537

Pelagic Fur Seal Investigations, 1965

By Clifford H. Fiscus and Hiroshi Kajimura

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FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES

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United States Fish and Wildlife Service
Special Scientific Report--Fisheries No. 537

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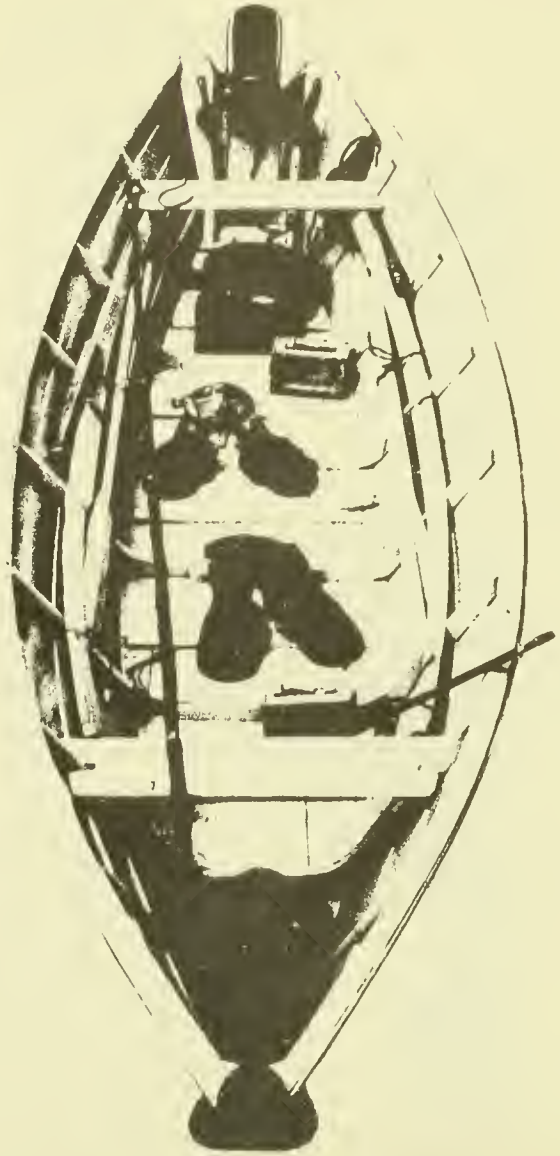
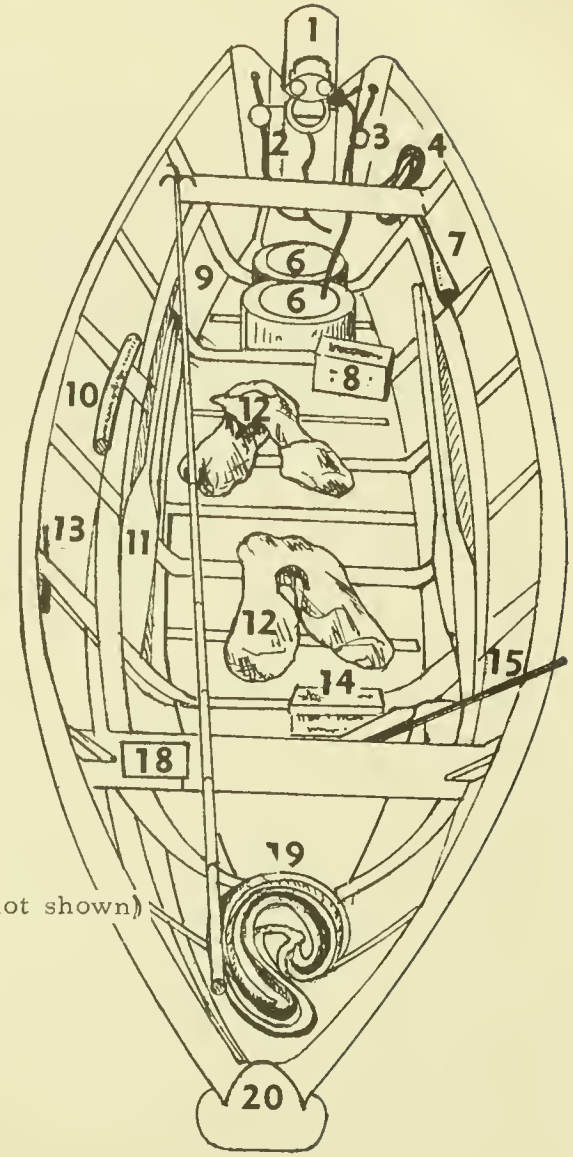


1--10 hp. outboard motor
2--stern lift line
3--motor safety line
4--20-ft. 1/2-in. nylon stern line
5--1 watt radio (not shown)
6--6-gal. gas tanks
7--seal-club gaff
8--small boat emergency kit contents: 1 box rations, 1 qt. water, 1 signal flag, 1 pliers, 1 screwdriver, 1 crescent wrench, 1 pocket compass, 2 sparkplugs, 2 shearpins, 1 emergency flare.
9--15-ft. bamboo gaff
10--radar reflector screen
11--oars and oarlocks
12-- lifejackets
13--sticking knife
14--ammunition box, contains 100 rounds 00 buckshot
15--12-gauge shotgun
16--boat bailer (not shown)
17--flotation jackets (optional--not shown) can be used in place of lifejackets
18--waterproof notebook, and pencil
19--30-ft., 1-in. Manila bow line
20--bow lift line



Frontispiece--Dory equipped for pelagic sealing.

Pelagic Fur Seal Investigations, 1965

By

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ABSTRACT

Pelagic fur seal research as required by the Interim Convention on Conservation of North Pacific Fur Seals was conducted off Washington (2-24 April) and off California (11 April to 23 June). One hundred forty-seven fur seals (Callorhinus ursinus) were taken off Washington and 269 off California. Off Washington, seals were most numerous near Grays Harbor in mid-April. Off California, seals were concentrated off Monterey from late April to early June and near Cordell Bank west of Pt. Reyes in April and early May. Observation or transect lines extending from 10 to 80 miles offshore were established between Bodega Head and Pt. Sur, Calif., at 20-mile intervals, to study distribution and migration. Seals were most abundant from 30 to 40 miles offshore. Of the 387 female seals taken, 44 percent were pregnant; the youngest pregnant females were 5 years old. A squid, Moroteuthis robusta, is reported for the first time as fur seal food. By volume, the principal species of fish eaten by seals off California was Merluccius productus and off Washington was Engraulis mordax.

INTRODUCTION

The United States has engaged in pelagic research on fur seals intermittently since 1883. In that year James G. Swan (1883), U.S. Fish Commission, worked on seals brought into Neah Bay, Wash., by Indian sealers.

Charles H. Townsend (1898) and A. B. Alexander (1892)[1] of the U.S. Fish Commission began pelagic studies in 1892 from the U.S. Revenue Marine Cutter Corwin in the Bering Sea and Gulf of Alaska. Townsend, Alexander, and Frederic A. Lucas continued ocean investigations in 1896 under a commission headed by David Starr Jordan (Jordan, 1899). Between 1896 and 1952 no large-scale investigations were carried out. Observations and collections made by many observers during this time are summarized by Taylor, Fujinaga, and Wilke (1955).

As part of cooperative investigations by Canada, Japan, and the United States in 1952, Victor B. Scheffer collected seals offshore from California to Alaska (Taylor, Fujinaga, and Wilke, 1955). Wilke and Kenyon (1957) studied food habits of fur seals in the Bering Sea in 1955.

Pelagic research under the Interim Convention on Conservation of North Pacific Fur Seals began in 1958. Members of the Convention are Canada, Japan, the U.S.S.R., and the United States.

One objective of the Convention is to determine "what the relationship is between fur seals and other living marine resources and whether fur seals have detrimental effects on other living marine resources substantially exploited by any of the Parties, and, if so, to what extent." The first part of this objective will probably never be entirely satisfied, and though we have acquired detailed knowledge about the food of fur seals, the effects resulting from their feeding are obscure and likely to remain so indefinitely.

Other research required by the Convention is partly completed. The migration routes of fur seals and their wintering areas are generally known, but relatively little information is available on far-offshore distribution and the movements of seal pups during their first months at sea. The age and sex of seals moving and feeding off the coast during different

[1] In Records of the United States Fish Commission, prepared by General Services Administration, The National Archives, Washington, D.C., 1953 (Record Group 22). (Manuscript report by A. B. Alexander concerning fur seals, 1892, 23 p.)

months are generally known, but little progress has been made on estimating the numbers of seals on migration routes and in wintering areas in the eastern Pacific. Sampling indicates, however, that few seals under age 8 originating from Robben Island or the Commander Islands migrate along the coast of North America.

The most dependable data on pregnancy and mortality rates are obtained from seals collected at sea. These data are essential for population and recruitment estimates for the Pribilof seal herd.

Investigations off California from April to June 1965 expanded studies carried on in the spring of 1964. A collection of seals on the salmon trolling grounds off Washington provided information about these animals in an area where a salmon population was present during the time of the study.

