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Clifford H. Fiscus
and
Roger, W. Mercer

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U.S. DEPARTMENT OF COMMERCE
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National Marine Fisheries Service

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by

Clifford H. Fiscus and Roger W. Mercer

Resource Assessment and Conservation Engineering 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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ABSTRACT

The International North Pacific Fisheries Commission began a research program in 1955 to determine the ocean distribution and migrations of Pacific Salmon. The Pacific Salmon Investigations program of the Northwest and Alaska Fisheries Center, National Marine Fisheries Service-, NOAA, conducted one phase of these investigations, making 1601 drift gillnet sets from 1955 to 1972 in the North Pacific Ocean--from the western Aleutian Islands eastward in the Gulf of Alaska and in the Bering Sea.

This report describes cephalopods (almost entirely squids) that were taken in addition to salmon during these studies. Approximately 25% of all gillnet sets yielded cephalopods; catch per set ranged from 1 to 178 squids. Date, location, water temperature, and mesh size of sets that produced squids are given. Those squids that were identified are listed, and a brief description of their range and maximum size is given.

Six species of squid and one species of octopod were taken in the gill-nets; *Onychoteuthis borealijaponicus, Gonatopsis borealis, Gonatus* spp., *Berryteuthis* spp., *Ommastrephes bartramii, Chiroteuthis* spp., and *Japetella heathi.* The most frequently caught squid, *Onychoteuthis borealijaponicus*, may be sufficiently abundant in late summer and fall north-of the subarctic boundary to warrant investigation as a potential commercial species. *Ommastrephes bartramii* which may be abundant south of the subarctic boundary also warrants investigation. Other species were not taken in sufficient quantity by gillnetting to indicate commercial potentialities although some of the gonatids could contribute to a commercial catch depending to some extent on the type of fishing gear used.

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INTRODUCTION

The International North Pacific Fisheries Commission (INPFC) began a research program in 1955 to determine the ocean distribution and migrations of Pacific salmon and the continent of origin of salmon taken on the high seas. A major part of this program has involved high-seas sampling by member nations using surface gillnets, purse seines, and longlines. The history and objectives of INPFC research are summarized by Jackson (1963) and Manzer et al. (1965).

The Pacific Salmon Investigations program of the Northwest and Alaska Fisheries Center (NWAFC) conducted one phase of the INPFC investigations. They fished surface gillnets to study the distribution, migrations, and environmental relationships of salmon. Cephalopods (almost entirely squids) were taken incidentally in these operations and although only a small percentage were preserved and later identified, the numbers were sufficient to provide some information on the distribution of squids in the area surveyed. Of 1,601 drift gillnet sets made by this program, 398 sets yielded between 1 and 178 cephalopods. This report describes the species of squid taken, their distribution, size composition, and commercial potentialities.

METHODS AND MATERIALS

Fishing procedures are described in Manzer et al. (1965) and in INPFC Annual Reports for 1955 to 1972. (Anonymous 1956-1960; Hanavan 1961; French 1962, 1964a, 1964b, 1966; French et al. 1967a, 1967b, 1969, 1970, 1971, 1972, 1973, 1974). Surface gillnets were fished for about 13 h at each station mostly during hours of darkness. The nets averaged 26 shackles (91.4 m per shackle) long and were 4 fathoms (7.3 m) deep. Mesh sizes were normally 2.50 in (64 mm), 3.25 in (83 mm), 4.50 in (114 mm), and 5.25 in (133 mm), from 1955 through 1960. In some years, other mesh sizes were added to the gillnet string. Normally, 4 shackles each of 2.50, 3.25, and 5.25 in mesh and 12 shackles of 4.50 in mesh were used. In 1955, a 2.25 in (.57 mm) mesh and in some later years 51 mm and 99 mm mesh were used. The depth of gillnets was also increased from 4 to 12 fm (21.9 m) in some years (1965-67). Most squids were taken in the 2.50 (64 nun) to 3.25 in (83 mm) mesh.

From 1955 to 1967 multifilament nylon gillnets were used, but beginning in 1962 monofilament gillnets were added to the strings. In this report, we make no distinction between the two types of nets. It is possible that one type may fish better than the other; however,, our data are insufficient to make that determination.

In the early years of the program, few squids were saved as storage facilities on vessels were limited; however, records were kept of the numbers of squid taken by mesh size from each set. Detailed information by cruise and set number, date, location, and surface water temperature of those sets containing squids are presented in Table 1. Locations of all sets which produced squid are presented in Figure 1. Those squid that were saved for later examination were measured and identified to species. Locations of capture for identified specimens are presented

Table 1. Pacific Salmon Investigations gillnet sets with cephalopods.

CRU	SET	YR/MO/DY	LAT	LONG	HRS	TEMP C°	#SQUID	CPUE	SHACKLES
2	3	55/08/14	N50-00	W165-25	14	11.0	10	0.0595	12
2	4	55/08/15	N49-00	W165-07	16	11.6	3	0.0156	12
2	7	55/08/18	N46-00	W164-57	16	15.8	3	0.0156	12
2	8	55/08/19	N44-59	W165-17	14	16.8	14	0.0833	12
2	9	55/08/20	N45-00	W167-35	11	16.6	59	0.4470	12
2	10	55/08/21	N44-50	W170-03	12	16.6	69	0.4792	12
2	11	55/08/22	N45-58	W169-56	18	16.1	1	0.0046	12
2	12	55/08/23	N46-54	W169-52	16	15.5	13	0.0677	12
2	13	55/08/24	N47-56	W170-07	16	15.8	1	0.0052	12
2	16	55/09/03	N50-00	W175-00	18	10.2	2	0.0093	12
2	17	55/09/04	N49-00	W175-06	15	10.8	1	0.0056	12
2	19	55/09/22	N51-03	W154-35	21	10.1	11	0.0437	12
2	20	55/09/23	N50-05	W154-42	12	10.0	3	0.0208	12
2	22	55/09/25	N47-57	W155-50	11	11.5	5	0.0379	12
2	23	55/09/28	N47-57	W144-52	23	12.9	1	0.0036	12
4	9	56/06/26	N50-00	W175-05	16	6.8	1	0.0052	12
4	13	56/07/09	N56-00	180-00	16	7.4	1	0.0052	12
4	23	56/08/08	N50-59	W174-57	16	11.5	31	0.1076	18
4	24	56/08/09	N49-59	W174-58	17	12.4	32	0.1046	18
4	25	56/08/10	N49-00	W175-00	16	13.5	53	0.1840	18
4	26	56/08/11	N48-00	W175-00	15	13.5	25	0.0926	18
4	27	56/08/12	N47-00	W175-00	16	14.2	6	0.0208	18
4	28	56/08/14	N47-00	180-00	16	17.1	96	0.3333	18
4	29	56/08/15	N48-00	W179-54	13	15.1	72	0.3077	18
4	30	56/08/16	N49-00	W179-57	15	13.4	80	0.2963	18
4	33	56/08/25	N51-00	E175-00	14	9.7	4	0.0159	18
4	34	56/08/26	N50-00	E175-00	15	11.2	5	0.0185	18
4	37	56/09/02	N47-00	180-00	12	11.7	17	0.0787	18
4	38	56/09/03	N48-00	180-00	15	11.7	2	0.0074	18
4	39	56/09/04	N49-00	180-00	16	11.6	13	0.0451	18
6	9	56/07/25	N50-00	W155-00	15	9.6	3	0.0111	18
6	10	56/07/26	N49-00	W155-00	16	9.7	8	0.0278	18
6	11	56/07/27	N48-01	W154-53	15	11.2	4	0.0148	18
6	13	56/07/29	N45-51	W154-53	15	12.6	0	0.00 0	18
6	15	56/08/01	N47-00	W160-00	13	12.3	8	0.0342	18
6	16	56/08/02	N48-00	W160-00	17	11.7	7	0.0229	18
6	17	56/08/03	N48-58	W160-00	16	11.2	0	0.00 0	18
6	18	56/08/04	N50-00	W160-00	14	10.4	2	0.0119	12
6	19	56/08/05	N51-00	W160-10	14	10.3	4	0.0238	12
6	24	56/08/20	N51-00	W170-00	13	10.4	2	0.0128	12
6	25	56/08/21	N50-00	W170-00	15	10.8	1	0.0056	12
6	26	56/08/22	N49-00	W170-00	14	12.0	38	0.2262	12
6	30	56/08/28	N47-00	W165-00	8	12.0	1	0.0104	12
6	32	56/08/30	N49-00	W165-00	12	10.3	6	0.0417	12
6	33	56/08/31	N50-00	W165-00	12	9.7	3	0.0147	17
6	41	56/09/14	N49-00	W160-00	15	11.1	6	0.0250	16
6	43	56/09/17	N49-00	W150-00	12	13.3	2	0.0104	16
6	44	56/09/22	N49-00	W135-00	12	15.3	20	0.0980	17
7	6	56/07/19	N48-00	W145-00	13	12.3	1	0.0043	18
7	7	56/07/21	N48-00	W150-00	20	11.2	1	0.0028	18
7	8	56/07/22	N49-00	W150-00	12	10.4	2	0.0093	18
7	9	56/07/23	N50-00	W150-00	12	10.3	5	0.0231	18

Table 1. (continued)

