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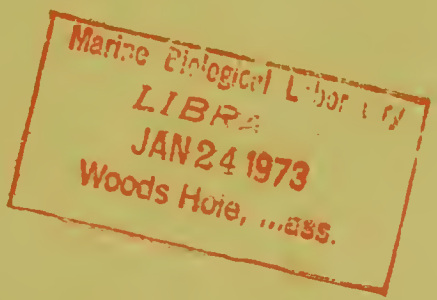
U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Fish Larvae Collected from the Northeastern Pacific Ocean and Puget Sound During April and May 1967

KENNETH D. WALDRON



SEATTLE, WA
December 1972

National Marine Fisheries Service, Special Scientific Report--Fisheries Series

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ABSTRACT

Fish larvae belonging to 24 families and the suborder Blennioidea were collected from Puget Sound and the Pacific Ocean off British Columbia, Washington, and Oregon during April and May 1967. All families and the Blennioidea were present in oceanic waters, but only 13 families and the Blennioidea were present in Puget Sound. The most abundant families in the oceanic area were Scorpaenidae, Myctophidae, and Pleuronectidae, whereas in Puget Sound the most abundant families were Gadidae, Pleuronectidae, and Scorpaenidae. Variations in composition and numbers of larvae in the catch were associated with area, water depth, water temperature, and time of day at which the collections were made.

INTRODUCTION

A large number of plankton samples have been collected from the offshore waters of Washington and Oregon, but there is a dearth of reports about the fish larvae in these collections. This lack of published reports became apparent during an investigation of the spawning habits of Pacific hake, *Merluccius productus* (Ayres), in waters north of California.

In 1965 an experimental fishery developed for hake off the coasts of Washington and Oregon, as well as within Puget Sound. At the same time scientists at the National Marine Fisheries Service (NMFS: then the Bureau of Commercial Fisheries) began studies of the life history of hake found in these waters.

Two stocks contribute to the hake fishery of Washington. One is present throughout the year within Puget Sound, possibly extending northward into the Strait of Georgia, and is known to spawn in Puget Sound.[1] The second, called the oceanic stock, is present in the coastal waters from California to at least southern British Columbia (Grinols and Tillman, 1970; Nelson, 1970; Nelson and Larkins, 1970). From May to November, adult oceanic hake are abundant northward from central California to Southern Vancouver Island, with the center of abundance off northern Oregon and southern Washington; they are scarce or absent from this same area from December through April. It is also known that large numbers of hake eggs and larvae are present in waters off southern California during

[1] Larkins, H. A., H. H. Shippen, and K. D. Waldron. 1967. Features of a northern Puget Sound hake population. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Northwest Fisheries Center, Seattle, Wash. Unpublished manuscript, 19 p.

February through April (Ahlstrom and Counts, 1955). Based on these facts it was inferred that hake migrate along the Pacific coast between a northern feeding ground (late spring to fall) and a southern spawning ground (winter through early spring). The extent of the adult hake population off southern California has not been well defined, and few catches of the magnitude of those made in the northern feeding grounds have been made off southern California (Nelson and Larkins, 1970).

Grinols and Tillman (1970) pointed out that some hake populations move from shallow to deep water during their spawning migration. The evidence for such a migration among Pacific hake was weaker than that for latitudinal migration, but it was felt necessary to investigate the possibility by searching for eggs and larvae in the area offshore from the northern feeding grounds.

Existing reports of fish larvae and eggs were based upon collections made at times of year or with types of tows not well suited for collecting hake larvae. LeBrasseur (1964,[2] 1965,[3] 1970) did not find hake in a large series of plankton collections made over a number of years by the Fisheries Research Board of Canada. Most of the samples reported by LeBrasseur were collected by vertical net tows; larval fish were present in less than 5% of these tows.

Aron (1960) reported on collections made with Isaacs-Kidd midwater trawls during the summer. He did not find hake in oceanic collections but did catch 13 juvenile hake in Puget Sound. After examining existing data it was decided to search for hake eggs and larvae in waters off Oregon, Washington, and British Columbia at a time of year when hake would be expected to spawn. This survey was undertaken during April and May 1967, and also provided a means of obtaining reference specimens and information about the spawning behavior of other fishes.

METHODS AND EQUIPMENT

A pattern of stations was laid out between 42° to 51°N and extending offshore about 550 km (Fig. 1 and Appendix Tables 1 and 2). Within these bounds, stations were located with reference to certain bathyorographical features, e.g., the Cobb Seamount (U.S. Naval Oceanographic Office, 1971). Along the inshore portion of each line, stations were located at the 55-, 119-, 183-, and 914-m (30-, 65-, 100-, and 500-fm) isobaths. Along the deeper portions of the lines, stations were spaced at 111 km (60 nautical miles) intervals. Two NMFS vessels at Seattle were used to carry out the survey. The RV *John N. Cobb* was used to sample at the inshore series of 40 stations, i.e., those located from the 55 to 914 m isobaths, and the RV *George B. Kelez* covered a series of 48 stations beyond the 914 m (500 fm) isobath. All stations were fished between April 12 and May 11, a period believed to be near optimum to discover evidence of hake spawning, if indeed any occurred in the area. The *John N. Cobb* fished 3 Puget Sound and 40 oceanic stations between 12 and 19 April; the *George B. Kelez* fished 11 Puget Sound and 48

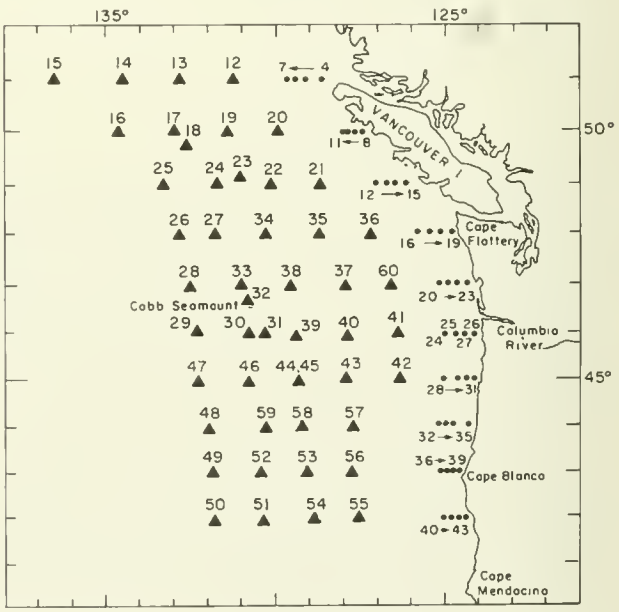

Figure 1.—Location of stations in the oceanic fishing area; 12 April to 11 May 1967. Stations are designated by dots for the RV *John N. Cobb* and by triangles for the RV *George B. Kelez*; station positions are listed in Appendix Tables 1 and 2.