EQUIPMENT, METHODS, AND PERSONNEL

Vessels, boats, equipment, and methods used in hunting and in collecting data were described by Fiscus, Baines, and Wilke (1964). Equipment and methods are now standardized, although specialized equipment and techniques are used dependent on collecting requirements. The frontispiece shows a dory equipped for sealing. Equipment carried in dories has been selected on the basis of experience at sea since 1958.

Seals are taken from the vessel, or from a dory, with 12-gage shotguns, loaded with buckshot. Seals are weighed, measured, and skinned, and the stomachs, reproductive tracts, and right upper canine teeth are saved for examination in the laboratory (ages are determined from longitudinal sections of the canine teeth).

A study of the accuracy of determining age from upper canine teeth of fur seals is in progress at the Marine Mammal Biological Laboratory. Preliminary results in reading the ages of sectioned teeth of seals of known age indicate the following percent error: males age 2 through 5, error by three readers (33 teeth) ranged from 9 to 24 percent with the greatest error of ± 1 year; females age 1 through 7, error for three readers (93 teeth) ranged from 9 to 25 percent with 99 percent differing by no more than ± 1 year and a greatest error of ± 2 years; females 8 through 13, error for two readers (39 teeth) ranged from 41 to 59 percent with 91 percent within ± 1 year and a greatest error of -4 to +2 years. The sample of known-age males age 6 and females age 14 and older was too small to use in this study.

The method of handling skins described by Fiscus and Kajimura (1965) was modified in 1965 to include blubbering (the act of removing fat, muscle, and connective tissue from the skin) prior to salting. This was done to determine if differences in quality of curing existed between skins blubbered soon after collecting and those blubbered several weeks to several months after they were taken. After a skin was stripped from the seal carcass and washed, it was soaked in clean sea water overnight, then blubbered on a portable fleshing beam, drained, and cured in salt for 2 weeks before barreling.

Observations of marine mammals and collections of fur seals in 1965 were made off Washington from the chartered purse seiners M/V St. Michael[2] 2-4 April and M/V Harmony[3] 6-24 April; the St. Michael was also used off central California 11 April to 23 June.

Records for three female seals are not complete. These three animals are included in the sections on distribution of seals by date and locality, and relative abundance and size of groups, only.

Biologists aboard the St. Michael were Clifford H. Fiscus and Hiroshi Kajimura. Biologists on the Harmony were Raymond E. Anas, Alton Y. Roppel, and Ford Wilke. Assistants on the vessels and in the Seattle laboratory were Richard K. Stroud and James A. Wood. Allan H. Vogel assisted in the Seattle laboratory. Hiroshi Kajimura observed pelagic research in Japan from 10 April to 10 May 1965 (app. B).

RESEARCH IN 1965

In 1965, fur seal research was carried out at sea off the coast of Washington between lat. 46° N. and 49° N., in April, and off the coast of California between lat. 36° N. and 39° N., from April to May.

Distribution off Washington

Seals were widely scattered and scarce off Cape Flattery and the northern Washington coast in early April; however, in mid-April concentrations of seals were located 10 to 20 miles off Grays Harbor (fig. 1). For example, 96 seals were seen 15 April and 145 on 22 April in water from 30 to 100 fathoms (55 to 182 m.) deep.

Surface water temperatures off Washington ranged from 8° to 12° C. in the survey areas. Off Cape Flattery, temperatures were mostly 10° to 11° C.

Distribution off California

With two exceptions, investigations were carried out between Bodega Head (lat. 38° 18' N.) and Pt. Sur (lat. 36° 18' N.) from shore to about 100 miles out. Two cruises were made south from Pt. Sur to Morro Bay (lat. 35° 23' N.) to survey what in the past has been a

[2] M/V St. Michael: registered length 72.5 feet, 107 gross tons, 380 horsepower, cruising speed 10 knots.

[3] M/V Harmony: registered length 70.5 feet, 90 gross tons, 220 horsepower, cruising speed 9 knots.

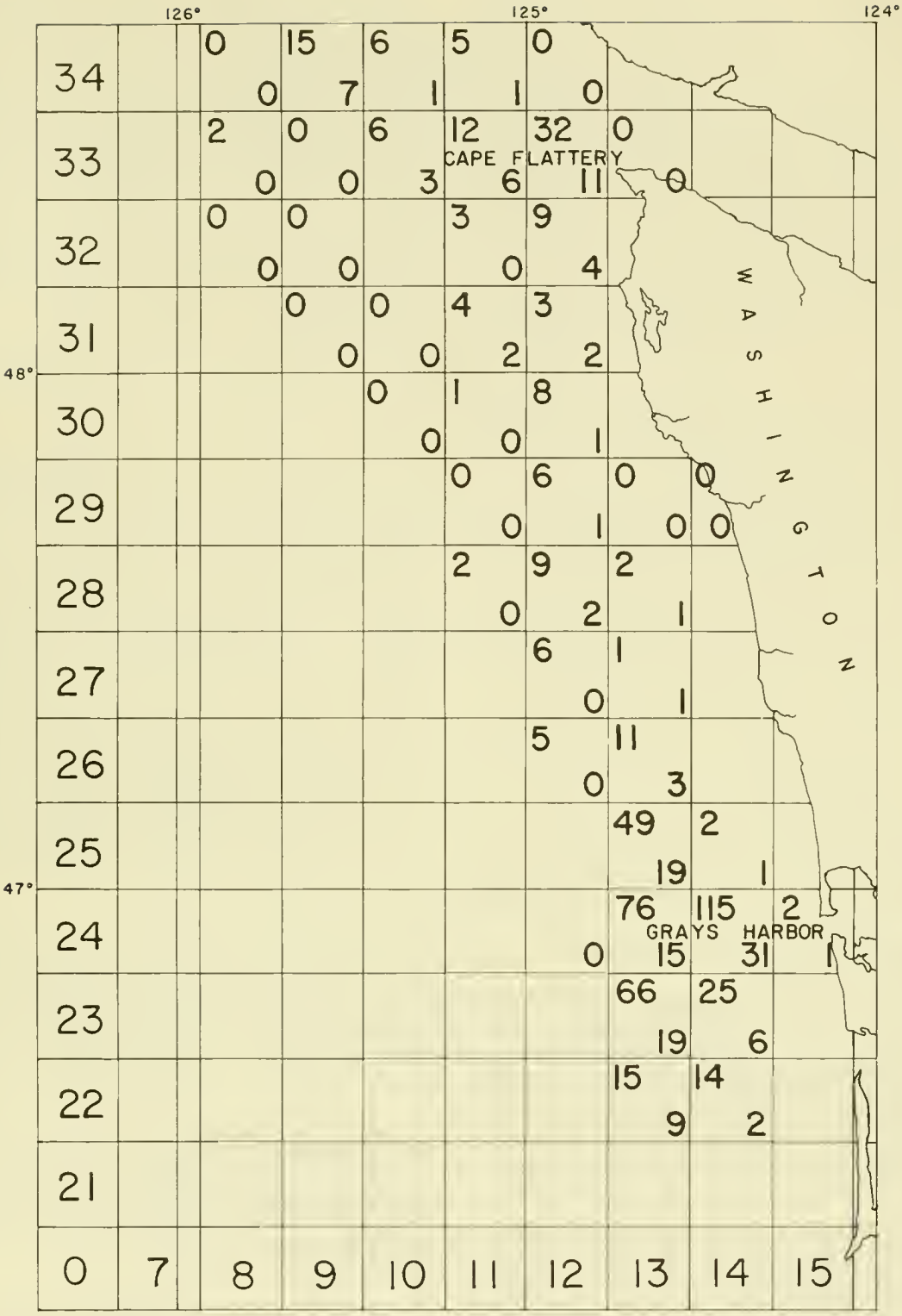

Figure 1.--Number of seals observed (upper figure in each square) and collected (lower) from lat. 46° N. to lat. 48° 40' N. The sides of each square measure 10 nautical miles.

major wintering area. Although visibility was excellent during both surveys, only 21 seals were seen on the first cruise (28-29 May) and 1 on the second (21-22 June).

A concentration of seals was located north of Pt. Sur in and near the Monterey seavalley from late April to early June. Seals were on the Farallon grounds southwest and west of the Farallon Islands throughout the survey period. Concentrations of seals were also observed on or near Cordell Bank west of Pt. Reyes in April and in early May.

Seals off California seldom come close to land; however, during a severe storm on 14 April we saw an adult female about a half mile from shore at the western approach to Drakes Bay. Seals were abundant offshore at this time.

Seven observation or transect lines were established between Bodega Head and Pt. Sur at 20-mile intervals as a basis for a systematic study of the distribution and migration of fur seals off California. These lines, which extended from 10 to 80 miles out from shore (figs. 2 and 3), were cruised once each month, and the seals seen were recorded (table A-1). Because of the annual northward migration, the number of seals seen per month decreased from 264 in April to 72 in June. Seals were most abundant from 30 to 70 miles offshore (figs. 2 and 3). The greatest concentration was from 30 to 40 miles offshore; abundance decreased rapidly toward shore and gradually between 40 and 80 miles out. The largest number of seals seen in 1 day in each month were: 16 April - 101, 26 May - 66, and 14 June - 46. Thirty seals were seen on the last day (23 June) in the area.