CRU	SET	YR/MO/DY	LAT	LONG	HRS	TEMP C°	#SQUID	CPUE	SHACKLES
7	10	56/07/24	N51-00	W150-00	13	10.7	7	0.0299	18
7	19	56/08/07	N54-00	W150-00	20	11.4	1	0.0028	18
7	28	56/08/21	N52-00	W155-00	14	11.7	2	0.0079	18
7	29	56/08/22	N51-00	W155-00	14	11.7	3	0.0119	18
7	30	56/08/23	N50-00	W155-00	14	11.1	7	0.0278	18
7	31	56/08/26	N49-00	W155-00	62	11.1	5	0.0045	18
7	32	56/08/28	N48-00	W155-00	14	11.7	1	0.0040	18
7	33	56/08/30	N48-00	W150-00	20	12.8	3	0.0088	17
7	34	56/08/31	N49-00	W150-00	11	11.7	4	0.0214	17
7	35	56/09/01	N50-00	W150-00	13	11.6	7	0.0317	17
7	36	56/09/02	N51-00	W150-00	12	11.1	4	0.0196	17
7	37	56/09/03	N52-00	W150-00	14	11.3	20	0.0840	17
7	39	56/09/12	N53-00	W145-00	15	12.5	12	0.0444	18
7	40	56/09/13	N52-00	W145-00	12	13.1	9	0.0417	18
7	41	56/09/14	N51-00	W145-00	13	13.6	2	0.0085	18
7	42	56/09/15	N50-00	W145-00	13	14.0	2	0.0085	18
7	43	56/09/17	N52-00	W140-00	16	14.3	3	0.0104	18
7	45	56/09/19	N50-00	W140-00	12	14.2	3	0.0139	18
8	1	56/07/18	N46-17	W126-58	6	15.8	1	0.0119	14
8	5	56/07/24	N50-00	W137-00	8	12.8	3	0.0268	14
8	6	56/07/25	N50-00	W140-00	8	12.2	2	0.0179	14
8	8	56/07/27	N47-20	W140-00	9	13.1	2	0.0159	14
8	9	56/07/28	N46-00	W140-00	8	14.4	97	0.8661	14
8	10	56/07/30	N46-00	W133-30	8	14.4	10	0.0893	14
8	15	56/08/15	N45-00	W135-00	10	17.2	4	0.0222	18
8	16	56/08/17	N45-00	W140-00	10	16.8	7	0.0389	18
8	18	56/08/20	N47-20	W145-00	10	14.1	5	0.0278	18
8	19	56/08/21	N48-40	W145-00	11	13.6	1	0.0051	18
8	21	56/08/23	N49-59	W141-48	10	14.6	13	0.0722	18
8	22	56/08/24	N49-58	W139-00	11	14.6	43	0.2172	18
8	23	56/08/25	N49-00	W137-07	9	15.0	5	0.0309	18
8	24	56/08/26	N48-06	W135-10	9	16.4	26	0.1605	18
9	31	57/08/11	N53-00	W165-00	13	11.9	6	0.0385	12
9	34	57/08/18	N53-00	W165-00	39	12.8	23	0.0491	12
9	35	57/08/20	N50-00	W165-00	16	12.4	60	0.3125	12
9	36	57/08/21	N50-00	W165-00	17	12.5	78	0.3824	12
9	37	57/09/08	N58-00	W140-00	13	13.8	3	0.0192	12
10	1	57/06/10	N50-00	E175-00	15	5.3	0	0.00 0	23
10	2	57/06/11	N50-00	E175-00	10	5.6	1	0.0043	23
10	5	57/06/20	N53-00	E175-00	10	5.7	0	0.00 0	23
10	10	57/07/04	N53-00	W175-00	13	7.0	27	0.0903	23
10	19	57/07/24	N53-00	E175-00	12	9.9	1	0.0036	23
10	24	57/07/28	N56-00	E175-00	9	9.8	1	0.0048	23
10	26	57/08/08	N50-00	E175-00	12	9.5	3	0.0104	24
10	27	57/08/09	N50-00	E175-00	14	9.8	2	0.0060	24
10	35	57/08/20	N50-00	E175-00	11	10.2	5	0.0189	24
10	36	57/08/23	N51-30	E175-00	13	9.0	3	0.0096	24
10	38	57/09/07	N55-00	W150-00	8	12.9	4	0.0208	24
11	1	57/07/21	N50-00	W174-59	12	9.8	3	0.0104	24
11	8	57/07/30	N53-00	W174-59	14	9.2	1	0.0030	24
11	10	57/08/01	N53-01	W175-00	14	9.7	4	0.0119	24
11	11	57/08/06	N51-30	W175-03	10	10.4	1	0.0042	24

Table 1. (continued)

CRU	SET	YR/MO/DY	LAT	LONG	HRS	TEMP C°	#SQUID	CPUE	SHACKLES
11	12	57/08/07	N50-59	W175-10	15	10.7	2	0.0056	24
11	13	57/08/08	N49-59	W175-00	12	9.9	7	0.0243	24
11	14	57/08/09	N50-00	W175-01	15	11.0	7	0.0194	24
11	20	57/08/18	N53-00	W175-01	14	10.4	1	0.0030	24
11	21	57/08/20	N50-00	W175-01	15	11.6	17	0.0472	24
11	22	57/08/21	N50-00	W175-01	14	12.1	18	0.0536	24
11	23	57/08/22	N50-59	W175-01	13	11.1	10	0.0321	24
11	24	57/08/23	N51-31	W175-02	11	11.4	10	0.0379	24
11	25	57/09/08	N50-02	W140-00	11	13.8	6	0.0227	24
11	26	57/09/10	N50-00	W135-01	16	14.6	8	0.0208	24
12	34	58/08/18	N51-00	W165-00	14	10.2	2	0.0060	24
12	35	58/08/19	N50-00	W165-00	13	9.8	4	0.0128	24
12	36	58/08/25	N52-35	W145-03	13	11.8	5	0.0160	24
12	37	58/08/27	N55-00	W140-00	14	14.1	4	0.0119	24
13	16	58/07/13	N50-18	E177-28	12	6.7	1	0.0035	24
13	26	58/07/24	N53-00	E179-48	14	7.2	2	0.0060	24
13	32	58/08/06	N50-00	W175-00	11	8.6	4	0.0152	24
13	33	58/08/07	N49-00	W175-00	13	9.1	18	0.0577	24
13	34	58/08/09	N49-00	W170-00	15	9.2	4	0.0111	24
13	40	58/08/25	N49-43	W146-10	12	11.8	4	0.0139	24
13	41	58/08/27	N51-30	W140-00	11	14.9	1	0.0038	24
14	35	59/08/07	N49-00	W175-00	11	10.6	1	0.0025	36
14	36	59/08/09	N48-00	W175-00	14	11.2	1	0.0020	36
14	37	59/08/12	N49-05	W170-10	11	10.7	3	0.0076	36
15	25	59/07/05	N51-00	W169-56	11	8.0	2	0.0051	36
15	30	59/07/16	N49-02	W165-00	11	9.1	1	0.0025	36
15	31	59/07/17	N48-01	W165-05	12	9.9	3	0.0069	36
15	32	59/07/19	N47-01	W160-02	11	10.2	3	0.0076	36
15	34	59/07/21	N49-02	W160-00	12	10.2	1	0.0023	36
15	39	59/07/26	N53-55	W159-40	10	10.4	5	0.0139	36
16	8	60/05/29	N45-00	W175-00	12	6.5	1	0.0023	36
17	8	60/06/08	N53-37	E175-54	7	4.8	0	0.00 0	36
17	22	60/07/03	N50-02	W178-36	12	6.9	1	0.0023	36
17	31	60/07/29	N50-39	E178-02	13	9.1	2	0.0043	36
17	35	60/08/18	N50-40	W176-30	13	10.1	2	0.0043	36
18	2	61/05/14	N53-12	W165-52	11	5.3	1	0.0023	40
20	24	61/07/25	N50-30	W160-00	16	10.8	2	0.0031	40
20	33	61/09/02	N57-00	W150-00	20	13.3	9	0.0122	37
21	6	61/08/21	N52-59	W150-02	11	12.8	0	0.00 0	38
21	8	61/08/23	N51-01	W149-56	11	12.8	2	0.0063	29
21	9	61/08/24	N50-00	W150-02	10	12.9	3	0.0088	34
21	12	61/08/27	N52-00	W147-00	11	13.3	2	0.0052	35
21	13	61/08/29	N53-00	W147-00	10	13.2	4	0.0114	35
21	14	61/08/30	N54-00	W147-00	7	12.8	3	0.0122	35
21	15	61/08/31	N55-00	W147-00	11	13.4	3	0.0078	35
21	16	61/09/01	N56-00	W147-00	11	13.3	3	0.0078	35
21	17	61/09/02	N57-00	W147-00	12	13.2	1	0.0024	35
21	18	61/09/03	N58-00	W147-00	11	13.6	6	0.0156	35
21	23	61/09/17	N55-00	W144-00	11	12.8	3	0.0080	34
21	26	61/09/22	N55-00	W141-00	12	12.4	6	0.0125	40
21	27	61/09/23	N56-00	W141-00	13	12.6	7	0.0150	36
21	29	61/09/27	N58-00	W141-00	13	12.2	2	0.0050	31

Table 1. (continued)