[2] LeBrasseur, R. J. 1964. Data record: a preliminary checklist of some marine plankton from the northeastern Pacific Ocean. Fish. Res. Board Can., Manuscr. Rep. Ser. (Oceanogr. Limnol.) No. 174, 14 p.

[3] LeBrasseur, R. J. 1965. Biomass atlas of net zooplankton in the northeastern Pacific Ocean, 1956-1964. Fish. Res. Board Can., Manuscr. Rep. Ser. (Oceanogr. Limnol.) No. 201, 14 p. text, [247 Fig.].

oceanic stations between 24 April and 11 May (Fig. 2).

Collections were made with 1-m nets constructed of white No. 30XXX grit gauze (nominal mesh aperture 0.7 mm when new and 0.5-0.6 mm after some use), similar in design to a 1-m net used extensively by the California Cooperative Oceanic Fishery Investigation (CalCOFI; Ahlstrom, 1952). These nets were towed over an oblique path to a depth of about 200 m, depth of water permitting. Vessel speed during the tows was maintained at 1 to 2 knots. The net was lowered rapidly (about 50 m of wire per minute) until the desired amount of wire had been paid out, and the net was then retrieved at about 20 to 25 m of wire per minute. The amount of water strained was estimated with a flowmeter[4] mounted in the center of the mouth of the net. A bathykymograph, Marine Advisors Model T-1, attached to the bridle of the net provided a record of the path of the net through the water with respect to depth and time. A single tow was made at each station unless an obvious gear malfunction occurred. Also, at each station the surface water temperature was measured, a salinity sample collected, and a bathythermograph lowered to a depth of about 275 m.

Plankton samples were preserved in 10% Formalin (3.7% formaldehyde) buffered with borax, and returned to the laboratory for further processing. In the laboratory the displacement volume of the total catch was measured, the fish eggs and larvae removed, and the remainder of the sample sent to the Smithsonian Oceanographic Sorting Center in Washington, D.C.

Total numbers of fish larvae caught at each station are presented in Appendix Table 3 and the total plankton volumes in Appendix Tables 1 and 2. The actual numbers and volumes may be converted to standard units through use of Standard Haul Factors (SHF) presented in Appendix Table 4. Factor (A), catch per 10 cubic meters of water strained per meter of depth fished, should be used to standardize the numbers of larvae because this permits comparison of numbers caught at different stations (Ahlstrom, 1948). Factor (B), catch per 1,000 cubic meters of water strained, can be used to standardize the volume of zooplankton.

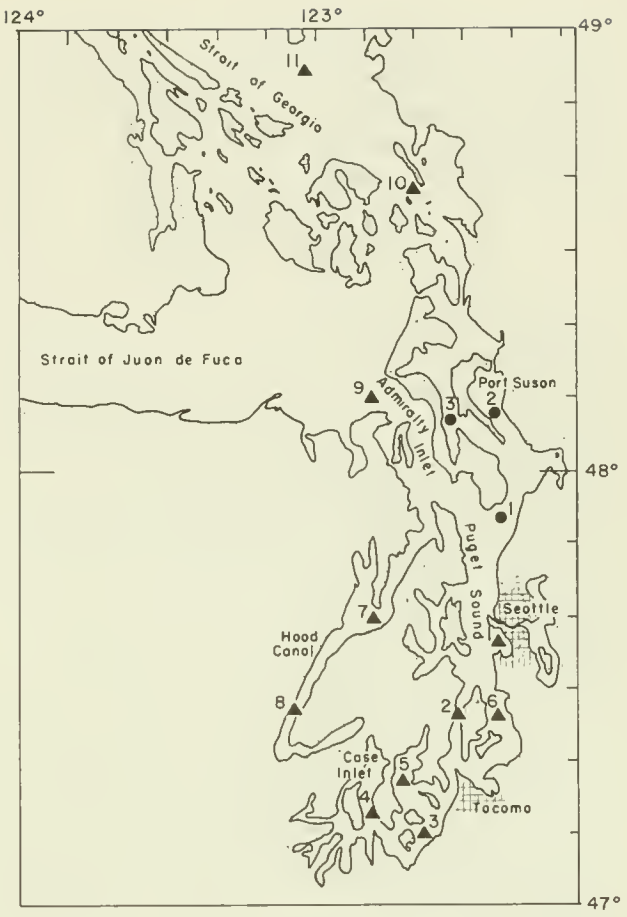

Figure 2.—Location of fishing stations in Puget Sound and adjacent waters, 10 April to 22 April 1967. Stations are designated by dots for the RV *John N. Cobb* and by triangles for the RV *George B. Kelez*; station positions are listed in Appendix Tables 1 and 2.

Because of the lack of any comprehensive key to fish larvae of the northeastern Pacific Ocean, identification was made by several means. Many of the larvae were identified by comparing them with specimens of known identity in the collections of the NMFS Fishery-Oceanography Center at La Jolla, Calif. The identification of some of the more northerly forms was based upon specimens of the Fisheries Research Board of Canada at their Biological Station in Nanaimo, British Columbia. Identification of a few specimens was made on the basis of published descriptions.

Larvae were classified to the smallest taxonomic group possible; in some cases this was

[4] Manufactured by Tsurumi-Seiki Kosakusho Co., Ltd., Yokohama, Japan.

only to family and, in the case of blennioids, only to suborder. Identification of some of the larvae is tentative due to lack of adequate published description or identified material. Specimens not positively identified are shown with a question mark after the listing.

RESULTS

Appendix Table 3 shows the catches of larvae made at each station of the survey, Appendix Tables 1 and 2 show the pertinent station data, and text Table 1 shows the numbers of larvae, percentage by area and by family, and the rank for family groups represented in the catch. Larvae belonging to 24 families plus the suborder Blennioidea were identified in the catches. Only 13 families and the Blennioidea were present in catches from Puget Sound. Catches from the oceanic area included representatives of 24 families and the Blennioidea. About 48% of all larvae were caught at 14 stations in Puget Sound and adjacent waters. The remaining 52% were caught at 88 oceanic stations. Fish larvae were caught at all but one station (*George B. Kelez* Station 13), although at three other oceanic stations only a single larva was caught. Standard length (SL) of the fish larvae was generally less than 10 mm, with a total range of 2.7 to 40 mm.

Hake eggs and larvae were absent from the oceanic areas, were scarce or absent from the area just north of Puget Sound (Admiralty Inlet and southern Strait of Georgia), but were abundant in Puget Sound, especially in Port Susan. Except for hake, fish eggs were not separated by species and were not considered in the remainder of this report.