Surface water temperatures off California ranged from 10° to 14° C. in the areas surveyed. Temperatures were mostly 11° to 12° C. in April and May and 12° to 13° C. in June.

Relative Abundance of Seals and Size of Groups

The number and relative abundance of seals seen and collected, by 10-day periods, are shown in tables A-2 and A-3. The decreasing number of seals seen per boat-hunting day off California in April, May, and June, is a result of the annual northward migration to the Pribilof Islands breeding grounds. This decrease was not apparent off Washington, where the survey ended at about the peak of migration.

A group of seals is defined as one or more seals that are feeding, traveling, or resting in close association with each other. A single seal is recorded as a group of 1. Seals separated from each other by more than 100 yards are recorded as separate groups. The percentage of seals in each group for Washington and California combined (table A-4) did not change greatly from that observed in 1964 (Fiscus and Kajimura, 1965); however, the proportion of single animals off California increased from 29.8 percent in 1964 to 50.6 percent in 1965.

As an example of seal grouping during migration, 67 animals observed moving north off Pt. Reyes, Calif., 29 April, were divided among groups of the following sizes (number of groups in parentheses): 1 seal - (12 groups), 2 - (3), 3 - (4), 4 - (3), 5 - (2), 7 - (1), 8 - (1). More than 70 percent of the seals were in groups of 3 to 8; groups as large as these are more common when seals are migrating than when they are on their wintering grounds off California.

Of 1,627 seals sighted in 1965, 419 were collected, 50 were wounded and lost, and 46 were killed and lost.

Distribution by Age and Sex

The age and sex of seals collected in 1965, by months and areas, are shown in table 1. Distribution by age and sex off California is similar to that of 1964 (Fiscus and Kajimura, 1965).

Monthly changes in the age and sex composition of fur seals collected off California (data for 5 years combined) are shown in table 2. The number and proportion of young males increase in April and May and decrease in June, when seals of all ages become less numerous. Males consistently form only a small part of the seal population off California; the few males collected were young. The gradual increase in the proportion of young (ages 1-4) females off California from 9.8 percent in January to 39.8 percent in June is a result of the northward migration of many of the older females toward the breeding grounds.

Tag Recoveries

Twenty tagged seals were taken in 1965. Of the seals killed and recovered in 1965, 12 percent of the seals age 4 and younger and 1 percent of those age 5 and older had been tagged (table 3). No seals tagged on Robben Island or the Commander Islands were taken.

Size

Lengths and weights are given for pregnant and nonpregnant females collected in 1965 in tables A-5 to A-8 and for males in tables A-9 and A-10. Mean lengths and weights of male and female fetuses collected in 1965 are shown by 10-day periods in table A-11.

Reproduction

Diagnosis of the reproductive condition of female fur seals is important in the study of possible segregation at sea by age, sex, or reproductive condition, and for the evaluation of pregnancy rate data.

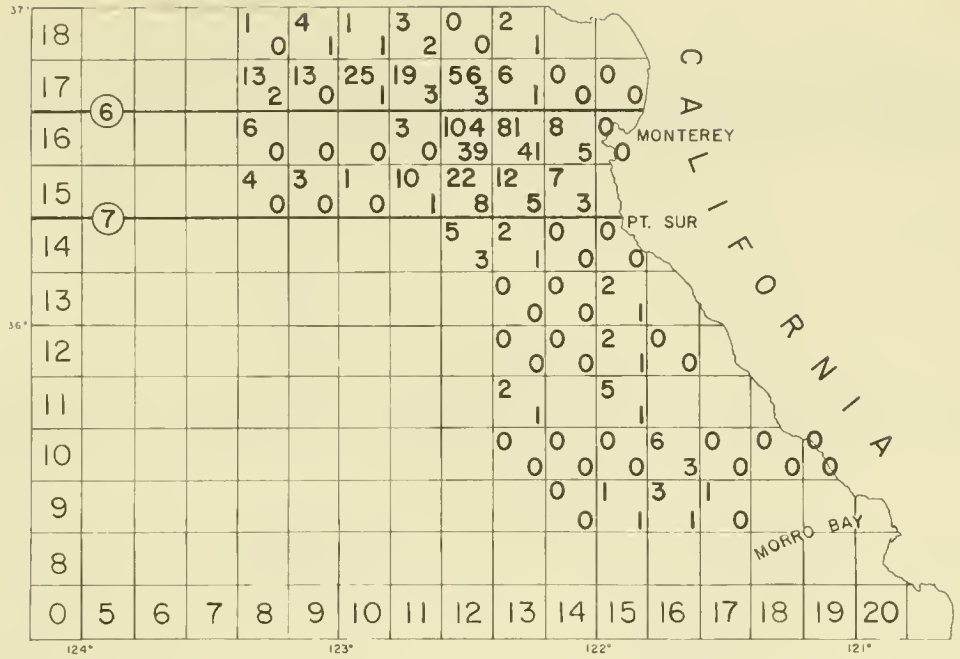

Figure 2.--Number of seals observed (upper figure in each square) and collected (lower) from lat. 35° 20' N. to lat. 37° N. The sides of each square measure 10 nautical miles.

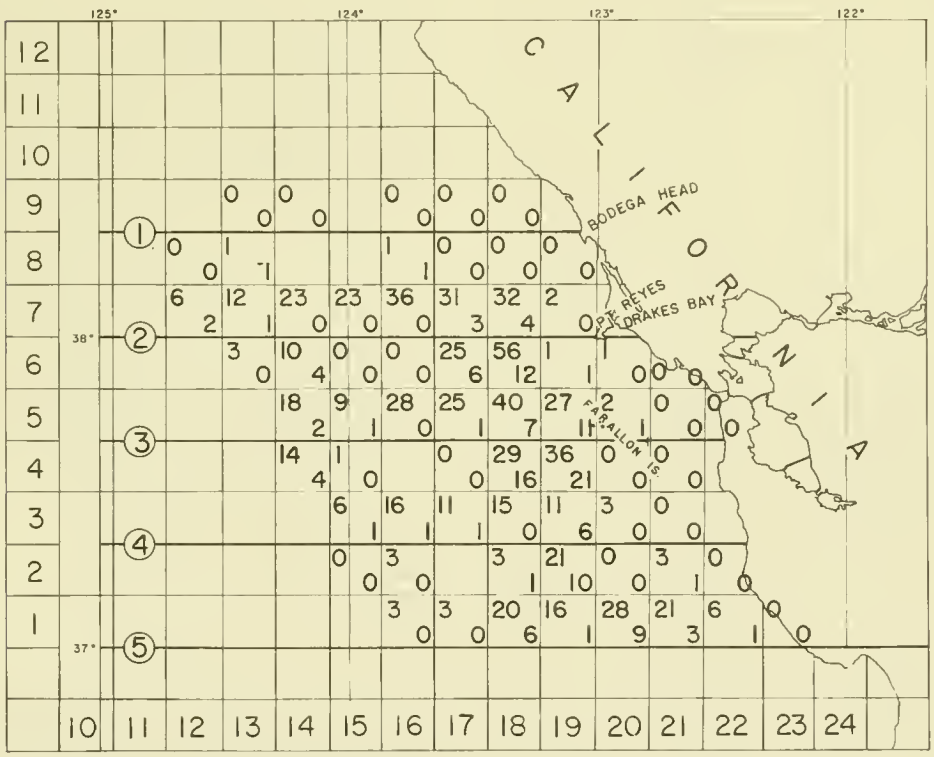

Figure 3.--Number of seals observed (upper figure in each square) and collected (lower) from lat. 37° N. to lat. 38° 30' N. The sides of each square measure 10 nautical miles.

Table 1. --Age and sex, by month and area, of fur seals collected pelagically by the U.S.A in 1965