CRU	SET	YR/MO/DY	LAT LONG	HRS	TEMP C°	#SQUID	CPUE	SHACKLES
22	9	62/03/05	N42-00 W175-00	12	10.2	3	0.0066	38
22	18	62/03/29	N48-00 W155-00	13	6.0	1	0.0019	40
22	19	62/03/30	N47-00 W155-00	13	6.8	2	0.0038	40
22	20	62/04/01	N46-00 W155-00	10	7.0	1	0.0025	40
24	34	62/08/08	N50-19 E178-59	11	10.1	0	0.00 0	36
24	36	62/08/10	N50-41 E175-54	11	9.3	15	0.0426	32
24	44	62/08/27	N52-14 W157-00	13	11.9	20	0.0427	36
24	45	62/08/28	N52-45 W157-00	13	12.2	10	0.0214	36
25	2	62/08/17	N54-45 W153-59	12	13.5	2	0.0046	36
25	4	62/08/19	N53-15 W154-03	10	13.0	9	0.0250	36
25	6	62/08/22	N51-45 W154-00	12	12.6	12	0.0278	36
25	7	62/08/24	N51-00 W154-00	11	13.0	7	0.0177	36
25	9	62/08/26	N50-43 W156-52	9	13.0	18	0.0556	36
25	10	62/08/27	N52-02 W157-04	10	12.7	24	0.0667	36
25	11	62/08/28	N52-45 W157-00	10	12.8	27	0.0750	36
25	12	62/08/29	N53-35 W156-59	11	12.8	5	0.0126	36
25	13	62/08/30	N54-01 W156-48	10	13.0	2	0.0056	36
25	14	62/08/31	N54-30 W156-44	11	13.2	2	0.0051	36
25	15	62/09/07	N54-00 W160-00	12	13.0	29	0.0671	36
25	16	62/09/09	N53-14 W159-58	12	12.3	16	0.0370	36
25	17	62/09/10	N52-30 W160-00	12	12.9	10	0.0231	36
25	20	62/09/14	N50-16 W162-57	12	12.9	52	0.1204	36
25	21	62/09/16	N51-45 W162-59	13	12.4	17	0.0363	36
25	22	62/09/17	N52-30 W162-59	13	11.8	3	0.0064	36
26	1	62/11/21	N45-57 W130-00	11	12.0	178	0.4495	36
26	2	62/11/22	N46-55 W131-40	11	11.4	9	0.0227	36
26	3	62/11/23	N47-47 W133-07	11	10.6	12	0.0303	36
26	4	62/11/29	N49-03 W135-00	14	8.4	1	0.0022	32
27	17	63/02/22	N45-02 E179-57	11	7.2	1	0.0028	32
28	7	63/02/22	N45-48 W165-00	12	7.0	1	0.0026	32
29	13	63/07/07	N51-17 W176-25	11	8.1	1	0.0028	32
29	28	63/08/02	N50-00 W176-26	12	11.1	26	0.0677	32
29	29	63/08/03	N50-28 W176-20	13	10.6	37	0.0889	32
29	30	63/08/04	N51-04 W176-20	14	10.6	18	0.0402	32
29	33	63/08/12	N51-09 W176-19	12	8.8	10	0.0260	32
29	34	63/08/13	N50-34 W176-19	11	11.3	31	0.0881	32
29	35	63/08/14	N50-00 W176-19	13	12.2	79	0.1899	32
29	36	63/08/15	N50-47 W176-18	12	11.9	22	0.0632	29
29	40	63/08/22	N51-26 W176-23	12	10.1	18	0.0833	18
29	41	63/08/23	N51-28 W176-23	12	9.9	4	0.0185	18
29	42	63/08/26	N51-20 W176-19	10	11.1	13	0.0722	18
29	43	63/08/27	N51-19 W176-17	12	10.5	29	0.0755	32
29	44	63/08/28	N51-25 W176-18	11	10.2	2	0.0057	32
29	45	63/08/29	N51-26 W176-24	13	10.0	7	0.0168	32
29	46	63/08/30	N51-22 W176-22	11	9.9	14	0.0398	32
29	47	63/08/31	N51-16 W176-22	9	9.5	15	0.0521	32
29	48	63/09/01	N50-52 W176-22	15	11.1	8	0.0167	32
29	49	63/09/02	N50-01 W176-19	11	11.1	12	0.0341	32
29	50	63/09/04	N50-38 W176-26	11	10.8	5	0.0142	32
29	51	63/09/09	N51-24 W176-23	12	10.6	3	0.0104	24
29	52	63/09/11	N50-35 W176-19	11	11.2	27	0.1023	24
30	22	63/07/26	N50-00 W162-00	12	10.6	4	0.0104	32

Table 1. (continued)

CRU	SET	YR/MO/DY	LAT	LONG	HRS	TEMP C°	#SQUID	CPUE	SHACKLES
30	24	63/07/28	N50-30	W162-00	13	10.5	9	0.0216	32
30	32	63/08/05	N51-30	W162-00	13	11.4	34	0.0817	32
30	33	63/08/06	N52-00	W162-00	14	10.9	4	0.0089	32
30	34	63/08/07	N52-20	W162-00	13	11.3	1	0.0024	32
30	43	63/08/18	N52-20	W162-00	14	11.6	19	0.0424	32
30	44	63/08/19	N51-40	W162-00	13	11.4	27	0.0649	32
30	45	63/08/20	N51-00	W162-00	14	11.6	42	0.0938	32
30	46	63/08/21	N50-20	W162-00	13	11.9	19	0.0457	32
30	47	63/08/22	N49-40	W162-00	14	12.9	1	0.0022	32
30	48	63/08/24	N49-00	W162-00	13	12.9	94	0.2260	32
30	49	63/08/25	N50-40	W162-00	15	11.6	36	0.0750	32
30	50	63/08/26	N51-20	W162-00	15	11.5	2	0.0042	32
30	51	63/08/27	N52-00	W162-00	11	11.5	8	0.0227	32
30	52	63/08/28	N52-40	W162-00	13	11.7	9	0.0216	32
30	53	63/08/29	N53-20	W161-56	14	11.7	1	0.0022	32
30	55	63/09/02	N53-30	W162-00	13	11.5	2	0.0048	32
30	56	63/09/03	N52-30	W162-00	14	11.0	25	0.0576	31
30	57	63/09/04	N52-00	W162-00	14	11.2	17	0.0379	32
30	58	63/09/05	N51-00	W162-00	14	11.2	47	0.1049	32
30	59	63/09/06	N50-00	W162-00	14	11.8	50	0.1116	32
30	60	63/09/07	N49-29	W161-59	13	12.0	79	0.1899	32
30	61	63/09/08	N50-30	W162-00	13	11.3	1	0.0024	32
30	62	63/09/09	N51-30	W162-00	17	11.2	11	0.0202	32
30	63	63/09/10	N53-02	W162-04	12	11.7	7	0.0182	32
30	65	63/09/12	N54-03	W159-20	13	12.7	3	0.0072	32
30	66	63/09/13	N54-56	W156-10	12	12.6	2	0.0052	32
32	4	64/09/27	N51-10	E173-00	12	7.9	1	0.0035	24
32	5	64/09/29	N51-10	E173-00	16	7.2	1	0.0026	24
32	9	64/10/08	N50-00	E169-00	12	6.9	2	0.0069	24
32	10	64/10/09	N48-30	E169-00	12	7.6	7	0.0243	24
36	2	65/10/04	N51-16	E172-58	13	9.1	6	0.0165	28
36	3	65/10/05	N50-19	E173-00	13	9.3	4	0.0082	28
36	4	65/10/06	N49-15	E172-58	14	9.9	14	0.0357	28
36	5	65/10/07	N48-22	E173-00	13	9.9	8	0.0220	28
36	6	65/10/08	N48-40	E172-59	14	9.9	36	0.0918	28
36	7	65/10/09	N47-30	E173-05	13	10.2	52	0.1429	28
36	8	65/10/10	N47-00	E173-20	13	11.6	15	0.0372	31
36	9	65/10/12	N45-51	E173-02	13	10.8	50	0.1374	28
36	10	65/10/13	N44-40	E173-02	13	12.0	6	0.0149	31
37	23	66/07/18	N49-00	W167-01	13	9.7	2	0.0051	30
37	24	66/07/20	N51-30	W166-59	13	9.2	4	0.0103	30
37	29	66/07/26	N49-57	W167-00	14	9.4	23	0.0548	30
37	30	66/07/27	N49-30	W167-01	13	9.6	21	0.0538	30
37	31	66/07/28	N50-30	W166-56	14	9.8	13	0.0310	30
37	32	66/07/29	N51-31	W167-00	13	9.8	2	0.0051	30
37	38	66/08/09	N50-30	W167-00	14	9.1	36	0.0857	30
37	39	66/08/10	N49-33	W167-02	13	10.6	20	0.0513	30
37	40	66/08/11	N49-00	W166-59	13	10.6	13	0.0333	30
37	41	66/08/12	N50-01	W167-07	14	10.3	22	0.0524	30
37	42	66/08/13	N51-00	W166-59	14	10.0	10	0.0238	30
37	46	66/08/17	N51-30	W167-00	14	10.0	8	0.0190	30
37	47	66/08/18	N50-28	W167-00	14	10.4	14	0.0333	30

Table 1. (continued)

CRU	SET	YR/MO/DY	LAT	LONG	HRS	TEMP C°	#SQUID	CPUE	SHACKLES
37	48	66/08/19	N49-29	W167-00	13	10.6	37	0.0949	30
37	49	66/08/20	N50-00	W167-00	13	10.0	6	0.0154	30
37	50	66/08/21	N50-59	W166-56	13	9.7	43	0.1103	30
37	51	66/08/22	N51-48	W166-45	13	10.2	27	0.0692	30
37	54	66/08/30	N51-28	W166-55	14	9.0	14	0.0333	30
37	55	66/08/31	N50-30	W166-59	14	9.8	42	0.1000	30
37	56	66/09/01	N49-30	W167-01	14	9.8	135	0.3214	30
37	57	66/09/02	N49-02	W167-04	14	10.7	98	0.2333	30
37	58	66/09/03	N50-00	W167-00	14	10.3	141	0.3357	30
38	6	66/07/01	N50-15	W176-22	11	7.4	1	0.0032	28
38	12	66/07/11	N50-30	W176-22	13	7.5	1	0.0027	28
38	16	66/07/15	N50-37	W176-22	13	8.5	1	0.0027	28
38	42	66/08/16	N50-15	W176-22	13	10.3	17	0.0467	28
38	43	66/08/17	N50-00	W176-22	13	10.2	49	0.1346	28
38	44	66/08/18	N49-45	W176-22	13	10.4	77	0.2115	28
38	45	66/08/19	N49-30	W176-22	13	10.4	69	0.1896	28
38	46	66/08/20	N51-00	W176-22	12	10.2	1	0.0030	28
39	16	66/08/02	N51-45	W158-00	12	9.0	1	0.0035	24
39	20	66/08/10	N51-10	W158-45	12	9.5	1	0.0035	24
39	21	66/08/11	N50-10	W158-48	12	9.9	12	0.0417	24
39	22	66/08/12	N49-30	W158-00	11	10.0	9	0.0341	24
39	23	66/08/15	N51-30	W157-50	12	9.3	4	0.0139	24
39	26	66/08/18	N54-00	W158-00	12	10.0	1	0.0035	24
39	29	66/08/26	N51-05	W158-00	12	10.0	25	0.0868	24
39	31	66/09/01	N51-40	W158-00	12	9.0	2	0.0072	23
40	1	67/01/30	N54-00	W162-00	10	2.9	2	0.0063	32
40	2	67/01/31	N53-09	W162-10	10	3.5	1	0.0031	32
40	6	67/02/07	N48-35	W162-00	10	5.0	4	0.0125	32
40	10	67/02/13	N48-10	W162-00	12	5.0	1	0.0026	32
40	12	67/02/15	N49-32	W162-00	11	4.4	2	0.0057	32
40	18	67/03/06	N53-30	W155-02	11	3.2	2	0.0057	32
40	21	67/03/12	N51-20	W155-00	11	3.7	1	0.0028	32
40	23	67/03/14	N49-43	W154-55	11	4.4	1	0.0028	32
40	24	67/03/15	N48-50	W155-02	11	5.2	1	0.0028	32
40	25	67/03/16	N47-57	W155-00	12	5.4	1	0.0026	32
40	27	67/03/18	N48-22	W155-00	10	5.2	6	0.0188	32
40	28	67/03/19	N49-15	W155-00	11	5.0	1	0.0028	32
40	29	67/03/20	N50-05	W154-58	11	4.4	2	0.0057	32
40	31	67/03/22	N51-47	W155-00	11	3.6	1	0.0028	32
41	6	67/06/29	N48-00	W176-22	12	8.0	3	0.0089	28
41	18	67/07/24	N49-45	W176-22	12	10.2	12	0.0357	28
41	19	67/07/25	N50-15	W176-22	12	10.4	0	0.00 0	28
41	23	67/08/03	N50-15	W176-22	12	11.0	56	0.1667	28
41	24	67/08/04	N49-30	W176-22	10	11.3	13	0.0464	28
41	26	67/08/15	N51-30	W176-22	11	9.4	2	0.0065	28
41	27	67/08/16	N51-00	W176-22	22	10.7	5	0.0081	28
41	28	67/08/17	N50-45	W176-22	10	11.6	57	0.2036	28
43	5	68/03/27	N49-46	W176-29	10	3.6	1	0.0025	40
43	15	68/05/20	N52-45	W164-00	11	5.4	2	0.0067	27
44	2	68/07/05	N46-28	W176-23	14	8.6	20	0.0595	24
44	24	68/07/29	N50-30	W176-22	14	9.5	1	0.0030	24
44	26	68/07/31	N49-45	W176-22	10	9.2	4	0.0167	24