The oceanic area was rather arbitrarily divided into inshore and offshore subdivisions, with the 914 m (500 fm) isobath as the dividing line. The inshore subdivision as used here is essentially the continental shelf and upper part of the continental slope. The offshore subdivisions were over the abyssal portion of the North Pacific Basin where depths were between the 1,829 and 3,658 m (1,000 and 2,000 fm) isobaths. These subdivisions were also characterized by the abundance of certain groups of larvae in the upper 250 m. In the offshore area, catches were composed mainly of Myctophidae (72%), Scorpaenidae (16%), Bathylagidae (6%), and Chauliodontidae (1%), with 14 families making up the remaining 5% of the catch. At stations of the inshore subdivision, plus four stations in offshore waters at which depths were less than 914 m (*George B. Kelez* stations 18, 23, 26, and 32[5]), the catch was predominantly Scorpaenidae (55%), Pleuronectidae (22%), Ammodytidae (5%), Myctophidae (5%), Osmeridae (2%), and Gadidae (2%), with 10 families making up the remaining 9% of the larvae. It is worthwhile to note that in waters over the continental shelf, four families (Scorpaenidae, Pleuronectidae, Gadidae, and Osmeridae) of potential commercial value contributed 81% of the larvae. In the offshore subdivision only one family (Scorpaenidae) of commercial importance contributed more than 1%, which made up 16% of the larvae; four other families (Pleuronectidae, Clupeidae, Bothidae, and Anoplopomatidae) also of commercial importance contributed an aggregate of 0.6% of the catch. The remaining larvae from the inshore and offshore subdivisions could be classed as forage fish. At other times of the year the proportion and distribution of commercially important fish could be expected to be somewhat different.

RELATIVE ABUNDANCE OF FISH LARVAE BY FAMILY

Five families of fish contributed 88% of the total larvae, and it is worthwhile to point out some features of their distribution.

Scorpaenidae

Scorpaenids were the most abundant fish encountered during the survey, constituting 29% of the total larvae collected. Of these, 30% were collected in Puget Sound (15 stations), and the remaining 70% in the oceanic area (87 stations). Over 99% of the larvae in this group were *Sebastes*; the remaining fraction of a percent were *Sebastolobus*. No attempt was made to separate the *Sebastes* except for *S. paucispinis*, into specific groups, though it was clear that several species were present in the

[5] Station 18 - Union Seamount, Station 23 - Explorer Seamount, Station 26 - Warwick Seamount, and Station 32 - Cobb Seamount.

Table 1.—Catch of fish larvae in Puget Sound and in oceanic areas, and the percentage composition and rank of abundance of the 10 most abundant groups in relation to total catch, April-May 1967.

Family and (in parentheses) suborder of fish	Total catch			Puget Sound catch				Catch in oceanic areas											
								Water depth ≤ 914 m				Water depth > 914 m				Total			
	No.	%	Rank	No.	% of family	% of catch	Rank	No.	% of family	% of catch	Rank	No.	% of family	% of catch	Rank	No.	% of family	% of catch	Rank
Identified larvae																			
Scorpaenidae	2593	29.4	1	786	30.3	18.5	3	1526	58.9	55.2	1	281	10.8	15.5	2	1807	69.7	39.5	1
Pleuronectidae	1587	18.0	2	961	60.5	22.7	2	620	39.1	22.4	2	6	0.4	0.3	6	626	39.4	13.7	3
Gadidae	1524	17.3	3	1469	96.4	34.7	1	55	3.6	2.0	6	0	—	—	—	55	3.6	1.2	7
Myctophidae	1447	16.4	4	0	—	—	—	136	9.4	4.9	4	1311	90.6	72.3	1	1447	100.0	31.6	2
Ammodytidae	569	6.5	5	431	75.7	10.2	4	138	24.3	5.0	3	0	—	—	—	138	24.3	3.0	4
Bathylagidae	143	1.6	6	7	4.9	0.2	9	27	18.9	1.0		109	76.2	6.0	3	136	95.1	3.0	5
Clupeidae	121	1.4	7	116	95.9	2.7	5	4	3.3	0.1		1	0.8	0.1		5	4.1	0.1	
Cottidae	69	0.8	8	25	36.2	0.6	7	40	58.0	1.4	7	4	5.8	0.2	8	44	63.8	1.0	8
Cyclopteridae	68	0.8	9	40	58.8	0.9	6	28	41.2	1.0	10	0	—	—	—	28	41.2	0.6	
Osmeridae	65	0.7	10	1	1.5	+		64	98.5	2.3	5	0	—	—	—	64	98.5	1.4	6
(Blennioidea)	50	0.6		13	26.0	0.3	8	36	72.0	1.3	8	1	2.0	0.1		37	74.0	0.8	9
Hexagrammidae	36	0.4		2	5.6	+		33	91.7	1.2	9	1	2.8	0.1		34	94.4	0.7	10
Chauliodontidae	21	0.2		0	—	—	—	0	—	—	—	21	100.0	1.2	4	21	100.0	0.5	
Bathymasteridae	10	0.1		0	—	—	—	8	80.0	0.3		2	20.0	0.1		10	100.0	0.2	
Agonidae	9	0.1		6	66.7	0.1	10	3	33.3	0.1		0	—	—	—	3	33.3	0.1	
Paralepididae	9	0.1		0	—	—	—	0	—	—	—	9	100.0	0.5	5	9	100.0	0.2	
Argentinidae	6	0.1		0	—	—	—	0	—	—	—	6	100.0	0.3	6	6	100.0	0.1	
Gobiidae	5	0.1		4	80.0	0.1		1	20.0	+		0	—	—	—	1	20.0	+	
Centrolophidae	4	+ [1]		0	—	—	—	0	—	—	—	4	100.0	0.2	8	4	100.0	0.1	
Melamphidae	3	+		0	—	—	—	0	—	—	—	3	100.0	0.2	10	3	100.0	0.1	
Bothidae	2	+		1	50.0	+		0	—	—	—	1	50.0	0.1		1	50.0	+	
Anoplopomatidae	1	+		0	—	—	—	0	—	—	—	1	100.0	0.1		1	100.0	+	
Icosteidae	1	+		0	—	—	—	0	—	—	—	1	100.0	0.1		1	100.0	+	
Melanostomiatidae	1	+		0	—	—	—	0	—	—	—	1	100.0	0.1		1	100.0	+	
Opisthoproctidae	1	+		0	—	—	—	1	100.0	+		0	—	—	—	1	100.0	+	
Total larvae identified	8345	94.7	—	3862	46.3	91.1	—	2720	32.6	98.4	—	1763	21.1	97.2	—	4483	53.7	97.9	—
Unidentified larvae	470	5.3	—	376	80.0	8.9	—	43	9.1	1.6	—	51	10.9	2.8	—	94	20.0	2.1	—
Total larvae	8815	100.0	—	4238	48.1	100.0	—	2763	31.3	100.0	—	1814	20.6	100.0	—	4577	51.9	100.0	—

[1] A plus (+) indicates the item accounted for less than 0.05% of the catch.

catch. Scorpaenid larvae ranged in size from 4.2 to 16.3 mm SL, with the majority from 5 to 7 mm.