Age	California				Washington				Total			
	Male		Female		Male		Female		Male		Female	
Years	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
						April						
1	-	-	1	2.3	6	31.6	6	4.6	6	28.6	7	4.1
2	-	-	3	7.0	3	15.8	2	1.6	3	14.3	5	2.9
3	2	100.0	3	7.0	8	42.1	20	15.6	10	47.6	23	13.4
4	-	-	6	14.0	2	10.5	27	21.1	2	9.5	33	19.3
5	-	-	2	4.6	-	-	8	6.2	-	-	10	5.9
6	-	-	5	11.7	-	-	18	14.0	-	-	23	13.4
7	-	-	2	4.6	-	-	12	9.4	-	-	14	8.2
8	-	-	1	2.3	-	-	16	12.5	-	-	17	9.9
9	-	-	4	9.4	-	-	3	2.3	-	-	7	4.1
10	-	-	2	4.6	-	-	2	1.6	-	-	4	2.3
11	-	-	4	9.4	-	-	4	3.1	-	-	8	4.7
12	-	-	3	7.0	-	-	1	0.8	-	-	4	2.3
13	-	-	1	2.3	-	-	-	-	-	-	1	0.6
14	-	-	2	4.6	-	-	1	0.8	-	-	3	1.8
15	-	-	-	-	-	-	2	1.6	-	-	2	1.2
16	-	-	2	4.6	-	-	2	1.6	-	-	4	2.3
17	-	-	2	4.6	-	-	1	0.8	-	-	3	1.8
18	-	-	-	-	-	-	2	1.6	-	-	2	1.2
20	-	-	-	-	-	-	1	0.8	-	-	1	0.6
Total	2		43		19		128		21		171	
						May						
1	2	40.0	3	2.4	-	-	-	-	2	40.0	3	2.4
2	-	-	2	1.6	-	-	-	-	-	-	2	1.6
3	-	-	11	8.9	-	-	-	-	-	-	11	8.9
4	3	60.0	21	17.1	-	-	-	-	3	60.0	21	17.1
5	-	-	6	4.9	-	-	-	-	-	-	6	4.9
6	-	-	7	5.7	-	-	-	-	-	-	7	5.7
7	-	-	5	4.1	-	-	-	-	-	-	5	4.1
8	-	-	9	7.3	-	-	-	-	-	-	9	7.3
9	-	-	5	4.1	-	-	-	-	-	-	5	4.1
10	-	-	3	2.4	-	-	-	-	-	-	3	2.4
11	-	-	6	4.9	-	-	-	-	-	-	6	4.9
12	-	-	9	7.3	-	-	-	-	-	-	9	7.3
13	-	-	3	2.4	-	-	-	-	-	-	3	2.4
14	-	-	6	4.9	-	-	-	-	-	-	6	4.9
15	-	-	8	6.6	-	-	-	-	-	-	8	6.6
16	-	-	5	4.1	-	-	-	-	-	-	5	4.1
17	-	-	6	4.9	-	-	-	-	-	-	6	4.9
18	-	-	3	2.4	-	-	-	-	-	-	3	2.4
19	-	-	2	1.6	-	-	-	-	-	-	2	1.6
20	-	-	1	0.8	-	-	-	-	-	-	1	0.8
21	-	-	1	0.8	-	-	-	-	-	-	1	0.8
23	-	-	1	0.8	-	-	-	-	-	-	1	0.8
Total	5		123		-		-		5		123	
						June						
1	3	100.0	-	-	-	-	-	-	3	100.0	-	-
2	-	-	1	1.1	-	-	-	-	-	-	1	1.1
3	-	-	17	18.3	-	-	-	-	-	-	17	18.3
4	-	-	19	20.4	-	-	-	-	-	-	19	20.4
5	-	-	7	7.5	-	-	-	-	-	-	7	7.5
6	-	-	7	7.5	-	-	-	-	-	-	7	7.5
7	-	-	5	5.4	-	-	-	-	-	-	5	5.4
8	-	-	7	7.5	-	-	-	-	-	-	7	7.5
9	-	-	5	5.4	-	-	-	-	-	-	5	5.4
10	-	-	3	3.2	-	-	-	-	-	-	3	3.2
11	-	-	4	4.3	-	-	-	-	-	-	4	4.3
12	-	-	2	2.2	-	-	-	-	-	-	2	2.2
13	-	-	4	4.3	-	-	-	-	-	-	4	4.3
14	-	-	1	1.1	-	-	-	-	-	-	1	1.1
15	-	-	4	4.3	-	-	-	-	-	-	4	4.3
16	-	-	3	3.2	-	-	-	-	-	-	3	3.2
17	-	-	1	1.1	-	-	-	-	-	-	1	1.1
18	-	-	3	3.2	-	-	-	-	-	-	3	3.2
Total	3		93		-		-		3		93	

Table 1.--Age and sex, by month and area, of fur seals collected pelagically by the U.S.A. in 1965--Continued

Age	California				Washington				Total			
	Male		Female		Male		Female		Male		Female	
Years	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
						Combined totals						
1	5	50.0	4	1.5	6	31.6	6	4.6	11	37.9	10	2.6
2	-	-	6	2.3	3	15.8	2	1.6	3	10.3	8	2.1
3	2	20.0	31	12.0	8	42.1	20	15.6	10	34.5	51	13.2
4	3	30.0	46	17.7	2	10.5	27	21.1	5	17.2	73	18.8
5	-	-	15	5.8	-	-	8	6.2	-	-	23	5.9
6	-	-	19	7.3	-	-	18	14.0	-	-	37	9.6
7	-	-	12	4.6	-	-	12	9.4	-	-	24	6.2
8	-	-	17	6.6	-	-	16	12.5	-	-	33	8.5
9	-	-	14	5.4	-	-	3	2.3	-	-	17	4.4
10	-	-	8	3.1	-	-	2	1.6	-	-	10	2.6
11	-	-	14	5.4	-	-	4	3.1	-	-	18	4.6
12	-	-	14	5.4	-	-	1	0.8	-	-	15	3.8
13	-	-	8	3.1	-	-	-	-	-	-	8	2.1
14	-	-	9	3.5	-	-	1	0.8	-	-	10	2.6
15	-	-	12	4.6	-	-	2	1.6	-	-	14	3.6
16	-	-	10	3.9	-	-	2	1.6	-	-	12	3.1
17	-	-	9	3.5	-	-	1	0.8	-	-	10	2.6
18	-	-	6	2.3	-	-	2	1.6	-	-	8	2.1
19	-	-	2	0.8	-	-	-	-	-	-	2	0.5
20	-	-	1	0.4	-	-	1	0.8	-	-	2	0.5
21	-	-	1	0.4	-	-	-	-	-	-	1	0.3
23	-	-	1	0.4	-	-	-	-	-	-	1	0.3
Total	10		259		19		128		29		387	

Table 2.--Age and sex of fur seals collected pelagically off California, by month[1/]

[Combined data for 1958, 1959, 1961, 1964, and 1965]

Month	Seals collected	Males[2/]		Females		Females			
						Ages 1-4		Ages 5-20+	
	Number	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Jan.	546	4	0.7	542	99.3	53	9.8	489	90.2
Feb.	1,194	2	0.2	1,192	99.8	103	8.6	1,089	91.4
Mar.	611	5	0.8	606	99.2	90	14.9	516	85.1
Apr.	474	26	5.5	448	94.5	98	21.9	350	78.1
May	332	18	5.4	314	94.6	97	30.9	217	69.1
June	96	3	3.1	93	96.9	37	39.8	56	60.2

1/ Data for 1958, 1959, and 1961 from North Pacific Fur Seal Commission (1964); data for 1964 from Fiscus and Kajimura (1965).

2/ All males are age 4 or less, except one 5-year-old collected in 1964.

Table 3.--Tag recoveries from fur seals collected pelagically by the U.S.A. in 1965

[Figures in parentheses indicate animals that had lost tags; they are included in the totals.]

Age	Year of tagging	Tag series	Locality of tag recovery, and sex					Seals collected in each age group 1/	
			Seals tagged	California		Washington			
				♂	♀	♂	♀	♂	♀
Years			No.	No.	No.	No.	No.	No.	No.
1	1964	Q	24,991	1	-	-	-	11	10
2	1963	P	24,971	-	-	-	-	3	8
3	1962	O	49,908	1(1)	2	1(1)	2(1)	10	51
4	1961	N	49,921	-	4(1)	1	5(2)	5	73
5	1960	M	59,981	-	1	-	-	-	23
6	1959	L	49,881	-	-	-	1(1)	-	37
11	1954	G	10,000	-	1	-	-	-	18

1/ Table does not include seals born in years when no tagging was done, or year classes from which no tagged seals were taken.

Reproductive condition.--Of the females collected off California and Washington in 1965, 45 percent were nulliparous, 12 percent were nonpregnant primiparous and multiparous, and 44 percent were pregnant (tables A-12 and A-13). The youngest pregnant females taken were three primiparous 5-year-olds.

Pregnancy rate.--The number of female seals (and the percentage pregnant) collected in the eastern Pacific from 1958 to 1965 are shown in table 4; records for 1965 are given by area and month in table A-14.

Data on pregnancy rates are necessary for making population estimates and for determining the effects of a reduction in size of the herd. For example, the low pregnancy rates of 3- and 4-year-old females may increase now that killing of females on the Pribilof Islands has reduced the herd to the approximate level of maximum sustained yield. Pregnancy rates representative of the population cannot be accurately determined from animals taken on the Pribilof Islands because the females segregate by reproductive condition when on land (Roppel, Johnson, Anas, and Chapman, 1965). Therefore, knowledge of variation in rates among females taken at sea, by year, season, and area, is important as a basis for determining pregnancy rates representative of the total population.

Regardless of area or season of collection, the total annual samples show little variation in pregnancy rates among females in ages 7-13 during the period 1958-65. The variation increased among 6-year-old females, and at age 5 the pregnancy rate in different years ranged from 21 to 56 percent (mean 39 percent). These variations are unexplained.

Uterine horn of conception and fetal sex ratio.--The uterus of the female fur seal is bicornuate. One uterine horn carries a conceptus one year and the other horn carries a conceptus the following year unless the female fails to conceive one or more years. Examination of 5,057 pregnant females collected since 1958 shows that 51.3 percent of the fetuses were carried in the left uterine horn. This difference, together with the necessity of alternating horns in order to conceive each year, means that the first conception, or conceptions that occur following an interruption, must be most frequently in the left uterine horn.