Table 1. (continued)

CRU	SET	YR/MO/DY	LAT	LONG	HRS	TEMP C°	#SQUID	CPUE	SHACKLES
44	27	68/08/01	N49-15	W176-22	9	9.2	8	0.0370	24
44	28	68/08/02	N49-00	W176-22	9	9.9	11	0.0509	24
44	29	68/08/04	N49-30	W176-22	9	9.9	30	0.1389	24
44	30	68/08/05	N50-15	W176-22	14	9.4	3	0.0089	24
44	31	68/08/06	N50-45	W176-22	15	9.4	2	0.0056	24
44	32	68/08/07	N51-34	W176-22	13	6.4	1	0.0064	12
44	36	68/08/12	N51-00	W176-22	14	9.9	1	0.0030	24
44	37	68/08/13	N50-30	W176-22	14	9.9	6	0.0179	24
44	39	68/08/15	N50-00	W176-22	8	9.5	20	0.0781	24
45	2	69/01/14	N55-07	W147-22	13	3.2	2	0.0064	24
45	7	69/01/25	N54-15	W155-00	12	3.0	1	0.0035	24
45	10	69/01/28	N50-12	W154-55	12	4.3	4	0.0139	24
45	12	69/01/31	N47-00	W154-59	12	6.2	1	0.0035	24
45	15	69/02/15	N50-00	W165-00	11	3.8	1	0.0038	24
45	16	69/02/16	N49-01	W164-58	11	4.0	1	0.0038	24
46	10	69/05/08	N50-00	W165-00	13	4.5	2	0.0057	27
46	16	69/05/18	N52-30	W165-00	13	4.2	1	0.0028	27
46	18	69/05/23	N50-45	W165-00	14	4.8	1	0.0026	27
47	11	69/07/13	N51-15	W176-22	12	7.7	1	0.0025	34
47	13	69/07/15	N50-40	W176-22	11	7.7	1	0.0027	34
47	16	69/07/20	N48-40	W176-22	12	9.1	2	0.0049	34
47	19	69/07/23	N51-00	W176-22	13	8.6	1	0.0023	34
47	25	69/07/29	N51-35	W176-22	10	10.2	2	0.0077	26
47	30	69/08/06	N50-10	W176-22	13	10.4	24	0.0710	26
47	31	69/08/07	N50-43	W176-22	14	10.6	2	0.0055	26
47	32	69/08/08	N51-00	W176-22	14	.0	1	0.0029	25
47	33	69/08/09	N49-30	W176-22	11	11.3	9	0.0327	25
47	37	69/08/13	N51-15	W176-22	12	12.2	3	0.0147	17
47	38	69/08/14	N50-45	W176-22	13	12.1	37	0.1674	17
47	39	69/08/15	N51-20	W176-22	10	7.4	3	0.0176	17
47	40	69/09/06	N50-20	W162-30	14	13.1	9	0.0268	24
47	41	69/09/07	N51-00	W160-00	13	12.7	76	0.2436	24
47	42	69/09/08	N51-30	W160-00	14	12.4	41	0.1220	24
47	43	69/09/10	N52-30	W160-00	14	11.9	23	0.0685	24
47	44	69/09/11	N53-00	W160-00	13	11.7	3	0.0096	24
47	45	69/09/12	N53-30	W160-00	11	11.5	4	0.0152	24
48	1	70/02/01	N54-30	W155-00	14	3.9	1	0.0024	30
48	2	70/02/04	N51-30	W155-00	12	4.1	1	0.0028	30
48	3	70/02/05	N51-00	W155-00	12	4.1	1	0.0028	30
48	5	70/02/07	N49-40	W155-00	14	4.4	3	0.0071	30
48	10	70/02/22	N48-25	W163-25	13	4.2	2	0.0051	30
48	11	70/02/23	N49-16	W161-44	14	3.9	1	0.0024	30
48	16	70/03/01	N53-30	W160-00	13	3.4	1	0.0027	29
49	30	70/06/08	N51-03	W175-01	13	6.3	1	0.0026	30
50	5	70/08/04	N52-13	W161-04	14	9.2	2	0.0040	36
50	9	70/08/10	N52-42	W167-00	13	9.9	1	0.0021	36
50	13	70/08/14	N50-59	W171-56	14	9.3	6	0.0119	36
50	15	70/08/16	N51-02	W175-00	14	9.3	1	0.0020	36
50	17	70/08/20	N51-00	W177-00	13	8.2	2	0.0077	20
50	21	70/08/24	N51-00	E175-39	14	8.5	4	0.0079	36
50	22	70/08/25	N51-30	E173-30	14	8.4	8	0.0159	36
50	23	70/08/26	N52-00	E171-30	13	10.1	6	0.0128	36

Table 1. (concluded)

CRU	SET	YR/MO/DY	LAT	LONG	HRS	TEMP C°	#SQUID	CPUE	SHACKLES
50	25	70/08/28	N53-35	E174-10	11	10.1	1	0.0032	28
51	2	71/01/28	N50-10	W160-00	14	4.0	4	0.0079	36
51	3	71/01/29	N49-30	W160-00	13	4.3	2	0.0043	36
51	5	71/02/01	N50-10	W165-00	13	4.4	1	0.0032	24
51	6	71/02/02	N50-50	W165-00	13	3.9	1	0.0032	24
52	8	71/05/07	N51-00	W164-45	14	3.3	1	0.0019	37
52	11	71/05/11	N50-15	W169-30	14	4.2	1	0.0019	37
53	1	71/07/29	N52-45	W153-15	13	10.1	1	0.0020	39
53	3	71/08/03	N52-00	W156-20	14	11.2	3	0.0055	39
53	4	71/08/04	N51-45	W157-45	14	11.2	8	0.0147	39
53	5	71/08/05	N52-10	W159-00	14	11.2	6	0.0110	39
53	8	71/08/10	N51-25	W166-45	13	10.6	3	0.0059	39
53	11	71/08/13	N51-00	W171-20	14	11.3	16	0.0293	39
53	12	71/08/15	N51-00	W174-20	14	9.9	32	0.0586	39
53	13	71/08/20	N51-30	W176-30	13	10.1	112	0.2209	39
53	15	71/08/23	N50-30	E179-10	14	8.6	116	0.2125	39
53	16	71/08/24	N50-45	E177-29	14	10.0	74	0.1355	39
53	17	71/08/25	N51-00	E176-10	14	9.8	68	0.1245	39
53	18	71/08/26	N51-30	E174-45	13	7.0	5	0.0099	39
53	19	71/08/27	N51-30	E173-29	14	8.9	4	0.0073	39
53	20	71/08/28	N52-00	E171-50	14	10.0	18	0.0330	39
53	21	71/08/29	N52-14	E170-30	13	9.7	5	0.0099	39
54	15	72/08/03	N51-00	E177-23	13	8.7	2	0.0077	20
54	16	72/08/04	N50-48	E179-50	12	6.9	5	0.0208	20
54	17	72/08/05	N51-00	W177-45	14	8.9	8	0.0286	20
54	18	72/08/11	N51-00	W175-15	13	8.9	11	0.0423	20
54	19	72/08/12	N51-10	W173-20	14	9.3	20	0.0714	20
54	20	72/08/13	N50-50	W171-35	14	7.8	1	0.0036	20
54	21	72/08/14	N51-00	W169-50	14	8.2	1	0.0036	20
54	22	72/08/15	N51-15	W168-00	13	8.9	1	0.0038	20
54	25	72/08/18	N50-40	W163-00	17	9.9	54	0.1588	20
54	26	72/08/19	N51-20	W161-20	14	10.3	6	0.0214	20
54	27	72/08/20	N51-00	W159-40	14	10.4	27	0.0964	20
54	28	72/08/21	N51-15	W157-50	14	11.1	27	0.0964	20
54	29	72/08/22	N51-00	W156-00	14	11.6	29	0.1036	20

Column headings defined:

CRU = Cruise number

HRS = Hours the gear was fished

TEMP C° = Surface temperature

CPUE = Catch per unit effort (#Squid/Shackle .hour)