The distribution of scorpaenid larvae was not uniform in either major area, with a range of 8 to 136 larvae per station in Puget Sound, and 0 to 542 in the oceanic area. Abundance seemed to be related to area, particularly in the oceanic region.

In the oceanic area scorpaenid larvae were most abundant in waters over the continental shelf and upper continental slope (i.e., where depth of water was 914 m or less); 84% of the oceanic catch was collected in this region. The largest single catch (542 larvae) was made at a station near the Cobb Seamount where the water depth was about 250 m. At three oceanic stations the catch exceeded 150 scorpaenid larvae, and bottom depth at these stations was less than 914 m. The average catch was only 9.4 scorpaenids at the remaining 84 oceanic stations. At 21 stations no scorpaenid larvae were caught.

Pleuronectidae

Flatfishes, the second most abundant family group, made up 18% of the total catch; 61% of the flatfishes were caught in Puget Sound and 39% in oceanic waters. In Puget Sound the most abundant larvae were *Parophrys vetulus* (58%), *Psettichthys melanostictus* (16%), *Platichthys stellatus* (12%), and *Lyopsetta exilis* (12%). By contrast, in the oceanic area, one species (tentatively identified as *Isopsetta isolepis*) made up 70% of the pleuronectid larvae; *Parophrys vetulus* contributed 10%, *Platichthys stellatus* 7%, and *Psettichthys melanostictus* 6%. Larvae of *Microstomus pacificus*, commercially one of the most important flatfishes of the Pacific coast, accounted for only about 0.6% of the total pleuronectid larvae caught. Most pleuronectid larvae were from 5 to 9 mm SL with an extreme range of 4 to 16 mm. In general, larvae of *Platichthys stellatus* were the shortest and those of *Glyptocephalus zachirus* the longest.

In the oceanic area almost the entire catch came from stations over the continental shelf in 55 m of water (96%). Only 0.1% of the catch came from waters beyond the continental slope. The average catch was 60 peluronectid larvae at the 55 m oceanic stations and 69 larvae per station within Puget Sound.

Gadidae

Larvae of the family Gadidae were the third most abundant group and constituted 17% of the total catch; 96% of these were caught in Puget Sound. Larvae of *Merluccius productus*, the Pacific hake, were caught only in Puget Sound and occurred at 14 of the 15 stations in that area; 50% were caught at a single station in Port Susan. Hake larvae made up 59% of all gadids. Although positive identification was not made, it was felt that the remaining gadids were *Theragra chalcogramma* or *Microgadus proximus*, the walleye pollock, and Pacific tomcod, respectively. No gadids were collected beyond the continental slope in the ocean area. Gadid larvae ranged from 2.8 to 15.9 mm SL. Most hake were 5 to 6 mm in length and "other gadids" were 5 to 8 mm SL.

Myctophidae

The fourth most abundant group, the myctophids, were restricted entirely to the oceanic area where they were second in abundance. They had a somewhat more uniform pattern of distribution than either the scorpaenids or the pleuronectids. There were more zero catches of this family in the area over the continental shelf than over deeper water, and the largest catches were made in the southern portion of the survey area (from lat 45°N southward). There was a noticeable difference between day and night catches, as was expected. Equating day collections to those made between 0501 and 1900 hr and night collections to those between 1901 and 0500 hr (PST), 35% of the day collections and 15% of the night collections contained no myctophids. All of the large catches (more than 75 larvae per station) were made at night. The mean catch for stations with catches of myctophids was 16 larvae per station for daytime catches and 30 per station for nighttime catches.

The dominant species were *Stenobrachius leucopsarus* (78%), *Tarletonbeania crenularis* (10%), and *Diaphus theta* (8%). The size of myctophid larvae ranged from 2.7 to 18.8 mm SL, with the majority in the 5 to 10 mm range. The largest larvae were those of *Tarletonbeania crenularis*.

Some species seemed to have a distribution

related to surface temperature. *Lampanyctus ritteri* and *Diaphus theta* were present only in the southern portion of the survey where the surface water was generally warmer than 9.0°C; *Tarletonbeania crenularis* was most abundant where surface water was warmer than 8.0°C, whereas *Stenobrachius leucopsarus* and *Protomyctophum thompsoni* (*Electrona arctica* in Clemens and Wilby, 1961) were found throughout the survey area in which surface water temperatures ranged from 5.8° to 10.9°C.

Ammodytidae

Sand lances, the fifth most abundant family of larvae, were most common in Puget Sound and occurred at 10 of 15 stations. Over one-half of the entire catch was taken at a single station in Hood Canal, and 76% of the catch was from Puget Sound. The remaining 24% was from the inshore oceanic area, distributed from the most northerly to the most southerly line of stations. The largest oceanic catches were made off Vancouver Island. Larval Ammodytidae were 4.5 to 40 mm SL, but most were in the range of 6 to 12 mm.

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[6] Dr. B. Miller's primary affiliation is with the University of California at Davis.

Appendix Table 1.—Station data for RV *John N. Cobb*, 10 April to 19 April 1967.