Of 4,369 fetuses collected in 1958-65, 49.2 percent were males and 50.8 percent were females.

Attached Organisms (Commensals)

Algae and gooseneck barnacles are commonly found on the guard hairs of seals that have been at sea for an extended period. Of 270 seals collected off California in 1965, algae were attached to the guard hairs of 42.2 percent, barnacles 33.3 percent, and both algae and barnacles on 18.1 percent (table 5). The amount of algae ranged from a few spots to almost complete coverage of the animal.

Table 4.--Number of female seals collected pelagically by the U. S. A. in the eastern Pacific and (in parentheses) percentage pregnant, 1958-65

Age Years	Year								1958-65 combined
	1958	1959	1960	1961	1962	1963	1964	1965	
3	39 (2.6)	43 (0.0)	18 (0.0)	84 (0.0)	93 (1.1)	53 (0.0)	74 (0.0)	51 (0.0)	455 (0.4)
4	42 (2.4)	93 (6.4)	36 (2.8)	96 (1.0)	140 (2.9)	113 (7.1)	62 (1.6)	73 (0.0)	655 (3.4)
5	70 (45.7)	114 (56.1)	55 (49.1)	68 (20.6)	123 (26.0)	162 (43.8)	84 (35.7)	23 (26.1)	699 (39.5)
6	99 (80.8)	118 (77.1)	45 (80.0)	62 (75.8)	72 (54.2)	90 (74.4)	81 (75.3)	37 (56.8)	604 (73.2)
7	103 (89.3)	143 (76.2)	66 (78.8)	95 (75.8)	93 (84.9)	77 (88.3)	44 (77.3)	24 (79.2)	645 (81.4)
8	102 (89.2)	164 (86.6)	105 (85.7)	107 (79.4)	98 (89.8)	87 (97.7)	46 (84.8)	33 (84.8)	742 (87.3)
9	81 (96.3)	108 (88.9)	144 (92.4)	114 (93.9)	73 (83.6)	60 (85.0)	30 (83.3)	17 (70.6)	627 (89.8)
10	97 (87.6)	96 (85.4)	129 (91.5)	112 (93.8)	100 (89.0)	72 (93.1)	49 (87.8)	10 (90.0)	665 (89.9)
11	113 (92.0)	98 (89.8)	136 (91.2)	82 (89.0)	91 (89.0)	88 (94.3)	42 (85.7)	18 (83.3)	668 (90.4)
12	134 (82.0)	76 (88.2)	106 (90.6)	71 (93.0)	97 (89.7)	92 (92.4)	51 (84.3)	15 (73.3)	642 (88.0)
13	110 (82.7)	56 (89.3)	120 (87.5)	76 (82.9)	58 (94.8)	76 (90.8)	33 (84.8)	8 (100.0)	537 (87.3)
14	92 (81.5)	70 (84.3)	107 (80.4)	67 (92.5)	65 (87.7)	57 (80.7)	38 (76.3)	10 (80.0)	506 (83.4)
15	71 (78.9)	87 (88.5)	67 (83.6)	68 (79.4)	53 (81.1)	75 (85.3)	41 (65.9)	14 (78.6)	476 (81.5)
16	56 (78.6)	69 (75.4)	53 (71.7)	55 (85.5)	50 (82.0)	45 (82.2)	22 (72.7)	12 (83.3)	362 (78.7)
17	36 (55.6)	36 (80.6)	46 (67.4)	24 (62.5)	44 (72.7)	28 (71.4)	21 (61.9)	10 (80.0)	245 (68.6)
18	22 (59.1)	27 (85.2)	23 (82.6)	25 (64.0)	25 (72.0)	12 (58.3)	20 (60.0)	8 (37.5)	162 (68.5)
19	14 (28.6)	16 (81.3)	19 (57.9)	10 (50.0)	15 (60.0)	5 (60.0)	7 (57.1)	2 (0.0)	88 (55.7)
20	3 (33.3)	5 (40.0)	6 (16.7)	7 (100.0)	11 (72.7)	11 (45.5)	10 (20.0)	2 (0.0)	55 (47.3)
21	1 (100.0)	7 (85.7)	6 (50.0)	2 (50.0)	3 (100.0)	4 (50.0)	- -	1 (0.0)	24 (66.7)
22	1 (0.0)	5 (40.0)	- -	- -	3 (66.7)	- -	- -	- -	9 (44.4)
23	- -	1 (0.0)	1 (0.0)	1 (0.0)	- -	2 (0.0)	1 (100.0)	1 (0.0)	7 (14.3)
24	- -	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	- -	- -	- -	4 (0.0)
26	- -	1 (0.0)	- -	- -	- -	- -	- -	- -	1 (0.0)
Total	1,286 (76.1)	1,434 (73.8)	1,289 (79.7)	1,227 (68.5)	1,308 (63.4)	1,209 (69.3)	756 (58.7)	369 (45.8)	8,878 (69.6)
6-26 years	1,135 (83.3)	1,184 (83.4)	1,180 (84.4)	979 (84.3)	952 (83.2)	881 (86.0)	536 (78.9)	222 (73.4)	7,069 (83.2)

Table 5.--Number and percentage of seals collected off California in 1965 with algae or barnacles growing on guard hairs

Month	Seals collected	Algae		Barnacles		Algae and barnacles	
	Number	Number	Percent	Number	Percent	Number	Percent
April....	46	13	28.3	7	15.2	1	2.2
May.....	128	63	49.2	40	31.3	27	21.1
June.....	96	38	39.6	43	44.8	21	21.9
Total	270	114	42.2	90	33.3	49	18.1

Algae grew most frequently on the throat, nape, and back. Barnacles were most frequently attached to guard hairs on the ear pinna, nape, and back. The number of barnacles found on individual seals ranged from 1 to 42; size of capitulum ranged from 1 to 15 mm.

Algae identified as Ectocarpus spp. were taken from seals collected in 1964 in the same area and at the same time of year as in 1965. The algae collected in 1965 were not identified.

Lepas pectinata pacifica was identified on 85 seals and L. anatifera on 9. Both species were growing on eight seals. Legas spp. (?) were found on four seals. Cypris stages of L. p. pacifica were present on 15 seals.[4]

Food

Fur seals feed on a variety of fishes and cephalopods. Reports on the food and feeding of fur seals in the eastern North Pacific and Bering Sea were given by: Lucas (1899); Scheffer (1950); Taylor, Fujinaga, and Wilke (1955); North Pacific Fur Seal Commission Report on Investigations from 1958 to 1961 (1964); Fiscus, Baines, and Wilke (1964); Fiscus, Baines, and Kajimura (1965); and Fiscus and Kajimura (1965).

In 1965, 416 stomachs taken from seals collected in waters off Washington (147) and California (269) were examined: 324 or 78 percent (67 percent off Washington and 84 percent off California) contained food. Of these, however, 136 contained only trace amounts[5] of food (Washington 56, California 80).

Fish and cephalopods found in the stomachs of fur seals were identified by comparison with preserved whole specimens and skeletons, and by using identification keys prepared by Andriashev (1937, 1954); Berry (1912, 1914); Clemens and Wilby (1961); Clothier (1950); Fraser-Brunner (1949); Hitz (1965); Phillips (1957, 1964); Roedel (1953); Sasaki (1929); Schultz (1936); and Wilimovsky (1958).[6] Whenever possible, vertebral counts were made to aid in identification of unknown fish found in fur seal stomachs. Lengths and weights of whole fish and squids were measured for use in studies of size of food species taken and stomach capacity of fur seals.

New species of fish or squid are added to the list of fur seal food almost every year. In 1965, Moroteuthis robusta is reported for the first time as fur seal food. The major food species usually remain the same in a given area, but their rank may change from year to year and from season to season. Observations at sea and examination of stomach contents during the past 8 years (1958-65) show that fur seals feed primarily between dusk and dawn. Food species occurring in fur seal stomachs are shown in figures A-1 to A-8. The detailed results of stomach contents are shown in tables 6 and 7. Figure 4 shows the percentage volume and percentage occurrence of food items that contributed more than 2 percent of the total food volume in each of the areas.

The numbers of stomachs collected off California and Washington since 1958 are as follows:

	1958	1959	1961	1964	1965
Washington	83	230	382	28	147
California	470	1,263	847	305	269

The following fishes and cephalopods were found in fur seal stomachs examined in 1965. The common and scientific names of fish are from the list (where applicable) published by the American Fisheries Society (1960). Cephalopod names are those used by Berry (1912, 1914) and Sasaki (1929).

Lampetra tridentata. Pacific lampreys were found in the stomachs of five seals collected off Washington in 1965 (fig. A-1); this species was also in the stomachs of three seals collected off Grays Harbor, Wash., in 1961.[7]

Clupeidae. Vertebral fragments of fish belonging to this family were in the stomachs of two fur seals collected off California (fig. A-2). Pacific herring (Clupea harengus pallasi) were identified in the stomachs of four seals taken off California and in the stomachs of five taken off Washington (fig. A-3). Pacific herring is not an important fur seal food off the California and Washington coasts (North Pacific Fur Seal Commission, 1964; Fiscus and Kajimura, 1965).

