m

Bottom salinity: 30.9 ppt

Bottom temperature: 12.7 C

Distance traveled: 333 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	50	300
Northern anchovy	23	138
Pacific tomcod	223	1339
Shiner perch	245	1471
Spotfin surfperch	5	30
Walleye surfperch	1	6
Saddleback sunnel	29	174
Kelp greenling	31	186
Lingscod	1	6
Buffalo sculpin	56	336
Pacific staghorn sculpin	17	102
Cabezon	1	6
Unidentified sculpin	59	354
Speckled sanddab	14	84
English sole	145	871
Dungeness crab	724	4348
Cancer oregonensis	1	6
Red rock crab	3	18
TOTALS	1628	9775

H=2.63 J=0.63 SD=0.75 SR=2.30

STATION: 12

Gear: 8-m trawl

Date: 4 Oct 1985

Depth: 3.7 m

Bottom salinity: 32.0 ppt

Bottom temperature: 11.4 C

Distance traveled: 463 m

Species	Number Captured	No. Per Hectare
Spiny dosfish	6	26
Shiner perch	1	4
Pacific sand lance	1	4
Buffalo sculpin	2	9
Pacific staghorn sculpin	11	48
Unidentified sculpin	2	9
Speckled sanddab	26	112
English sole	69	298
Sand sole	1	4
Dunsmuir crab	87	376
TOTALS	206	890

H=2.05 J=0.62 SD=0.69 SR=1.69

STATION: 13

Gear: 8-m trawl

Date: 7 Oct 1985

Depth: 9.1 m

Bottom salinity: 32.6 ppt

Bottom temperature: 10.0 C

Distance traveled: 250 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	6	48
Pacific tomcod	4	32
Bay pipefish	4	32
Pacific staghorn sculpin	20	160
Speckled sanddab	22	176
English sole	34	272
Sand sole	20	160
Dunsmuir crab	144	1152
TOTALS	254	2032

H=2.05 J=0.68 SD=0.64 SR=1.26

STATION: 14

Gear: 8-m trawl

Date: 7 Oct 1985

Depth: 10.4 m

Bottom salinity: 32.6 ppt

Bottom temperature: 10.0 C

Distance traveled: 250 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	12	96
Pacific herrings	34	272
Northern anchovy	258	2064
Pacific tomcod	7	56
Shiner perch	1	8
Snake prickleback	2	16
Pacific staghorn sculpin	13	104
Speckled sanddab	7	56
English sole	128	1024
Sand sole	2	16
Dungeness crab	127	1016
TOTALS	591	4728

H=2.17 J=0.63 SD=0.71 SR=1.57

STATION: 15

Gear: 8-m trawl

Date: 7 Oct 1985

Depth: 10.7 m

Bottom salinity: 32.4 ppt

Bottom temperature: 10.3 C

Distance traveled: 222 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	4	36
Pacific herrings	19	171
Northern anchovy	7	63
Pacific tomcod	11	99
Bay pipefish	1	9
Snake prickleback	13	117
Pacific staghorn sculpin	40	360
Speckled sanddab	3	27
English sole	210	1892
Sand sole	1	9
Dungeness crab	185	1667
TOTALS	494	4450

H=2.01 J=0.58 SD=0.67 SR=1.61

STATION: 16

Gear: 8-m trawl

Date: 7 Oct 1985

Depth: 4.3 m

Bottom salinity: 31.1 ppt

Bottom temperature: 11.7 C

Distance traveled: 333 m

Species	Number Captured	No. Per Hectare
Spiny dosfish	1	6
Pacific herrings	1	6
Shiner perch	9	54
Pacific staghorn sculpin	9	54
Speckled sanddab	6	36
English sole	18	108
Dunsmuir crab	172	1033
TOTALS	216	1297

H=1.16 J=0.41 SD=0.35 SR=1.12

STATION: 17

Gear: 8-m trawl

Date: 7 Oct 1985

Depth: 13.4 m

Bottom salinity: 32.7 ppt

Bottom temperature: 10.2 C

Distance traveled: 370 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	111	600
Pacific herrings	2	11
Northern anchovy	138	746
Night smelt	1	5
Pacific tomcod	104	562
Bay pipefish	6	32
Shiner perch	304	1643
Spotfin surfperch	5	27
Snake prickleback	1	5
Saddleback sunnel	7	38
Kelp greenling	24	130
Linscod	3	16
Buffalo sculpin	61	330
Red Irish lord	31	168
Pacific staghorn sculpin	12	65
Speckled sanddab	1	5
English sole	40	216
Dunsmuir crab	1540	8324
Red rock crab	14	76
Kelp crab	1	5
TOTALS	2406	13004