Station	Position		Date	Fishing time		Maximum depth of net (m)	Displacement volume of catch (ml)	Surface water temperature (°C)
	Lat N	Long W		Time begin (PST)	Duration (min)			
1	47°50′	122°24′	10 Apr	1700	13	72	137	9.0
2	48 06	122 22	10 Apr	1920	12	81	174	8.8
3	48 07	122 31	10 Apr	2057	12	77	278	9.0
4	51 00	128 41	12 Apr	1023	9	41	235	8.0
5	51 00	129 07	12 Apr	1241	12	88	292	8.0
6	51 00	129 19	12 Apr	1405	16	173	340	8.5
7	51 00	129 36	12 Apr	1615	16½	264	107	8.0
8	50 00	127 34	13 Apr	0336	10	41	127	8.5
9	50 00	127 43	13 Apr	0440	13	90	125	8.2
10	50 00	127 46	13 Apr	0506	16	164	208	8.2
11	50 00	127 51	13 Apr	0555	18	268	89	9.0
12	49 00	126 58	13 Apr	1329	18	212	135	9.1
13	49 00	126 35	13 Apr	1541	15	161	357	9.1
14	49 00	126 17	13 Apr	1715	12	101	212	8.9
15	49 00	126 03	13 Apr	1830	10	34	312	8.9
16	48 00	125 43	14 Apr	0126	22	200	274	9.0
17	48 00	125 19	14 Apr	0451	15	147	126	9.0
18	48 00	125 02	14 Apr	0536	12	90	99	9.0
19	48 00	124 50	15 Apr	0140	10	40	125	9.0
20	47 00	125 04	15 Apr	0849	22	230	120	9.3
21	47 00	124 58	15 Apr	0945	17	171	98	9.9
22	47 00	124 42	15 Apr	1124	13½	101	170	9.9
23	47 00	124 24	15 Apr	1304	11	32	230	9.9
24	46 00	124 58	15 Apr	2018	22½	236	151	9.5
25	46 00	124 39	15 Apr	2212	16½	180	129	9.0
26	46 00	124 04	17 Apr	0436	11½	38	304	9.5
27	46 00	124 18	17 Apr	0600	13	100	105	9.2
28	45 00	124 57	17 Apr	1342	22	212	142	10.0
29	45 00	124 21	17 Apr	1658	19	176	85	10.0
30	45 00	124 12	17 Apr	1805	14	113	190	10.0
31	45 00	124 05	17 Apr	1900	10	36	156	10.0
32	44 00	125 00	18 Apr	0228	26	232	88	10.0
33	44 00	124 56	18 Apr	0325	17½	180	610	10.0
34	44 00	124 43	18 Apr	0450	13	101	67	10.0
35	44 00	124 13	18 Apr	0725	9	50	110	9.9
36	43 00	124 58	18 Apr	1444	20½	232	119	10.7
37	43 00	124 51	18 Apr	1544	15½	176	109	10.7
38	43 00	124 40	18 Apr	1703	12	100	69	10.7
39	43 00	124 31	18 Apr	1756	9½	51	192	10.5
40	42 00	124 50	19 Apr	0030	20	204	137	10.9
41	42 00	124 36	19 Apr	0218	17	154	139	10.0
42	42 00	124 31	19 Apr	0305	11	96	171	10.0
43	42 00	124 22	19 Apr	0405	10	48	122	10.0

Appendix Table 2.—Station data for RV *George B. Kelez*, 20 April to 11 May 1967.

Station	Position		Date	Fishing time		Maximum depth of net (m)	Displacement volume of catch (ml)	Surface water temperature (°C)	Surface salinity (‰)
	Lat N	Long W		Time begin (PST)	Duration (min)				
1	47°36′	122°22′	20 Apr	1115	10	153	41	8.6	27.51
2	47 26	122 31	20 Apr	1258	13	129	118	8.6	28.86
3	47 10	122 39	20 Apr	1514	13	102	77	8.6	27.85
4	47 13	122 50.3	20 Apr	1647	6	29	157	8.7	27.85
5	47 17	122 43	21 Apr	0646	8	65	77	9.1	28.14
6	47 25	122 23	21 Apr	0930	10	175	39	9.3	28.63
7	47 40	122 47	21 Apr	1513	7½	78	143	10.1	26.54
8	47 24	123 07	21 Apr	1755	10	61	197	11.0	18.70
9	48 12	122 49	22 Apr	0950	7	27	59	8.4	30.32
10	48 39	122 40	22 Apr	1245	7	41	41	8.9	29.80
11	48 53	123 01	22 Apr	1454	13	112	150	9.1	28.63
12	51 00	131 22	24 Apr	0130	24	276	520	8.2	31.76
13	51 00	132 57	24 Apr	0808	23	252	2,412	7.2	32.28
14	51 00	134 29	24 Apr	1510	19	255	456	6.6	32.36
15	51 00	136 32	25 Apr	0000	26	316	309	5.8	32.59
16	50 00	134 30	25 Apr	0958	25	194	492	6.4	32.55
17	50 00	133 00	25 Apr	1600	28	272	681	7.2	32.39
18	49 36	132 47	25 Apr	1920	24	214	1,320	7.0	32.35
19	50 00	131 26	26 Apr	0155	20	211	750	7.4	32.48
20	50 03	130 00	26 Apr	1015	19	175	862	7.8	32.34
21	49 00	128 38	28 Apr	0702	19	246	447	8.2	32.38
22	49 00	130 09	28 Apr	1445	25	224	510	8.7	32.13
23	49 04	131 00	28 Apr	1900	23	272	793	8.3	32.48
24	49 00	131 39	28 Apr	2215	22	250	523	7.2	32.39
25	49 00	133 10	29 Apr	0442	21	262	606	7.2	32.56
26	48 03	132 45	29 Apr	1043	20	206	370	7.3	32.57
27	48 00	131 43	29 Apr	1508	25	246	559	7.7	32.50
28	47 00	132 27	29 Apr	2204	21	252	521	7.6	32.55
29	46 00	132 12	30 Apr	0410	19	228	583	7.8	32.66
30	46 00	130 45	30 Apr	1008	22	264	370	8.5	32.69
31	46 00	130 24	30 Apr	1215	22	226	642	7.9	32.62
32	46 42	130 45	30 Apr	1705	22	252	347	7.9	32.56
33	47 00	130 58	30 Apr	1934	23	242	413	8.0	32.54
34	48 00	130 13	1 May	0235	23	267	900	8.1	32.36
35	48 00	128 44	1 May	1120	21	226	259	8.7	32.43
36	48 00	127 14	1 May	1658	21	218	461	9.2	32.31
37	47 00	128 00	1 May	2358	20	242	473	8.6	32.51
38	47 00	129 29	2 May	0633	23	262	986	8.5	32.48
39	46 00	129 19	2 May	1237	24	242	730	9.2	32.56
40	46 00	127 52	2 May	1855	21	228	328	9.5	32.56
41	46°00′	126°25′	3 May	0104	23	255	192	9.6	32.49
42	45 00	127 27	5 May	1705	20	242	111	10.3	32.53
43	45 00	127 54	5 May	2350	23	255	191	9.7	32.53
44	45 00	129 19	6 May	1000		Aborted haul			
45	45 00	129 19	6 May	1300	20	232	284	9.6	32.62

Appendix Table 2.—Station data for RV *George B. Kelez*, 20 April to 11 May 1967.—Cont.