Engraulis mordax. Northern anchovy ranked third in total food volume and fifth in frequency off California; off Washington it was first in

[4] Identification of 39 barnacle samples was verified by Dora P. Henry, Oceanography Department, University of Washington.

[5] Trace amount = a stomach containing less than 5 cc. of food.

[6] N. J. Wilimovsky. 1958. Provisional keys to the fishes of Alaska. Bureau of Commercial Fisheries Biological Laboratory, Juneau, Alaska. 113 p. [Processed manuscript.]

[7] Clifford H. Fiscus, Karl Niggol, and Ford Wilke. 1961. Pelagic fur seal investigations, California to British Columbia, 1961. Bureau of Commercial Fisheries, Marine Mammal Biological Laboratory, Seattle, Wash. [Processed, 87 p.]

Table 6.--Stomach contents of fur seals collected off California, 1965[1]

Food	Spring April-May			Summer June			Combined total		
	Volume		Frequency	Volume		Frequency	Volume		Frequency
	Cc.	Percent	Number	Cc.	Percent	Number	Cc.	Percent	Number
Fish:									
Clupeidae	--	--	--	5	0.0	2	5	0.0	2
Clupea harengus pallasi	47	0.1	4	--		--	47	0.0	4
Engraulis mordax	10,686	11.7	26	6,003	29.7	13	16,689	15.0	39
Myctophidae	5	0.0	1	--	--	--	5	0.0	1
Cololabis saira	2,857	3.1	7	433	2.1	7	3,290	3.0	14
Merluccius productus	36,049	39.6	49	4,653	23.1	21	40,702	36.7	70
Trachurus symmetricus	710	0.8	4	2,953	14.6	11	3,663	3.3	15
Sebastodes spp.	11,085	12.2	33	1,810	9.0	12	12,895	11.6	45
Anoplopoma fimbria	--	--	--	1,294	6.4	3	1,294	1.2	3
Pleuronectidae	645	0.7	2	--	--	--	645	0.6	2
Unidentified fish	143	0.2	41	14	0.1	40	157	0.1	81
Octopus:									
Tremoctopus sp.	T	--	1	--	--	--	T	--	1
Squid:									
Loligo opalescens	25,507	28.0	60	2,104	10.4	25	27,611	24.8	85
Onychoteuthis banksii	2,386	2.6	34	525	2.6	15	2,911	2.6	49
Moroteuthis robusta	129	0.1	1	--	--	--	129	0.1	1
Abraliopsis sp.	129	0.1	5	T	--	1	129	0.1	6
Gonatidae	5	0.0	16	T	--	9	5	0.0	25
Gonatus fabricii	T	--	13	46	0.2	4	46	0.0	17
G. magister	57	0.1	2	240	1.2	2	297	0.3	4
Gonatopsis borealis	258	0.3	1	116	0.6	1	374	0.3	2
Unidentified squid	T	--	2	T	--	5	T	--	7
Bird (feathers)	320	0.4	2	--	--	--	320	0.3	2
Organic material	T	--	1	--	--	--	T	--	1
Total	91,018	100.0		20,196	100.0		111,214	100.0	
Stomachs with food	145			81			226		
Stomachs empty	28			15			43		
	173			96			269		

[1] T = trace, (< 5 cc.). Trace counts are included in frequency counts.

volume and second in frequency. Seals taken off Monterey, Calif., and Grays Harbor, Wash., had fed on anchovy (fig. A-4).

Oncorhynchus spp. Salmon had been eaten by seven seals collected off Grays Harbor and by one taken off Cape Flattery, Wash. (fig. A-5). One stomach contained coho salmon, O. kisutch (1-year ocean growth), and another a chinook salmon, O. tshawytscha (2-year ocean growth).[8] Salmon ranked third in total food volume and fourth in frequency of occurrence; it was not found in the stomachs of seals collected off California.

Thaleichthys pacificus. Eulachon ranked second in volume and third in frequency off Washington. Nine of eleven occurrences were from seals taken off Cape Flattery (fig. A-3).

Myctophidae. A lanternfish was eaten by a fur seal collected in lat. 37° 49' N., long. 124° 11' W. (fig. A-1). Specific identification could not be made because many identifying photophores were missing. Lanternfishes are a minor food item of fur seals collected in the eastern Pacific Ocean, although they are the principal food of fur seals off Japan in spring.

Cololabis saira. Pacific saury (fig. A-6) ranked sixth in importance as a food species

Table 7.--Stomach contents of fur seals collected off Washington, 1965

Food	Spring April		
	Volume		Frequency
	Cc.[1]	Percent	Number
Fish:			
Lampetra tridentata	863	6.1	6
Clupea harengus pallasi	1,311	9.3	5
Engraulis mordax	6,717	47.6	20
Oncorhynchus spp.	1,590	11.3	8
Thaleichthys pacificus	2,506	17.7	11
Merluccius productus	T	--	1
Gasterosteus aculeatus	813	5.8	7
Sebastodes spp.	244	1.7	1
Anoplopoma fimbria	30	0.2	1
Unidentified fish	10	0.1	39
Squid:			
Loligo opalescens	33	0.2	21
Gonatidae	T	--	1
Gonatus fabricii	T	--	2
Unidentified squid	T	--	2
Bird (feather)	T	--	1
Pebbles	--	--	3
Organic material	--	--	2
Total	14,117	100.0	
Stomachs with food	98		
Stomachs empty	49		
	147		

[1] T=trace, (< 5 cc.). Trace counts are included in frequency counts.

[8] The salmon were identified from scales by Raymond E. Anas, Bureau of Commercial Fisheries, Marine Mammal Biological Laboratory, Seattle, Wash.

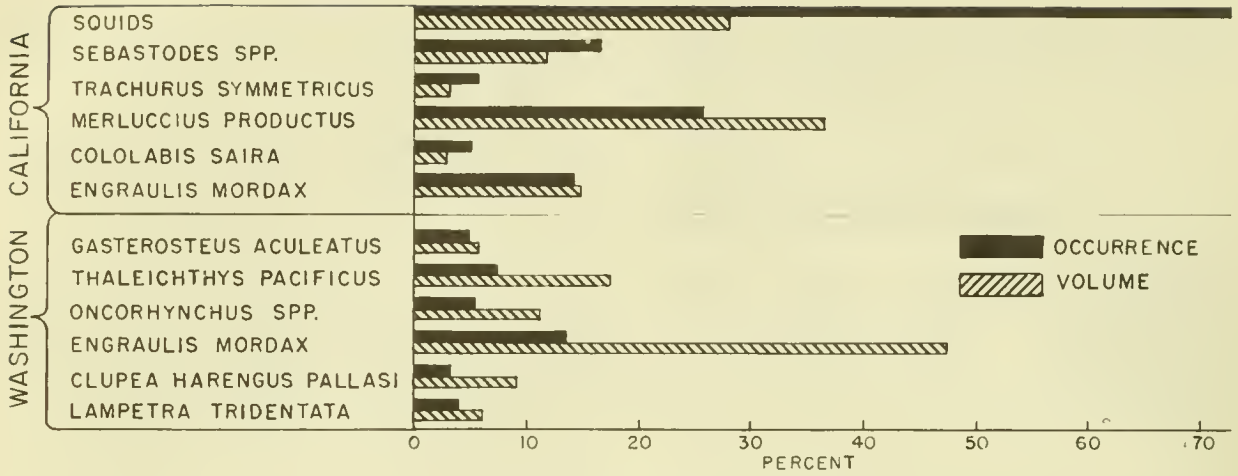

Figure 4.--Percentage of stomach content volume and percentage occurrence of principal food species in fur seal stomachs, by area, in 1965.

off California. Sixty-three saury formed 53 percent of the total volume in one stomach. Lengths of four specimens ranged from 21 to 27 cm.

Merluccius productus. Pacific hake occurred in the stomachs of 70 fur seals collected off California and 1 off Washington (fig. A-7). It ranked first in total volume of food (36.7 percent) and second in frequency off California, where it also had been a major food item in past years. At times fur seals were feeding mostly on hake near the Farallon Islands and off Monterey, Calif.; one stomach contained the remains of 31.

Gasterosteus aculeatus. Threespine sticklebacks occurred in the stomachs of seven fur seals collected off Cape Flattery, Wash., and formed 5.8 percent of the total food volume. The one previous occurrence in fur seal stomachs was in 1959 from the same general area (fig. A-6). Canadian biologists have frequently found this species in the stomachs of seals taken off Vancouver Island (North Pacific Fur Seal Commission, 1964).

Trachurus symmetricus. Jack mackerel ranked fifth in volume of food (3.3 percent) off California and were found in 15 stomachs (fig. A-1).

Sebastodes spp. Rockfish ranked fourth in both volume (11.6 percent) and frequency (45) off California. All rockfish from California were juveniles (vertebral length from 47 to 99 mm.). They were most numerous in stomachs from seals collected off Monterey (fig. A-8). One stomach contained 137 small rockfish. Adult rockfish (according to size of vertebrae) occurred once in the stomach of a fur seal collected off Washington.