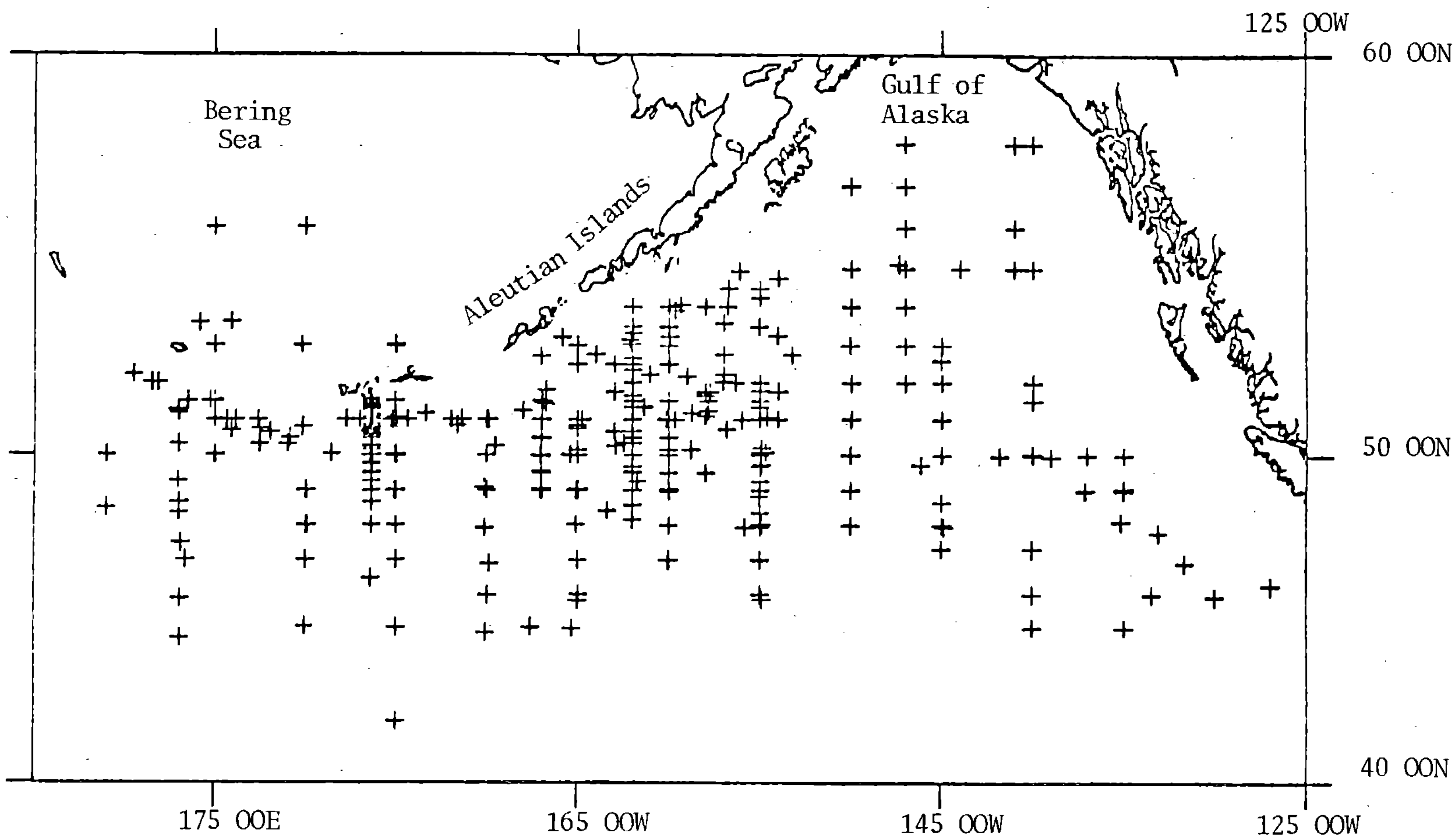

Figure 1. Gillnet sets which yielded squids, 1955-72.

in Figure 2; data on their capture, location, and mesh size in which they were caught are presented in Table 2.

Squid specimens returned from the field were preserved in 10% Formalin, in 1957 and frozen fresh in all other years. They were identified, measured, weighed, and in most instances sexed by the senior author. The laboratory procedure was to allow the frozen specimens to thaw and drain overnight. Excess moisture was wiped from individuals and the dorsal mantle length (DML) was measured in millimeters using calipers and a meter stick. Individual specimens were then weighed on a platform scale having 5 g graduations and sexed. The presence or absence of spermatophores in Needham's sac in the male was noted and the length of the nidamental gland in females was recorded as an indication of maturity.

RESULTS

Cephalopods representing five families (four squids, one octopod) were caught in gillnets in the North Pacific Ocean during salmon investigations. Information on these cephalopods, their size, distribution, and potential for a fishery are presented in the following sections.

Onychoteuthis borealijaponicus

The only member of this genus found in the North Pacific Ocean, it ranges from Baja California, Mexico north in the eastern North Pacific Ocean to the Gulf of Alaska and in the western North Pacific Ocean, from off Japan north to the Kurile Islands. Although records are scant, it presumably ranges across the North Pacific Ocean along the subarctic boundary and seasonally (summer and fall) at higher latitudes into subarctic waters. (Young 1972, Bernard 1980, Murata et al 1976, Naito et al 1977a, and the present paper).

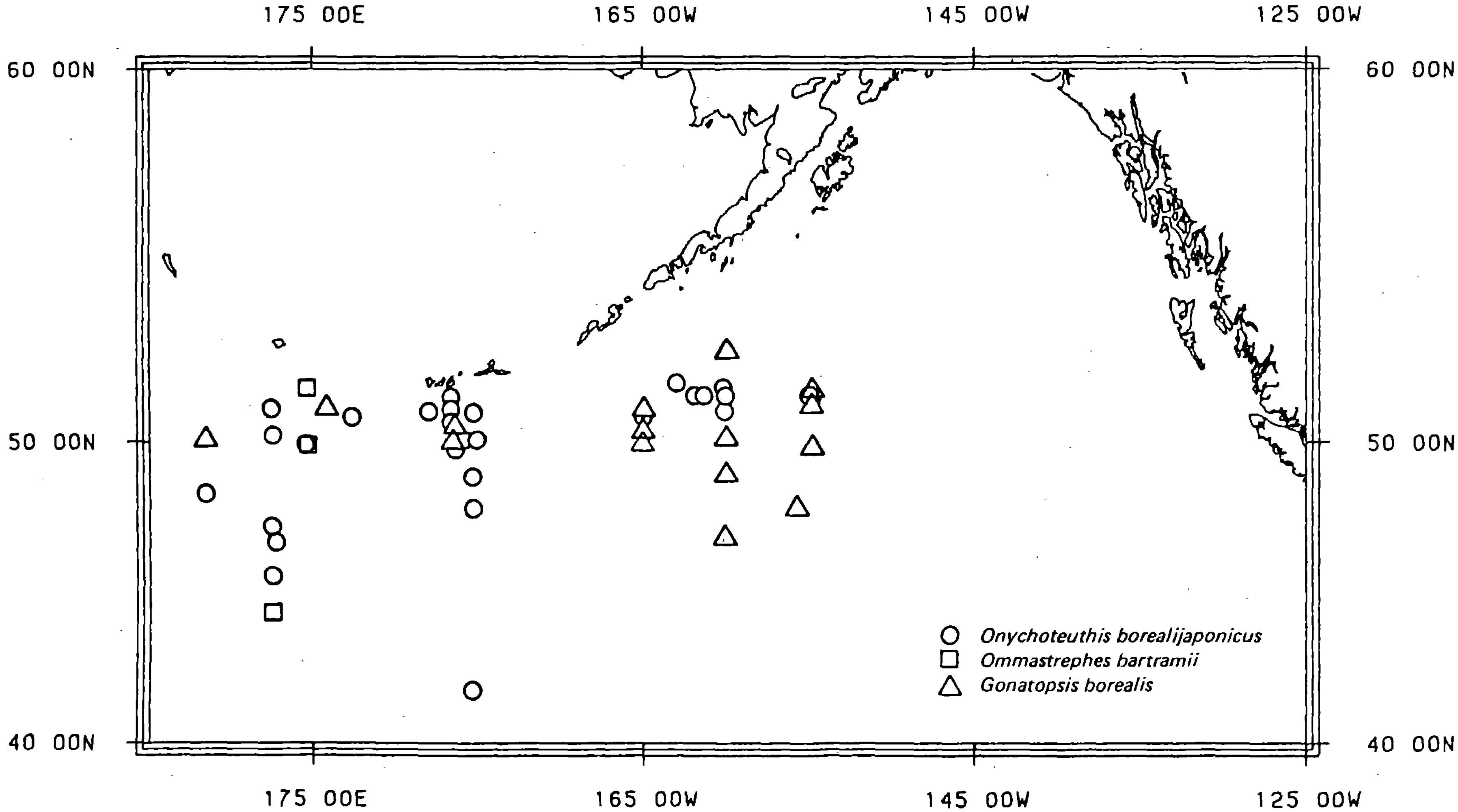

Figure 2. Locations where identified squids were captured, 1955-72.