Station	Position		Date	Fishing time		Maximum depth of net (m)	Displacement volume of catch (ml)	Surface water temperature (°C)	Surface salinity (‰)
	Lat N	Long W		Time begin (PST)	Duration (min)				
46	45 00	130 44	6 May	2245	20	257	548	9.0	32.63
47	45 00	132 10	7 May	0650	22	252	674	9.2	32.71
48	44 00	131 55	7 May	1303	24	242	465	9.6	32.67
49	43 00	131 49	7 May	1911	22	226	310	10.0	32.76
50	42 00	131 42	8 May	0130	23	248	140	9.6	32.73
51	42 00	130 19	8 May	0800	23	255	174	10.7	32.84
52	43 00	130 26	8 May	1426	20	240	284	10.3	32.68
53	43 00	129 04	8 May	2057	18	242	275	10.1	32.67
54	42 00	128 57	9 May	0255	19	259	97	9.9	32.72
55	42 00	127 35	9 May	0918	18	214	114	10.3	32.80
56	43 00	127 42	9 May	1548	18	232	145	10.5	32.73
57	44 00	127 46	9 May	2256	24	199	211	9.8	32.52
58	44 00	129 09	10 May	0638	20	257	229	9.5	32.63
59	44 00	130 11	10 May	1210	20	214	256	9.2	32.64
60	47 00	126 32	11 May	1023	22	252	286	10.3	32.49

Appendix Table 3.—Numbers of fish larvae

Station No.	Area [1]	Station totals	Clupea harengus pallasi	Osmeridae	Bathylagus ochotensis	Bathylagus pacificus	Bathylagus stilbius	Macropinna microstoma	Tactostoma macropus	Nansenia candida	Lestidium ringens	Chauliodus macouni	Myctophidae (total)	Diaphus theta	Lampanyctus ritteri	Protomyctophum thompsoni	Stenobrachius leucorsarus	Tarletonbeania crenularis	Merluccius productus	Other Gadidae	Melamphaeidae (?)	Gobiidae	Sebastes spp.	Sebastolobus spp.	Anoplopoma fimbria
1-6701- 1	PS	455	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	89	-	-	98	-	-
2	PS	675	11	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	450	23	-	-	8	-	-
3	PS	136	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26	12	-	-	24	-	-
K-6703- 1	PS	124	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	31	-	-	19	-	-
2	PS	158	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	68	-	-	32	-	-
3	PS	310	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	86	-	-	64	-	-
4	PS	271	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	11	-	-	26	-	-
5	PS	279	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	5	-	-	31	-	-
6	PS	374	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	108	98	-	-	25	-	-
7	PS	373	91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	152	3	-	-	107	-	-
8	PS	300	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	-	-	4	90	-	-
9	PS	444	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	46	-	-	88	-	-
10	PS	85	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	22	-	-	38	-	-
11	PS	254	1	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	2	82	-	-	136	-	-
Total	PS	4238	116	1	-	-	7	-	-	-	-	-	-	-	-	-	-	-	893	576	-	4	786	-	-
1-6701- 4	51	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
5	51	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	51	42	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	4	-	-
7	51	299	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	297	-	-
K-6703-12	51	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
13	51	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	51	12	-	-	-	1	-	-	-	-	-	-	8	-	-	-	8	-	-	-	-	-	1	-	-
15	51	36	-	-	-	1	-	-	-	-	-	-	34	-	-	5	29	-	-	-	-	-	1	-	-
1-6701- 8	50	236	3	-	-	1	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	159	-	-
9	50	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57	-	-
10	50	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-
11	50	61	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	-	-
K-6703-16	50	6	-	-	-	-	-	-	-	-	-	-	4	-	-	-	4	-	-	-	-	-	2	-	-
17	50	11	-	-	-	-	-	-	-	-	-	-	5	-	-	-	4	1	-	-	-	-	4	-	-
19	50	10	-	-	-	-	-	-	-	-	-	-	7	-	-	2	5	-	-	-	-	-	3	-	-
20	50	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-
1-6701-12	49	7	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
13	49	29	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	26	-	-
14	49	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-
15	49	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-	-
K-6703-18	49	16	-	-	-	-	-	-	-	-	-	-	4	-	-	-	4	-	-	-	-	-	12	-	-
21	49	4	-	-	-	1	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	1	-	-
22	49	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
23	49	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
24	49	14	-	-	-	-	-	-	-	-	-	-	6	-	-	2	4	-	-	-	-	-	5	-	-
25	49	3	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	1	-	-
1-6701-16	48	71	-	-	-	3	-	-	-	-	-	-	16	-	-	-	0	7	-	-	-	-	45	-	-
17	48	41	-	-	-	2	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	35	-	-
18	48	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
19	48	166	1	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	1	-	-	-
K-6703-26	48	10	-	-	-	-	-	-	-	-	-	-	5	-	-	-	5	-	-	-	-	-	5	-	-
27	48	21	-	-	1	-	-	-	-	-	-	-	11	-	-	-	11	-	-	-	-	-	0	-	-
K-6703-34	48	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-	-	-	-	-	-
35	48	27	-	-	-	-	-	-	-	-	-	-	24	-	-	-	23	1	-	-	-	-	2	-	-
36	48	7	-	-	-	-	-	-	-	-	-	1	2	-	-	-	2	-	-	-	-	-	2	-	-
1-6701-20	47	33	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	28	-	-
21	47	27	-	-	-	-	-	-	-	-	-	-	6	-	-	-	6	-	-	-	-	-	21	-	-
22	47	4	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-
23	47	96	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
K-6703-28	47	14	-	-	-	-	-	-	-	-	-	-	12	-	-	1	10	1	-	-	-	-	-	-	-
33	47	5	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-	-	-	2	-	-
37	47	47	-	-	1	-	-	-	-	-	-	-	31	-	-	4	23	4	-	-	-	-	15	-	-
38	47	7	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-	-	-	-	5	-	-
60	47	51	-	-	-	1	-	-	-	-	-	-	40	-	-	2	37	1	-	-	-	-	8	-	1
1-6701-24	46	18	-	-	-	-	-	-	-	-	-	-	13	1	-	-	11	1	-	-	-	-	1	-	-
25	46	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	-
26	46	211	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	1	-
27	46	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K-6703-29	46	30	-	-	2	-	-	-	-	-	-	4	22	-	-	1	15	6	-	-	-	-	1	-	-
30	46	33	-	-	2	-	-	-	-	-	-	1	26	1	-	1	16	8	-	-	-	-	4	-	-
31	46	74	-	-	3	1	-	-	-	-	-	-	23	-	-	-	13	10	-	-	-	-	46	-	-
32	46	555	-	-	-	-	-	-	-	-	-	-	12	-	-	1	8	3	-	-	-	-	542	-	-
39	46	131	-	-	-	-	-	-	-	-	-	-	52	-	-	-	38	14	-	-	-	-	77	-	-
40	46	76	-	-	6	1	-	-	-	-	-	-	50	-	-	-	45	5	-	-	-	-	18	-	-
41	46	42	-	-	1	1	-	-	-	-	-	-	23	-	-	-	21	2	-	-	-	-	17	-	-

collected during April and May 1967.