Anoplopoma fimbria. Sablefish were found in three fur seals collected off California and one off Washington (fig. A-8). They have been a minor food of seals off California and Washington (North Pacific Fur Seal Commission, 1964; Fiscus and Kajimura, 1965).

Pleuronectidae. Flatfish of this family were in two seals collected off California (fig. A-6).

Tremoctopus sp. The remains of a small pelagic octopus was in the stomach of a seal collected off California in lat. 38° 00' N., long. 124° 35' W. (fig. A-6). This octopus was found in the stomachs of 28 seals collected south of Pt. Sur, Calif. in 1961.[9]

Squids. Squids are one of the main foods of fur seals in the eastern North Pacific. They ranked first in frequency of occurrence off both California (196) and Washington (26); and second in total food volume off California (28.2 percent) and eighth off Washington (0.2 percent). Squid bodies are easily digested by fur seals. Squid beaks and pens, which are not digested and remain in the stomachs long after the bodies are digested, are listed as trace amounts when no body fragments remain.

The following squids from fur seal stomachs were identified: Loligo opalescens, Onychoteuthis banksii, Moroteuthis robusta, Abraliopsis sp., Gonatus fabricii, G. magister, and Gonatopsis borealis (figs. A-1 to A-5).

L. opalescens ranked first in frequency of occurrence and second in total volume of food off California (first in total volume among squids). Most of these squids were found in the stomachs of seals collected off Monterey, the Farallon Islands, and Pt. Reyes, Calif.; it ranked first in frequency of occurrence off Washington.

O. banksii occurred in the stomachs of 49 seals collected off California and ranked second in importance among squids. One stomach contained the remains of eight squids.

[9] See footnote 7.

The remains of M. robusta were found in the stomach of a fur seal collected about 25 miles west of the Farallon Islands on 21 May 1965. This is the second specimen identified from fur seal stomachs. The first, also taken off California, was obtained in 1961 but not identified until comparative material became available in 1962.

M. robusta is an important food of sperm whales off central California (Rice, 1963), but because of its large size is probably not regularly eaten by fur seals. The cartilaginous end cone of the pens from two whole specimens in our reference collection approximated one-fourth of their dorsal mantle length (DML). The end cone found in 1965 measured 150 mm., indicating a DML of about 600 mm. A squid of this size cannot be swallowed whole. Fragments of flesh were found in addition to the end cone. Beaks or additional parts of the pen were not found.

Abraliopsis sp. was of minor importance (seven occurrences) in 1965. Two stomachs contained fragments and beaks of 70 and 97 squids each. This squid was in stomachs of seals collected in the same general area in 1961.[10]

Three gonatids identified in 1965 were: Gonatus fabricii (California 17, Washington 2); G. magister (California 4); and Gonatopsis borealis (California 2).

Miscellaneous. Unidentified bird feathers were in the stomachs of two fur seals collected off California (the volume of feathers in one was 320 cc.) and in one collected off Washington. Other items were: pebbles (4-6 mm. diam.) in three stomachs; small fragments of wood (largest 1 cm. by 1 cm.) in two stomachs; and a piece of kelp in one stomach.

Relation of Fur Seals to Commercial Fisheries

The effect of predation by fur seals on various species of commercially important fishes and cephalopods cannot be determined without adequate knowledge of the distribution and abundance of each prey species, the extent to which these species are utilized by other predators, and the extent to which other predators of the prey species are removed by fur seals. Detailed knowledge of the ocean environment and its influence on fish populations is also needed if the effects of fur seals on commercially important species of fish are to be accurately appraised. Data collected to date indicate that fur seals feed heavily on the most readily available fishes or cephalopods.

To show the degree to which fur seals use commercially important fishes off California, the species found in the stomachs may be compared with those that support the fishery. The 10 leading fish and shellfish in the California commercial fishery, listed in the order of pounds landed in 1963 (California Department of Fish and Game, 1965), were: Trachurus symmetricus (jack mackerel); Thunnus alalunga (albacore); Scomber japonicus [diego] (Pacific mackerel); Loligo opalescens (squid); all species of Sebastodes and Sebastolobus (rockfish); Microstomus pacificus (Dover sole); Oncorhynchus kisutch and O. tshawytscha (salmon); Sardinops sagax (sardine); Thunnus thynnus (bluefin tuna); and Engraulis mordax (northern anchovy). Four of the ten commercially important species were found in fur seal stomachs: jack mackerel (3.3 percent of the total food volume in seal stomachs), squid (24.8 percent), rockfish (11.6 percent), and northern anchovy (15.0 percent). Almost no fishing for these species, however, is done in the offshore waters where fur seals feed. Pacific hake, which formed 36.7 percent of the total food volume in seal stomachs, are of little commercial value in California.

The most important commercial fish taken by fur seals collected off Washington were salmon, which occurred in 8 of 147 stomachs. Off Grays Harbor, Wash., fur seals were common in an area where salmon trollers were fishing.

No valid conclusion about the relation of fur seals to commercial fisheries can be drawn from the data available. Considering the volume and frequency of occurrence of commercially important food species in fur seal stomachs examined in 1965, predation by fur seals on commercial species of fish is not a cause for alarm.

SUMMARY

The United States has conducted pelagic research on fur seals since 1958 in cooperation with Canada, Japan, and the U.S.S.R. under the terms of the Interim Convention on Conservation of the North Pacific Fur Seals. In 1965, observations and collections were made off Washington 2-24 April and off central California 11 April to 23 June, by two chartered purse seine vessels.

Seals were widely scattered off Cape Flattery, Wash., in early April, but a concentration was located off Grays Harbor, Wash., in mid-April. Of 147 seals taken off Washington, only 19 were males. In California waters, seals were most numerous off Monterey and near Cordell Bank west of Pt. Reyes; 10 of 269 collected were males.

To study distribution and migration of fur seals off California, transect lines extending 10 to 80 miles offshore were established at 20-mile intervals between Bodega Head and Pt. Sur. Seals were counted along these lines each month. Seals were most abundant 30 to 40 miles offshore, and decreased gradually out to 80 miles.

[10] See footnote 7.

The number of seals seen off California decreased from April to June as a result of the northward migration of pregnant seals. This decrease was not apparent off Washington in April when the survey ended near the peak of migration.

As in other years, males formed only a small proportion of the total number of fur seals wintering off California.

Twenty tagged seals (including seven that had lost their tags) were collected in 1965.

Of 387 females collected in 1965, 45 percent were nulliparous, 12 percent were nonpregnant primiparous or multiparous, and 44 percent were pregnant. Three primiparous 5-year-olds were the youngest pregnant seals taken.

Data collected since 1958 on 5,057 pregnant females show that 51.3 percent of the pregnancies occurred in the left uterine horn; the first pregnancy occurs more frequently in that horn.

Male and female fetuses were about equally represented (50.8 percent females) in 4,369 fetuses.

Algae were found growing on guard hairs of 114 seals (42.2 percent), and gooseneck barnacles on guard hairs of 90 seals (33.3 percent) collected off California in 1965.

In a given area, the major food species of fur seals usually remain the same, but their rank may change from year to year and season to season.

A squid, Moroteuthis robusta, was recorded for the first time as fur seal food.

Merluccius productus and Loligo opalescens were the major food species (by volume) in stomachs of fur seals taken off California.

Engraulis mordax and Thaleichthys pacificus were the major food species off Washington.

Miscellaneous objects in fur seal stomachs included bird feathers, pebbles, small fragments of wood, and kelp.

The volume and frequency of occurrence of commercially important food species in fur seal stomachs give no cause for alarm about predation on commercial species of fish.

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APPENDIX A

Table A-1.--Distribution and migration studies: seals observed along transects, 1965

[- = no observations; 0 = no seals observed. The transect in lat. 36° 20' N. was not run in May.]

Distance from shore	Transect																	Total seals observed per distance unit
	38° 00' N.			37° 40' N.			37° 20' N.			37° 00' N.			36° 40' N.			36° 20' N.		
	Date																	
	16 Apr.	13 May	14 June	17 Apr.	12 May	14 June	18 Apr.	11-12 May	16 June	19 Apr.	11 May	16-17 June	20 Apr.	10 May	18 June	21 Apr.	18-19 June	
Miles	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
0-10	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	0	0	0
10-20	16	0	0	1	-	-	0	0	0	0	4	2	0	0	0	1	1	25
20-30	12	3	1	1	-	0	4	1	0	7	7	2	1	4	0	6	3	52
30-40	10	20	4	11	0	0	2	0	3	9	8	5	41	12	0	9	0	134
40-50	19	2	2	28	1	7	2	2	11	4	8	0	2	1	1	1	1	92
50-60	13	1	6	5	1	4	2	2	1	7	3	1	14	14	0	2	0	76
60-70	11	3	-	5	3	14	7	9	-	1	0	3	8	10	0	1	0	75
70-80	-	-	-	-	9	0	0	1	-	1	0	-	-	-	-	-	0	11
Total	81	29	13	51	14	25	17	15	15	29	30	13	66	41	1	20	5	465

Total seals observed: 16-21 April--264
10-13 May 129
14-19 June 72

Table A-2.--Number and relative abundance of seals seen, by 10-day periods, off California and Washington, 2 April to 23 June 1965

Area and period	Boat-hunting days[1]	Total seals seen	Seals seen per boat-hunting day	Seals seen per 10-day interval
	Number	Number	Number	Percent
California:				
Apr.:				
11-20	7.25	337	46.5	30.3
21-30	4.00	106	26.5	9.5
May:				
1-10	3.75	117	31.2	10.5
11-20	5.25	139	26.5	12.5
21-31	8.00	182	22.8	16.3
June:				
1-10	6.00	106	17.7	9.5
11-20	5.75	91	15.8	8.2
21-30	3.00	36	12.0	3.2
Total	43.00	1,114	25.9	100.0
Washington:				
Apr.:				
1-10	8.75	110	12.6	21.4
11-20	4.00	147	36.8	28.7
21-30	4.00	256	64.0	49.9
Total	16.75	513	30.6	100.0
All regions:				
Total	59.75	1,627		

[1] A boat-hunting day is a day in which a vessel is used for 8 hours or more; units of boat-hunting days are 0.25, 0.50, 0.75, and 1.00.