Table 2. Cephalopods caught in Pacific Salmon Investigations gillnet sets and preserved for examination at the Northwest and Alaska Fisheries Center,

							No. squid caught by mesh size (mm)						Shackles of each mesh fished				
Cruise	Set	Species 1/	No, squid examined	Date yr/mo/d	Lat-Long	Surface temp°C	64	83	99	114	113	Total Squid	64	83	99	114	133
10	19	O. bar.	1	57/07/24	53-00N,175-00E	9.9	1	-	-	-	-	1	4	4	-	11	4
10	27	O. bar.	1	57/08/09	50-00N,175-00E	9.8	1	-	-	1	-	2	4	4	-	11	4
10	27	O. bor.	1	57/08/09	50-00N,175-00E	9.8	1	-	-	1	-	2	4	4	-	11	4
22	9	O. bor.	3	62/3/5	42-00N,174-52W	10.2	-	No		Data-		3	6	4	4	20	4
36	2	O. bor.	6	65/10/4	51-16N,172-58E	9.1	-	5	-	1	-	6	4	4	-	12	4
36	3	O. bor.	3	65/10/5	50-19N,173-00E	9.3	2	2	-	-	-	4	4	5	-	12	4
36	3	G. bor.	1	65/10/5	50-19N,173-00E	9.3	2	2	-	-	-	4	4	5	-	12	4
36	4	O. bor.	7	65/10/6	49-15N,172-58E	9.9	-	7	-	7	-	14	4	8	-	12	4
36	5	O. bor.	7	65/10/7	48-22N,173-00E	9.9	-	7	-	1	-	8	4	8	-	12	4
36	6	O. bor.	9	65/10/8	48-40N,172-59E	9.9	-	30	-	5	1	36	4	8	-	12	4
36	7	O. bor.	7	65/10/9	47-30N,173-05E	10.2	2	46	-	11	-	52	4	8	-	12	4
36	9	O. bor.	15	65/10/12	45-51N,173-02E	10.8	7	39	-	-	5	50	7	8	-	12	4
36	10	O. bar.	4	65/10/13	44-40N,173-02E	12.0	-	-	-	4	2	6	7	8	-	12	4
37	38	O. bor.	6	66/8/9	50-30N,167-00W	9.1	4	18	-	1	3	26	6	5	-	7	6
38	6	G. bor.	1	66/7/1	50-15N,176-22W	7.4	1	-	-	-	-	1	6	6	-	10	6
38	12	G. bor.	1	66/7/11	50-30N,176-22W	7.5	1	-	-	-	-	1	6	6	-	10	6
38	16	G. spp.	1	66/7/15	50-37N,176-22W	8.5	1	-	-	-	-	1	6	6	-	10	6
38	42	O. bor.	6	66/8/16	50-15N,176-22W	10.3	5	12	-	-	-	17	6	6	-	10	6
38	?	O. bor.	2	-----	-----------	--	-	-	-	-	-	-	-	-	-	-	-
41	6	O. bor.	1	67/6/29	48-00N,176-21W	8.0	1	2	-	-	-	3	7	7	-	7	7
41	18	O. bor.	10	67/7/24	49-45N,176-22W	10.2	4	8	-	-	-	12	6	6	-	6	6
43	5	C. spp.	1	68/3/27	49-46N,176-29W	3.6	-	No		Data-		-	8	8	8	8	8
44	30	O. bor.	3	68/8/5	50-15N,176-22W	9.4	2	-	-	-	1	3	9	9	-	9	9
44	32	G. spp.	1	68/8/7	51-34N,176-22W	6.4	-	-	-	1	-	1	6	6	-	6	6
44	39	O. bor.	20	68/8/15	50-00N,176-22W	9.5	10	7	-	-	3	20	9	9	-	9	9

11 Species abbreviations defined on last page of Table 2.

Table 2. (Continued)

Cruise	Set	Species 1/	No. squid examined	Date yr/mo/d	Lat-Long	Surface temp °C	No squid caught by mesh size (mm) 64	83	99	114	133	Total squid	Shackles of each mesh fished 64	83	99	114	133
46	10	G. bor.	2	69/5/8	50-00N,165-00W	4.5	2	-	-	-	-	2	8	8	-	8	8
46	18	G. bor.	1	69/5/23	50-45N,165-00W	4.8	-	1	-	-	-	1	8	8	-	8	8
47	41	O. bor.	59	69/9/7	51-00N,160-00W	12.7	11	50	-	1	8	70	6	6	-	6	6
47	42	O. bor.	12	69/9/8	51-30N,160-00W	12.4	23	16	-	2	-	41	6	6	-	6	6
47	43	O. bor.	12	69/9/10	52-30N,160-00W	11.9	7	13	-	3	-	23	6	6	-	6	6
48	2	G. bor.	1	70/2/4	51-30N,155-00W	4.1	1	-	-	-	-	1	-	No Data			
48	3	G. bor.	1	70/2/5	51-00N,155-00W	4.1	1	-	-	-	-	1	-	"	"		"
48	5	G. bor.	3	70/2/7	49-40N,155-00W	4.4	3	-	-	-	-	3	-	"	"		"
48	10	G. bor.	1	70/2/22	48-25N,163-25W	4.2	1	-	-	-	-	1	-	"	"		"
48	11	G. bor.	1	70/2/23	49-16N,161-44W	3.9	1	-	-	-	-	1	-	"	"		"
48	16	G. bor.	1	70/3/1	53-30N,160-00W	3.4	1	-	-	-	-	1	-	"	"		"
49	30	G. spp.	1	70/6/8	51-03N,175-01W	6.3	-	-	No data		-	1	-	"	"		"
51	2	G. bor.	4	71/1/28	50-10N,160-00W	4.0	4	-	-	-	-	4	-	"	"		"
51	3	G. bor.	2	71/1/29	49-30N,160-00W	4.3	2	-	-	-	-	2	-	"	"		"
51	5	G. bor.	1	71/2/2	50-10N,165-00W	4.4	-	-	No data		-	1	-	"	"		"
53	15	O. bor.	116	71/8/23	50-27N,179-17E	8.6	-	"		"	-	116	-	"	"		"
53	16	O. bor.	73	71/8/24	50-50N,177-19E	10.0	-	"		"	-	74	-	"	"		"
53	16	J. hea.	1	71/8/24	50-50N,177-19E	10.0	-	"		"	-	74	-	"	"		"
54	15	G. bor.	1	72/8/3	51-00N,177-20E	8.7	-		No-data		-	2	-	"	"		"
54	16	O. bor.	5	72/8/4	50-45N,179-40E	6.9	-	"		"	-	5	-	"	"		"
54	17	O. bor.	8	72/8/5	50-56N,178-00W	8.9	-	"		"	-	8	-	"	"		"
54	18	O. bor.	11	72/8/11	50-59N,175-12W	8.9	-	"		"	-	11	-	"	"		"
54	19	O. bor.	10	72/8/12	51-10N,173-20W	9.3	-	"		"	-	20	-	"	"		"
54	25	O. bor.	49	72/8/18	50-40N,163-00W	9.9	-	"		"	-	54	-	"	"		"
54	26	O. bor.	6	72/8/19	51-20N,161-20W	10.3	-	"		"	-	6	-	"	"		"
54	27	O. bor.	20	72/8/20	51-04N,159-35W	10.4	-	"		"	-	27	-	"	"		"
54	28	O. bor.	8	72/8/21	51-15N,157-50W	11.1	-	"		"	-	27	-	"	"		"
54	29	O. bor.	10	72/8/22	51-00N,156-00W	11.1		"		"		29		"	"		"

1/ Species abbreviations defined:
- C. spp. - *Chiroteuthis spp.*
- G. bor. - *Gonatopsis borealis*
- G. spp. - *Gonatus spp.*
- O. bar. - *Ommastrephes bartramii*
- O. bor. - *Onychoteuthis borealiJaponicus*
- J. hea. - *Japatella heathi*

Records of this genus from the tropical Pacific and Hawaiian waters are most certainly 0. banksii (Young 1972).

According to Naito et al. (1977a), O. borealijaponicus inhabits the northern portion of the subtropical zone and the southern portion of the subarctic zone 1/. They found that O. borealijaponicus was present in surface waters that fell between 1° and 20° C. but was mostabundant where the temperature was from 6° to 14° C. Squids identified during this study, mostly O. borealijaponicus (which constituted 94% of the total squid examined), were caught in surface waters of 6.9° to 12.8° C, which agrees with the findings of Naito et al. (1977a). Most were caught where surface water temperatures ranged from 9° to 13° C (Figure 3). Based on these data, it is reasonable to conclude that O. borealijaponicus may be present from August through October in North Pacific waters where these temperatures occur. Test fishing in these waters could determine if this species is sufficiently abundant to support a commercial jig fishery.

Of the female reproductive organs, the paired nidamental glands are the most readily accessible, and they increase in size as maturity approaches. The lengths of these glands were measured from 74 females taken 23-24 August 1971 (Cruise 53) in an attempt to judge maturity in females. Of these glands, 75% fell within the length range of 40 to 54 mm (Figure 4a). The relationship between the length of nidamental glands and dorsal mantle length is presented in Figure 4b. We draw no conclusions from these data but suggest that until additional information becomes

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1/ See Dodimead et al. (1963) and Favorite et al. (1976) who describe the subarctic boundary and the oceanography of the subarctic Pacific region.

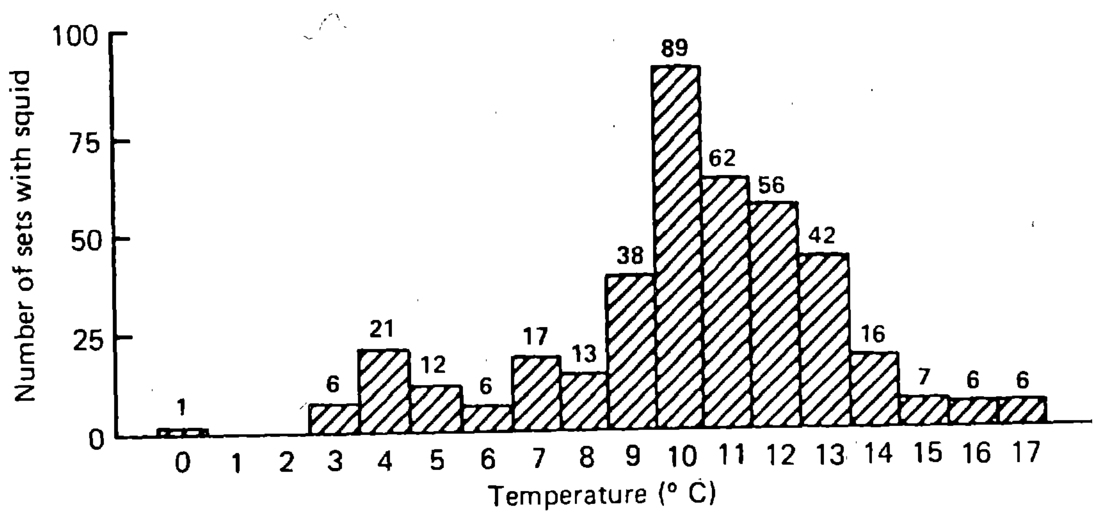

Figure 3. Gillnet sets in which squids were taken, by surface water temperature.