Station No.	Ophiodon elongatus	Other Hexagrammidae	Scorpaenichthys marmoratus	Other Cottidae	Agonidae	Cyclopteridae	Ammodytes hexapterus	Bathymasteridae	Blennioidei	Icichthys lockingtoni (?)	Icosteidae	Citharichthys stigmaeus	Pleuronectidae (total)	Atheresthes stomias (?)	Embassichthys bathybius (?)	Glyptocephalus zachirus	Hippoglossoides elassodon	Isopsetta isolepis (?)	Lyopsetta exilis	Microstomus pacificus	Parophrys vetulus	Platichthys stellatus	Pleuronichthys sp.	Psettichthys melanostictus	Unidentified Larvae
1-6701- 1	1	-	-	5	-	-	129	-	7	-	-	-	88	-	-	-	-	3	4	-	80	1	-	3	19
2	-	-	-	-	-	-	7	-	1	-	-	-	92	-	-	-	-	-	8	-	79	-	-	2	82
3	-	-	-	-	1	-	11	-	-	-	-	-	30	-	-	-	-	-	9	-	18	-	-	3	29
K-6703- 1	-	-	-	-	-	-	5	-	-	-	-	-	28	-	-	-	-	-	2	-	24	1	-	-	7
2	-	-	-	2	-	3	1	-	-	-	-	-	20	-	-	-	-	-	3	-	13	-	-	4	12
3	1	-	1	5	2	2	-	-	2	-	-	-	85	-	-	-	-	-	15	-	43	12	-	13	39
4	-	-	-	1	-	-	-	-	-	-	-	1	146	-	-	-	1	-	2	-	54	4	-	85	76
5	-	-	-	-	-	3	2	-	-	-	-	-	168	-	-	-	3	-	26	-	129	1	-	9	55
6	-	-	-	3	-	3	10	-	-	-	-	-	81	-	-	-	-	6	13	-	55	4	-	3	45
7	-	-	-	2	1	1	1	-	-	-	-	-	15	-	-	-	-	-	9	-	1	3	-	2	1
8	-	-	1	-	-	-	-	-	-	-	-	-	164	-	-	-	1	-	24	-	38	88	-	23	1
9	-	-	-	3	2	19	242	-	3	-	-	-	35	-	-	-	-	-	4	-	23	5	-	3	4
10	-	-	-	1	-	4	7	-	-	-	-	-	5	-	-	-	-	2	-	-	2	1	-	-	7
11	-	-	-	1	-	5	16	-	-	-	-	-	4	-	-	-	-	-	1	-	3	-	-	-	1
Total PS	2	-	2	23	6	40	431	-	13	-	-	1	961	-	-	-	5	11	120	-	562	120	-	150	376
1-6701- 4	-	1	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	34	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
K-6703-12	1	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-6701- 8	-	-	-	4	-	3	60	-	1	-	-	-	4	-	4	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	6	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	4
10	10	-	-	1	-	1	13	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	1	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1
K-6703-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-6701-12	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
14	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	1	18	-	-	-	1	9	-	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1
K-6703-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
24	-	-	1	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-6701-16	-	-	-	-	-	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
19	-	-	1	6	-	14	-	-	1	-	-	-	122	-	-	7	-	114	-	-	-	1	-	-	-
K-6703-26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K-6703-34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
36	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
1-6701-20	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
23	-	-	-	1	1	1	-	1	4	-	-	-	81	-	-	-	-	28	1	-	3	13	-	24	-
K-6703-28	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	1
33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1-6701-24	-	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1
25	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
26	-	-	1	3	-	1	3	-	8	-	-	-	167	-	-	1	1	153	-	-	7	5	-	-	-
27	-	-	-	-	-	-	1	-	-	-	-	-	13	-	-	-	-	8	-	-	-	-	-	2	7
K-6703-29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
39	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-
40	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix Table 3.—Numbers of fish larvae

Station No.	Area	Station Total	Clupea harengus pallasi	Osmeridae	Bathylagus ochotensis	Bathylagus pacificus	Bathylagus stilbius	Macropinna microstoma	Tactostoma macropus	Nansenia candida	Lestidium ringens	Chauliodus macouni	Myctophidae (total)	Diaphus theta	Lampanyctus ritteri	Protomyctophum thompsoni	Stenobrachius leucopsarus	Tarletonbeania crenularis	Merluccius productus	Other Gadidae	Melamphaeidae (*)	Gobiidae	Sebastes spp.	Sebastolobus spp.	Anoplopoma fimbria
1-6701-28	45	21	-	-	-	-	-	-	-	-	-	-	11	2	-	-	9	-	-	-	-	-	9	-	-
29	45	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
30	45	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	45	160	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-	-	3	7	-
K-6703-42	45	10	-	-	3	-	-	-	-	-	-	-	7	-	-	1	4	2	-	-	-	-	-	-	-
43	45	119	1	-	1	1	-	-	1	-	-	-	97	1	2	-	90	4	-	-	-	-	18	-	-
45	45	55	-	-	4	-	-	-	-	1	-	1	48	2	-	-	39	7	-	-	1	-	-	-	-
46	45	74	-	-	3	-	-	-	-	-	-	-	66	-	-	1	63	2	-	-	-	-	4	-	-
47	45	17	-	-	2	-	-	-	-	-	-	2	11	-	-	-	8	3	-	-	-	-	1	-	-
1-6701-32	44	26	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-	-	-	15	-	-
33	44	60	-	-	1	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	58	-	-
34	44	17	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	15	-	-
35	44	113	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	7	-	-	1	1	-
K-6703-48	44	42	-	-	10	-	-	-	-	-	1	-	23	-	2	-	12	9	-	-	-	-	2	-	-
57	44	125	-	-	4	-	-	-	-	-	-	1	104	-	1	1	97	5	-	-	-	-	16	-	-
58	44	42	-	-	3	2	-	-	-	1	-	2	34	-	-	-	30	4	-	-	-	-	-	-	-
59	44	21	-	-	9	-	-	-	-	1	-	2	8	-	1	-	5	2	-	-	-	-	1	-	-
1-6701-36	43	5	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
37	43	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	43	4	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1	-	-	2	-	-
39	43	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	2	-
K-6703-49	43	60	-	-	4	-	-	-	-	-	1	-	52	1	1	-	46	4	-	-	-	-	-	-	-
52	43	70	-	-	6	-	-	-	-	2	-	3	56	3	1	-	46	6	-	-	-	-	-	-	-
53	43	77	-	-	5	1	-	-	-	-	1	-	63	1	1	-	57	4	-	-	-	-	6	-	-
56	43	17	-	-	3	-	-	-	-	-	-	-	14	-	-	-	13	1	-	-	-	-	-	-	-
1-6701-40	42	91	-	-	16	-	-	1	-	-	-	-	47	2	2	2	32	9	-	-	-	-	17	-	-
41	42	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
42	42	11	-	-	1	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	4	1	-
43	42	69	-	37	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	3	-	-	10	1	-
K-6703-50	42	184	-	-	9	-	-	-	-	-	4	1	166	83	7	4	67	5	-	-	2	-	-	-	-
51	42	54	-	-	4	-	-	-	-	-	2	2	16	9	4	-	3	-	-	-	-	-	-	-	-
54	42	103	-	-	4	2	-	-	-	1	-	1	92	8	-	-	80	4	-	-	-	-	2	-	-
55	42	66	-	-	5	1	-	-	-	-	-	-	60	8	3	1	43	5	-	-	-	-	-	-	-
Oceanic total:		4577	5	64	113	23	-	1	1	6	9	21	1447	122	26	32	1124	142	-	55	3	1	1794	13	1
Grand total Puget Sd. & Oceanic		8815	121	65	113	23	7	1	1	6	9	21	1447	122	26	32	1124	142	893	631	3	5	2580	13	1