H=1.99 J=0.46 SD=0.57 SR=2.44

STATION: 18

Gear: 8-m trawl

Date: 8 Oct 1985

Depth: 8.2 m

Bottom salinity: 33.0 ppt

Bottom temperature: 9.9 C

Distance traveled: 352 m

Species	Number Captured	No. Per Hectare
Pacific herrings	1	6
Northern anchovy	3	17
Pacific tomcod	1	6
Shiner perch	2	11
Kelp greenlings	5	28
Red Irish lord	1	6
Pacific staghorn sculpin	9	51
Speckled sanddab	9	51
English sole	135	767
Sand sole	1	6
Dungeness crab	242	1375
Purple shore crab	1	6
TOTALS	410	2330

H=1.49 J=0.42 SD=0.54 SR=1.83

STATION: 19

Gear: 8-m trawl

Date: 8 Oct 1985

Depth: 12.8 m

Bottom salinity: 33.1 ppt

Bottom temperature: 9.2 C

Distance traveled: 185 m

Species	Number Captured	No. Per Hectare
Pacific tomcod	1	11
Kelp greenling	1	11
Pacific staghorn sculpin	2	22
Speckled sanddab	15	162
English sole	2	22
Sand sole	4	43
Dunsmuir crab	75	811
TOTALS	100	1082

H=1.27 J=0.45 SD=0.41 SR=1.30

STATION: 20

Gear: 8-m trawl

Date: 8 Oct 1985

Depth: 8.2 m

Bottom salinity: 33.3 ppt

Bottom temperature: 9.1 C

Distance traveled: 222 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	7	63
Pacific herrings	1	9
Pacific tomcod	1	9
Bay pipefish	1	9
Pacific staghorn sculpin	7	63
Speckled sanddab	5	45
Sand sole	7	63
Dunsmuir crab	89	802
TOTALS	118	1063

H=1.40 J=0.47 SD=0.42 SR=1.47

STATION: 21

Gear: 8-m trawl

Date: 8 Oct 1985

Depth: 13.4 m

Bottom salinity: 33.1 ppt

Bottom temperature: 9.4 C

Distance traveled: 185 m

Species	Number Captured	No. Per Hectare
Pacific tomcod	3	32
Bay pipefish	89	962
Shiner perch	6	65
Saddleback gunnel	2	22
Pacific staghorn sculpin	4	43
Speckled sanddab	3	32
English sole	2	22
Dunsmuir crab	21	227
TOTALS	130	1405

H=1.59 J=0.53 SD=0.50 SR=1.44

STATION: 22

Gear: 8-m trawl

Date: 8 Oct 1985

Depth: 10.4 m

Bottom salinity: 31.8 ppt

Bottom temperature: 10.9 C

Distance traveled: 426 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	3	14
Northern anchovy	3	14
Bay pipefish	5	23
Shiner perch	9	42
Snake prickleback	1	5
Pacific sand lance	55	258
Speckled sanddab	1	5
English sole	18	85
Sand sole	3	14
Dunsmuir crab	52	244
TOTALS	150	704

H=2.27 J=0.68 SD=0.72 SR=1.80

STATION: 23

Gear: 8-m trawl

Date: 8 Oct 1985

Depth: 9.1 m

Bottom salinity: 32.6 ppt

Bottom temperature: 10.1 C

Distance traveled: 574 m

Species	Number Captured	No. Per Hectare
Big skate	1	3
Bay pipefish	1	3
Shiner perch	1	3
Walleye surfperch	10	35
Snake prickleback	1	3
Saddleback sunnel	1	3
Kelp greenling	181	631
Linscod	1	3
Buffalo sculpin	41	143
Pacific staghorn sculpin	4	14
Cabezon	1	3
Speckled sanddab	22	77
English sole	136	474
Dunsmuir crab	668	2328
Red rock crab	4	14
TOTALS	1073	3737

H=1.72 J=0.44 SD=0.57 SR=2.01

STATION: 24

Gear: 8-m trawl

Date: 8 Oct 1985

Depth: 12.2 m

Bottom salinity: 33.0 ppt

Bottom temperature: 9.6 C

Distance traveled: 630 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	5	16
Pacific tomcod	4	13
Shiner perch	4	13
Walleye surfperch	3	10
Kelp greenling	6	19
Pacific staghorn sculpin	1	3
Speckled sanddab	40	127
English sole	3	10
Sand sole	2	6
Dungeness crab	306	971
TOTALS	374	1188