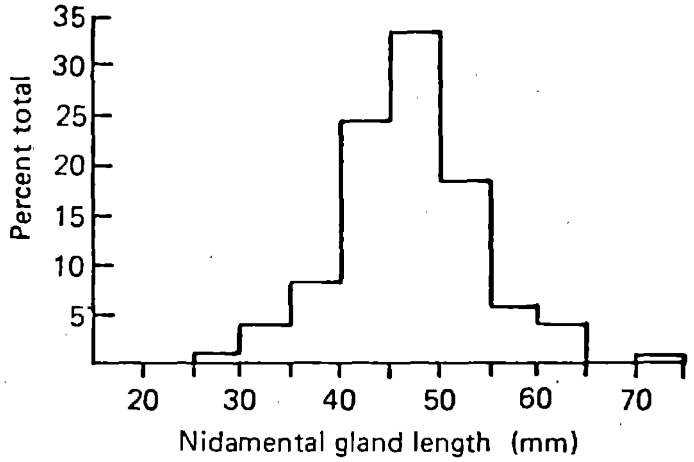

Figure 4a. Nidamental gland length from 74 female <u>Onychoteuthis borealijaponicus</u> captured 23-24 August 1971.

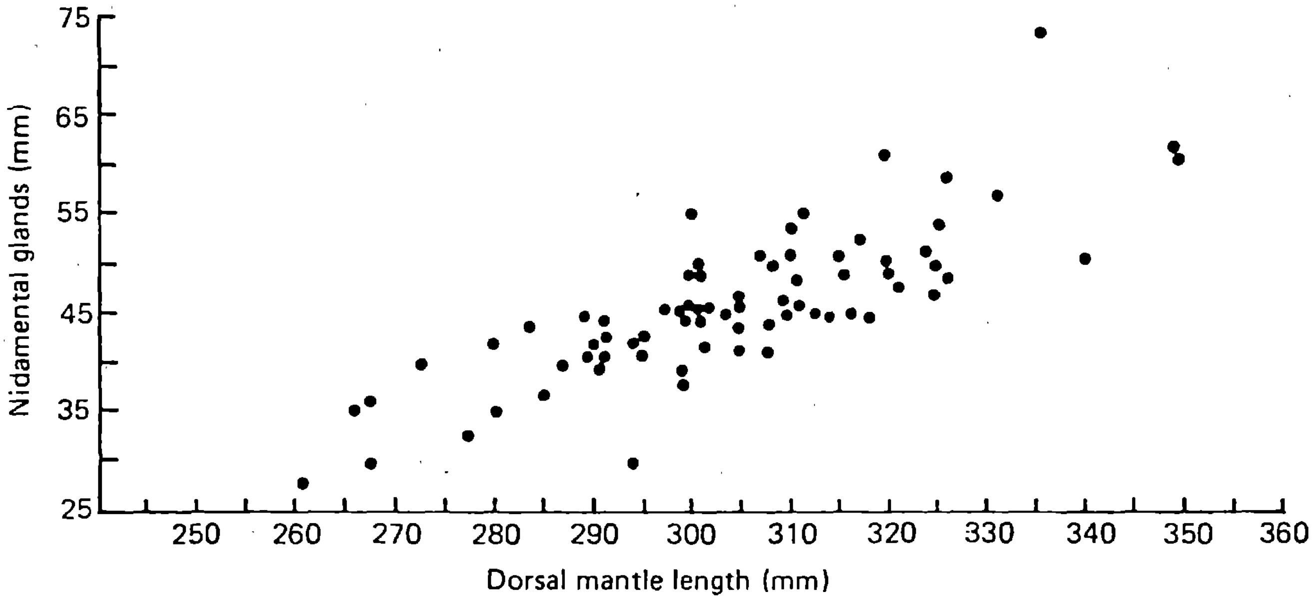

Figure 4b. Relationship between Nidamental gland length and Dorsal mantle length of 74 female <u>Onychoteuthis borealijaponicus</u> captured 23-24 August 1971.

available, females of this species with nidamental gland length of 40 mm and larger and dorsal mantle lengths of over 29 cm are approaching maturity. It is also possible that there may be considerable difference in the dorsal mantle length of mature females.

In males, the presence of spermatophores in Needham's sac was regarded as evidence of approaching maturity. The presence or absence of spermatophores was noted for males taken during cruises 53 (August 1971) and 54 (August 1972). The lengths and weights of specimens with and without spermatophores in Needham's sac were quite different (Table 3).

Table 3. Mean length and weight of male Onychoteuthis borealijaponicus with and without spennatophores present in Needham's sac, Cruises 53 and 54.

Cruise and date of collection	Total number males	Spermatophores in Needham's sac: Present length (mm)	Present weight (g)	Absent length (mm)	Absent weight (g)
Cruise 53		(N=29)		(N=11)	
23-24 August 1971	40	260.7	362.6	234.4	265.9
Cruise 54		(N=13)		(N=19)	
4-22 August 1972	32	256.0	355.8	235.8	273.2

Reproductive data indicated that many of the males and females in the catch were approaching sexual maturity as the season progressed. Although gillnets may have been selective for large squids, it is likely that maturing squids of this species congregated in the subarctic waters of the North Pacific Ocean south of the Alaska Peninsula and the Aleutian Islands in the late summer and fall preparatory to spawning.

Additionally, during Cruise 54, sets 16 and 17 (August 4-5) contained 12 males and only 1 female; sets 18 and 19 (August 11-12) contained 14 males and 7 females; sets 25-26-27 (August 18-19-20) contained 10 males and 62 females. The decrease of numbers of males relative to females during late August agrees with findings by Naito et al. (1977a). Naito et al. (1977a) suggested that the lower abundance of males in catches during August may be related to spawning activity. Murata et al. (1976) suggested that in the western Pacific O. borealijaponicus spawns on southward migration in late fall or winter.

Of the O. borealijaponicus examined, most were taken during Cruise 53 in August 1977 from south of Amchitka, Aleutian Islands (464 caught) and during Cruise 54 in August 1972 from south of Chirikof Island to the eastern Aleutian Islands (127 caught). The number of O. borealijaponicus measured, weighed, and sexed from Cruises 53 and 54 were 247 and 122, respectively.

Length-weight relationships for males and females are shown in figures 5 and 6. Data on lengths and weights of O. borealijaponicus that were tabulated are summarized below:

Area and sex of squid	Length (mm)		Weight (g)	
	Range	mean	Range	mean
South of Amchitka Is.				
Males	212-269	257	200-525	343
Females	243-352	306	325-990	640
South of Chirikof I.				
Males	207-282	244	180-475	304
Females	251-361	307	330-1100	655

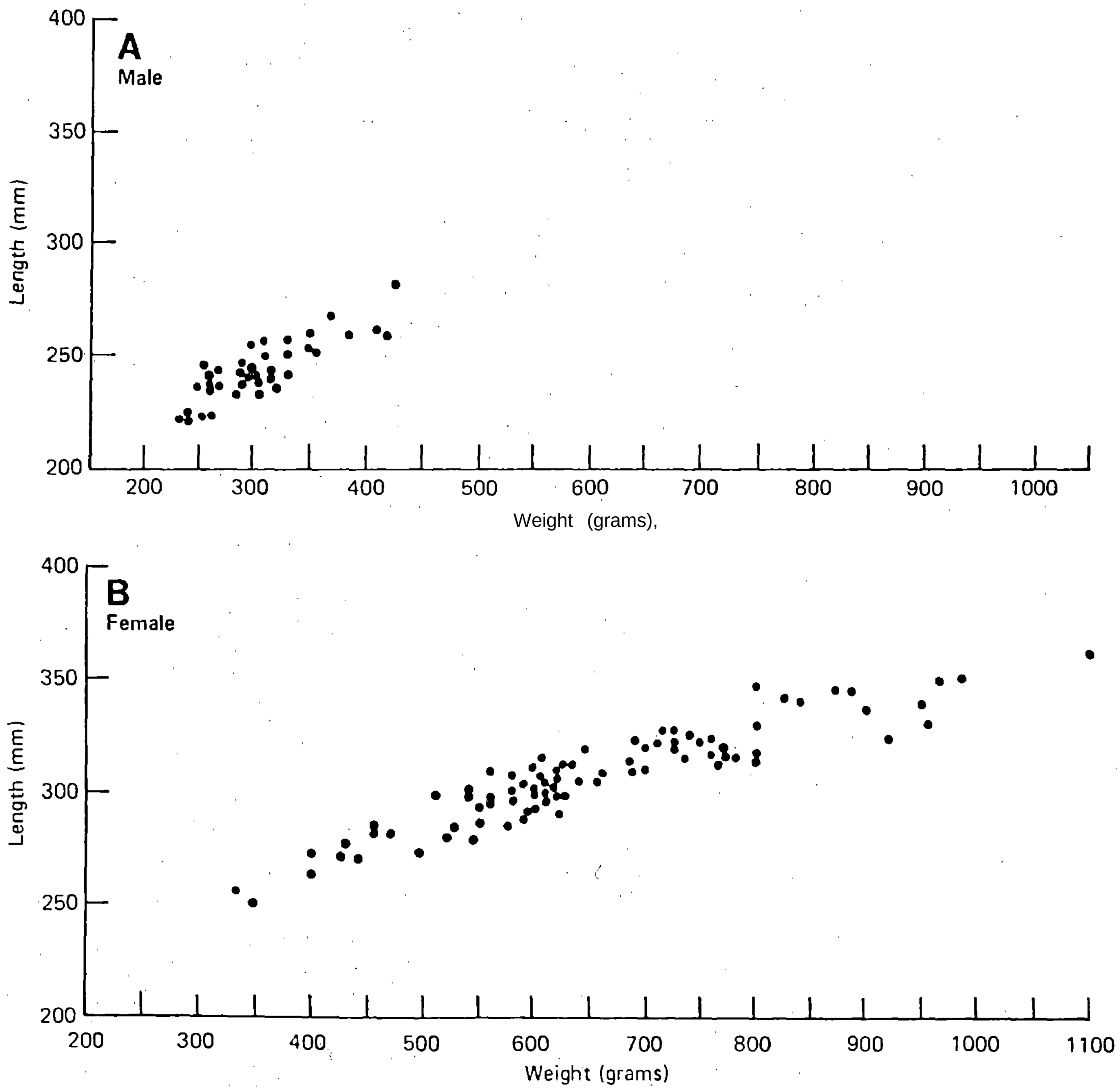

Figure 5. Length-weight relationships of male and female Onychoteuthis borealijaponicus taken during August 1972, south of the Alaska Peninsula and the eastern Aleutian Islands.