1/ Area: PS - Puget Sound and adjacent waters.

Number, e.g. 51, is latitude north, and indicates that the sample was collected on or north of that latitude.

collected during April and May 1967.—*Cont.*

Station No.	Ophidon elongatus	Other Hexagrammidae	Scorpaenichthys marmoratus	Other Cottidae	Agonidae	Cyclopteridae	Ammodytes hexapterus	Bathymasteridae	Blennioidei	Icichthys lockingtoni (?)	Icosteidae	Citharichthys stigmaeus	Pleuronectidae (total)	Atheresthes stomias (?)	Embassichthys bathybius (?)	Glyptocephalus zachirus	Hippoglossoides elassodon	Isopsetta isolepis (?)	Lyopsetta exilis	Microstomus pacificus	Parophrys vetulus	Platichthys stellatus	Pleuronichthys sp.	Psettichthys melanostictus	Unidentified Larvae
1-6701-28	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	1	8	-	1	-	-	-	-	-	-	123	-	-	1	-	94	-	-	18	8	-	2	-
K-6703-42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1-6701-32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	2	-	-	-	-	2	-	-	-	98	-	-	1	-	36	-	1	31	19	-	7	-
K-6703-48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-6701-36	-	-	-	1	-	-	-	-	-	-	-	-	3	-	-	-	-	3	-	-	-	-	-	-	-
37	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	-	-	-	-	1	-	-	-	4	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	1
K-6703-49	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
52	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-6701-40	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
43	-	-	2	4	-	1	-	-	6	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	1
K-6703-50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30
54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oceanic total:	12	22	8	36	3	28	138	10	37	4	1	1	626	5	4	10	1	436	1	4	60	46	1	37	94
Grand total Puget Sd. & Oceanic	14	22	10	59	9	68	569	10	50	4	1	2	1587	5	4	10	6	447	121	4	622	166	1	187	470

Appendix Table 4. — Factors for converting actual catches to standardized units. Standard Haul Factor (SHF) (A) converts to catch per 10 cubic meters of water strained per meter of depth fished. Standard Haul Factor (B) converts to catch per 1,000 cubic meters of water strained.

Station	SHF (A)	SHF (B)	Station	SHF (A)	SHF (B)	Station	SHF (A)	SHF (B)
RV *John N. Cobb*								
1	1.68	2.33	16	2.63	1.31	31	1.45	4.03
2	2.09	2.58	17	3.34	2.27	32	3.10	1.34
3	2.25	2.92	18	2.10	2.34	33	3.32	1.84
4	1.38	3.37	19	1.20	3.00	34	2.69	2.66
5	1.24	1.41	20	3.51	1.53	35	2.13	4.27
6	3.09	1.78	21	3.26	1.91	36	4.21	1.82
7	4.76	1.80	22	2.48	2.46	37	3.97	2.25
8	1.56	3.81	23	0.75	2.33	38	2.74	2.74
9	2.19	2.43	24	3.52	1.49	39	1.98	3.89
10	3.25	1.98	25	3.06	1.70	40	4.12	2.02
11	—	—	26	1.12	2.94	41	3.25	2.11
12	3.97	1.87	27	2.48	2.48	42	2.21	2.30
13	3.25	2.02	28	3.72	1.76	43	2.53	5.28
14	2.63	2.60	29	3.06	1.74			
15	0.99	2.90	30	2.60	2.30			
RV *George B. Kelez*								
1	3.71	2.43	21	4.06	1.65	41	4.72	1.85
2	4.31	3.34	22	3.26	1.45	42	4.59	1.90
3	2.26	2.21	23	4.19	1.54	43	4.70	1.84
4	2.02	6.96	24	4.55	1.82	44	—	—
5	2.98	4.58	25	5.62	2.15	45	5.16	2.22
6	4.86	2.78	26	3.94	1.91	46	5.19	2.02
7	3.39	4.34	27	4.01	1.63	47	4.33	1.72
8	1.85	3.03	28	4.60	1.82	48	3.63	1.50
9	1.00	3.70	29	4.84	2.12	49	4.06	1.80
10	2.25	5.48	30	5.09	1.93	50	4.45	1.79
11	2.48	2.22	31	4.02	1.78	51	3.54	1.39
12	4.97	1.80	32	5.05	2.00	52	4.63	1.93
13	4.32	1.71	33	4.31	1.78	53	5.30	2.19
14	4.34	1.70	34	4.58	1.71	54	5.32	2.05
15	6.16	1.95	35	3.90	1.73	55	4.31	2.01
16	—	—	36	4.18	1.92	56	4.34	1.86
17	5.61	2.06	37	5.68	2.35	57	2.65	1.33
18	3.85	1.80	38	4.66	1.78	58	4.47	1.74
19	3.84	1.82	39	3.54	1.46	59	3.98	1.86
20	3.34	1.91	40	4.15	1.82	60	4.29	1.70

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621. Predation by sculpins on fall chinook salmon, *Oncorhynchus tshawytscha*, fry of hatchery origin. By Benjamin G. Patten. February 1971, iii + 14 pp., 6 figs., 9 tables.

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629. Analysis of the operations of seven Hawaiian skipjack tuna fishing vessels, June-August 1967. By Richard N. Uchida and Ray F. Sumida. March 1971, v + 25 pp., 14 figs., 21 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - 35 cents.

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