H=1.08 J=0.32 SD=0.32 SR=1.52

STATION: 25

Gear: 8-m trawl

Date: 9 Oct 1985

Depth: 9.1 m

Bottom salinity: 32.9 ppt

Bottom temperature: 9.6 C

Distance traveled: 574 m

Species	Number Captured	No. Per Hectare
Pacific tomcod	1	3
Bay pipefish	2	7
Shiner perch	818	2850
Walleye surfperch	18	63
Saddleback sunnel	1	3
Kelp greenling	182	634
Lingscod	4	14
Buffalo sculpin	60	209
Red Irish lord	3	10
Pacific staghorn sculpin	10	35
Speckled sanddab	16	56
English sole	119	415
Dungeness crab	1281	4463
Red rock crab	14	49
Cancer gracilis	1	3
TOTALS	2530	8814

H=1.85 J=0.47 SD=0.63 SR=1.79

STATION: 26

Gear: 8-m trawl

Date: 9 Oct 1985

Depth: 10.1 m

Bottom salinity: 33.0 ppt

Bottom temperature: 9.2 C

Distance traveled: 352 m

Species	Number Captured	No. Per Hectare
Pacific tomcod	2	11
Shiner perch	1	6
Snake prickleback	2	11
Pacific staghorn sculpin	21	119
Speckled sanddab	16	91
English sole	50	284
Dungeness crab	508	2886
TOTALS	600	3408

H=0.88 J=0.31 SD=0.27 SR=0.94

STATION: 27

Gear: 8-m trawl

Date: 9 Oct 1985

Depth: 10.7 m

Bottom salinity: 30.5 ppt

Bottom temperature: 10.8 C

Distance traveled: 333 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	1	6
Pacific herrings	3	18
Northern anchovy	15	90
Longfin smelt	14	84
Whitebait smelt	6	36
Pacific tomcod	200	1201
Shiner perch	1134	6811
Spotfin surfperch	5	30
Walleye surfperch	2	12
Snake prickleback	13	78
Saddleback sunnel	2	12
Pacific staghorn sculpin	16	96
Speckled sanddab	3	18
English sole	212	1273
Sand sole	13	78
Dungeness crab	82	492
TOTALS	1721	10335

H=1.74 J=0.43 SD=0.53 SR=2.01

STATION: 28

Gear: 8-m trawl

Date: 9 Oct 1985

Depth: 12.8 m

Bottom salinity: 33.0 ppt

Bottom temperature: 9.1 C

Distance traveled: 574 m

Species	Number Captured	No. Per Hectare
Spiny dogfish	204	711
Pacific tomcod	184	641
Shiner perch	166	578
Saddleback sunnel	9	31
Kelp greenling	5	17
Pacific staghorn sculpin	29	101
English sole	70	244
Sand sole	2	7
Dungeness crab	227	791
Red rock crab	1	3
TOTALS	897	3124

H=2.49 J=0.75 SD=0.80 SR=1.32

STATION: 29

Gear: 8-m trawl

Date: 9 Oct 1985

Depth: 5.8 m

Bottom salinity: 31.5 ppt

Bottom temperature: 10.5 C

Distance traveled: 315 m

Species	Number Captured	No. Per Hectare
Whitebait smelt	1	6
Pacific tomcod	2	13
Bay pipefish	3	19
Snake prickleback	3	19
Saddleback gunnel	2	13
Black rockfish	1	6
Speckled sanddab	7	44
English sole	43	273
Dunsmuir crab	165	1048
TOTALS	227	1441

H=1.30 J=0.41 SD=0.43 SR=1.47

STATION: 30

Gear: 8-m trawl

Date: 9 Oct 1985

Depth: 9.1 m

Bottom salinity: 32.5 ppt

Bottom temperature: 9.8 C

Distance traveled: 685 m

Species	Number Captured	No. Per Hectare
Bay pipefish	2	6
Shiner perch	73	213
Walleye surfperch	21	61
Saddleback sunnel	1	3
Kelp greenling	373	1089
Lingscod	6	18
Buffalo sculpin	74	216
Red Irish lord	22	64
Pacific staghorn sculpin	8	23
Speckled sanddab	59	172
English sole	189	552
Dunsmuir crab	1521	4441
Red rock crab	16	47
TOTALS	2365	6905

H=1.80 J=0.49 SD=0.55 SR=1.54

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