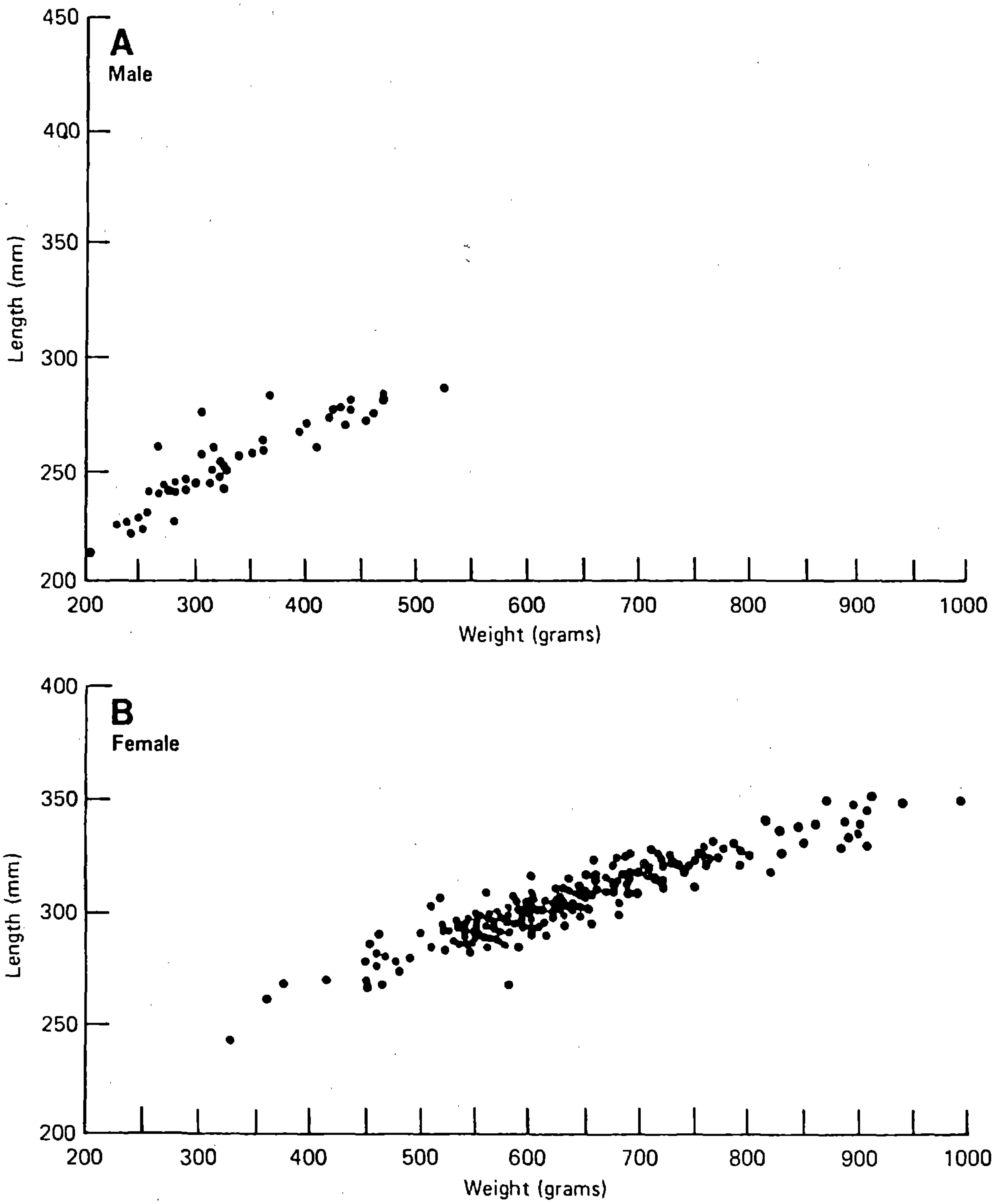

Figure 6. Length-weight relationships of male and female Onychoteuthis borealijaponicus taken during August 1971. south of Amchitka Island and the western Aleutian Islands.

These data agree with those of Naito et al. (1977b) who report a maximum mantle length in males of 30 cm (ours was 28.2 cm) and in females of 37 cm (ours was 36.1 cm). It is important to point out here that since most *Onychoteuthis* were caught in the smaller mesh sizes, it is possible the nets were selective for only large *Onychoteuthis* and that the length frequencies obtained here may not be representative of all *Onychoteuthis* present in the area.

Length-weight relationships between O. *borealijaponicus* taken in August 1971 south of the western Aleutians and in August 1972 from south of the eastern Aleutians and eastward to south of Chirikof Island, exhibit similar growth patterns. We may postulate that this species matures in late summer and early fall at about the same rate across the North Pacific, based on the condition of reproductive glands and size.

O. *borealijaponicus* may be sufficiently abundant in Alaskan surface waters north of the subarctic boundary in summer and fall, where they reach mean lengths (DML) of 26.5 cm (males) 30.7 cm (females) and mean weights of 32 kg (males) .65 kg (females), to support a commercial jig fishery. Methods used to jig this species along with catch per unit of effort data in the northwestern Pacific are discussed by kurata et al. (19761, Murata and Ishii (1977) and Okutani (1977). Results of experimental jigging for this species in the northeastern Pacific are discussed by Bernard (19801.

Gonatopsis borealis

This species ranges from Baja California, Mexico (Young 1972), north into subarctic waters and west to the coast of Japan. Naito et al. (1977a) stated that G. *borealis* inhabits only the subarctic zone.

5. *borealis* was taken in gillnets during all seasons of the year: January, February, March, May, July, August, and October. This species was the only squid taken in January and February of 1970 and 1971 when

surface water temperatures registered 3.4° to 4.4° C. Naito et al. (1977b) lists maximum mantle lengths of 27 cm (males) and 29 cm (females); however, Okutani and Satake (1978) identified two specimens from the stomachs of sperm whales that measured 32 and 48 cm DML. Our largest specimen measured 24.8 cm (not sexed). Of those that were sexed, the largest male measured 20.3 cm, and the largest female was 16.2 cm.

Gonatus spp.

Members of this genus range from Baja California, Mexico, north around the Pacific rim to Japan and into subarctic waters of the North Pacific Ocean and the Bering Sea. Young (1972), Bublitz (1981), Kubodera and Okutani (1981), and Jefferts (1981) have described from seven to nine species in this genus from the eastern North Pacific Ocean and Bering Sea.

Gonatus (six specimens) in our collection have not been identified to species. Catches by date were 15 July 1966, DML 291 mm; 7 August 1968, 87 mm; 8 June 1970, 295 mm; August 1971, 1 male 330 mm, and 2 females with DML of 265 and 329 mm and weights of 200 and 375 g. Some of these specimens may be referable to *Gonatus madokai* (Kubodera and Okutani 1977, Bublitz 1981). Surface water temperatures in which *Gonatus* spp were taken ranged from 6.4° to 8.5° C.

Berryteuthis spp

This genus ranges across the North Pacific Ocean from California to Japan and into the Bering Sea in subarctic waters. Two species have been described: B. *magister* and B. *anonychus*.

The only B. *magister* in our collection was taken in August 1971; it was a male measuring 152 mm DML and weighing 250 g. B. *magister* shifts to benthic waters as it reaches sexual maturity (Naito et al. 1977).

While some members of the family Gonatidae may be taken in surface waters, it will be more productive to fish mature Berryteuthis near the bottom along the edge of the continental shelf and slope with trawl gear.

Ommastrephes bartramii

According to Naito et al. (1977a), this species is primarily an inhabitant of subtropical surface waters in the western North Pacific east to about 180° longitude. Murata et al. (1976) also reported that this species occurs primarily in the warmer surface waters. Bernard (1981) described an experimental fishery for this species off the west coast of Vancouver Island in the eastern North Pacific in 1980, and mentions that it is found across the warm and temperate waters of the North Pacific.

We have identified 11 O. bartramii from the gillnet catches. Of the 11, 7 were taken in July from about 50° to 53°N, and 175°E in surface water temperatures of 9.8° to 9.9°C, and four were taken in October 1965 in. 44°40'N, 173°02'E in surface water temperatures of 12°C. O. bartramii taken in 1957 were measured but not sexed; they measured 375, 380, 385, 387, 415, and 420 mm DML. Naito et al. (1977b) list maximum DML of 48 cm (females) and 41 cm (males).

The potential for a fishery on O. bartramii along the subarctic boundary in summer and fall certainly warrants investigation. Bernard (1980) stated that large squids of this species tend to tear off of the jigs. Gillnets are usually used to capture this species and could be restricted to waters south of the subarctic boundary where salmonids do not occur.

Chiroteuthis spp.

One *Chiroteuthis* spp. was caught in a surface gillnet on 27 March 1968 in 49°46'N, 176°29'W. The surface water temperature was 3.6°C. Only the head and arms were recovered; tentacles and body were apparently lost when the net was hauled.

Japetella heathi

One small octopus, J. *heathi*, was taken by surface gillnet the night of 23-24 August 1971 in 50°50'N, 177°19'E. The surface water temperature was 10°C.

Summary

The squid O. *borealijaponicus* was taken incidentally in surface gillnets set for salmonids along the subarctic boundary and northward in sufficient numbers to indicate a possible potential for a jig fishery in the north Pacific from the Gulf of Alaska westward to the Aleutian Islands in summer and fall. O. *bartramii* was also taken from the subarctic boundary and southward and is probably present in sufficient numbers to support a fishery. Most *Gonatopsis borealis* were taken in winter; however, some were taken in summer and fall and this species may be taken in an *O*. *borealijaponicus* fishery. Other species taken in surface gillnets were *Gonatus* spp., *Berryteuthis* spp., *Chiroteuthis* spp. and *Japetella heathi* and while these species are present in the fishery area, it is doubtful- if they would contribute significantly to ‘the catch. *Berryteuthis magister*, which usually settle to benthic waters as they mature, are taken incidentally in the north Pacific and Bering Sea trawl fisheries and would probably not be taken by a jig fishery.

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