Table A-3.--Number and relative abundance of seals collected, by 10-day periods, off California and Washington, 2 April to 23 June 1965

Area and period	Boat-hunting days[1]	Seals collected			Seals collected per boat-hunting day	
		Males	Females	Total		
	Number	Number	Number	Number	Number	Percent
California:						
Apr.:						
11-20	3.75	2	26	28	7.5	10.4
21-30	3.00	--	18	18	6.0	6.7
May:						
1-10	3.50	3	23	26	7.4	9.6
11-20	2.75	1	23	24	8.7	8.9
21-31	8.00	1	77	78	9.8	28.8
June:						
1-10	6.00	1	64	65	10.8	24.1
11-20	2.50	2	5	7	2.8	2.6
21-30	3.00	--	24	24	8.0	8.9
Total	32.50	10	260	270	8.3	100.0
Washington:						
Apr.:						
1-10	8.75	11	21	32	3.7	21.5
11-20	4.00	6	41	47	11.8	31.5
21-30	4.00	2	68	70	17.5	47.0
Total	16.75	19	130	149	8.9	100.0
All regions:						
Total	49.25	29	390	419		

[1] A boat-hunting day is a day in which a vessel is used for 8 hours or more; units of boat-hunting days are 0.25, 0.50, 0.75, and 1.00.

Table A-4.--Number of seals per group among 1,627 seals sighted off California and Washington, 2 April to 23 June 1965

Area	Number of seals in group									Total
	1	2	3	4	5	6	7	8	9	
California:										
Number of groups	563	132	53	18	7	1	1	1	--	776
Number of seals	563	264	159	72	35	6	7	8	--	1,114
Percent of seals	50.6	23.7	14.3	6.5	3.1	0.5	0.6	0.7	0.0	100.0
Washington:										
Number of groups	162	65	26	12	8	5	1	--	2	281
Number of seals	162	130	78	48	40	30	7	--	18	513
Percent of seals	31.6	25.3	15.2	9.4	7.8	5.8	1.4	0.0	3.5	100.0
Combined Areas:										
Number of groups	725	197	79	30	15	6	2	1	2	1,057
Number of seals	725	394	237	120	75	36	14	8	18	1,627
Percent of seals	44.5	24.2	14.6	7.4	4.6	2.2	0.9	0.5	1.1	100.0

Table A-5.--Monthly mean lengths of pregnant fur seals collected pelagically by the U.S.A. in the eastern Pacific in 1965

Age	April		May		June		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean length	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
5	4	120.0	1	120.0	1	124.0	6	120.7	3.0
6	14	118.6	4	123.0	3	126.3	21	120.6	4.5
7	11	124.4	4	122.8	4	128.8	19	125.0	3.5
8	16	126.8	9	123.4	3	130.3	28	126.1	4.5
9	4	125.5	4	126.5	4	126.7	12	126.2	3.2
10	4	127.8	2	128.5	3	126.3	9	127.4	3.1
11	6	125.0	6	129.0	3	127.3	15	127.1	5.8
12	4	130.8	5	126.2	2	130.0	11	128.5	4.6
13	1	117.0	3	130.0	4	130.8	8	128.8	6.3
14	2	133.0	5	130.0	1	134.0	8	131.2	5.2
15	1	129.0	7	130.8	3	123.3	11	128.6	4.6
16	3	133.0	4	129.2	3	127.0	10	129.7	3.9
17	3	130.7	5	132.2	-	-	8	131.6	3.0
18	1	126.0	1	134.0	1	129.0	3	129.7	4.0
Total	74		60		35		169		

Table A-6.--Monthly mean weights of pregnant fur seals collected pelagically by the U.S.A. in the eastern Pacific in 1965

Age	April		May		June		Combined weight		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
5	4	29.8	1	26.0	1	31.0	6	29.3	3.4
6	14	31.2	4	39.0	3	41.3	21	34.1	5.1
7	11	35.6	4	37.2	4	43.2	19	37.6	4.4
8	16	34.4	9	38.6	3	42.7	28	36.6	4.4
9	4	36.2	4	39.2	4	42.5	12	39.3	3.8
10	4	39.5	2	46.0	3	43.3	9	42.2	3.7
11	6	37.3	6	46.3	3	44.0	15	42.3	5.1
12	4	43.5	5	43.6	2	48.0	11	44.4	5.6
13	1	33.0	3	47.7	4	49.0	8	46.5	6.4
14	2	44.5	5	48.8	1	57.0	8	48.8	5.6
15	1	43.0	7	49.0	3	46.7	11	47.8	4.1
16	3	43.3	4	47.0	3	46.3	10	45.7	4.2
17	3	45.0	5	52.6	-	-	8	49.8	5.7
18	1	44.0	1	56.0	1	48.0	3	49.3	6.1
Total	74		60		35		169		

Table A-7. --Monthly mean lengths of nonpregnant female fur seals collected pelagically by the U.S.A. in the eastern Pacific in 1965

Age.	April		May		June		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
1	7	76.6	3	77.0	-	-	10	76.7	2.9
2	5	89.6	2	93.0	1	96.0	8	91.2	2.9
3	23	99.9	11	101.4	17	103.0	51	101.3	3.7
4	33	109.4	21	110.0	19	110.8	73	109.9	4.1
5	6	117.0	5	110.0	6	118.0	17	115.3	5.8
6	9	117.2	3	115.7	4	120.0	16	117.6	4.7
7	3	122.0	1	120.0	1	125.0	5	122.2	4.6
8	1	122.0	-	-	4	125.8	5	125.0	5.2
9	2	121.5	1	116.0	1	118.0	4	119.2	3.4
10	1	117.0	1	134.0	-	-	2	125.5	12.0
11	1	129.0	-	-	-	-	1	129.0	0.0
12	1	118.0	2	130.5	-	-	3	126.3	7.6
13	-	-	1	125.0	1	129.0	2	127.0	2.8
14	1	131.0	2	125.5	-	-	3	127.3	3.5
15	-	-	1	123.0	-	-	1	123.0	0.0
16	1	121.0	-	-	1	124.0	2	122.5	2.1
17	1	131.0	2	130.5	2	124.0	5	128.0	4.6
18	1	126.0	1	133.0	-	-	2	129.5	4.9
19	-	-	3	130.7	-	-	3	130.7	2.9
20	1	125.0	-	-	1	135.0	2	130.0	7.1
21	-	-	2	128.5	-	-	2	128.5	3.5
23	-	-	1	128.0	-	-	1	128.0	0.0
Total	97		63		58		218		

Table A-8. --Monthly mean weights of nonpregnant female fur seals collected pelagically by the U. S. A. in the eastern Pacific in 1965

Age	April		May		June		Combined weights		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
1	7	7.7	3	8.7	-	-	10	8.0	1.6
2	5	12.4	2	14.0	1	14.0	8	13.0	1.2
3	23	16.3	11	17.5	17	17.6	51	17.3	2.4
4	33	20.5	21	20.8	19	22.3	73	21.0	2.5
5	6	25.3	5	22.2	6	26.2	17	24.7	2.5
6	9	24.9	3	25.3	4	27.2	16	25.6	2.5
7	3	29.3	1	28.0	1	32.0	5	29.6	1.8
8	1	32.0	-	-	4	31.8	5	31.8	3.1
9	2	29.5	1	27.0	1	26.0	4	28.0	2.2
10	1	31.0	1	46.0	-	-	2	38.5	10.6
11	1	32.0	-	-	-	-	1	32.0	0.0
12	1	28.0	2	37.0	-	-	3	34.0	5.6
13	-	-	1	43.0	1	37.0	2	40.0	4.2
14	1	47.0	2	36.0	-	-	3	39.7	7.0
15	-	-	1	32.0	-	-	1	32.0	0.0
16	1	30.0	-	-	1	36.0	2	33.0	4.2
17	1	45.0	2	46.0	2	38.5	5	42.8	5.8
18	1	35.0	1	45.0	-	-	2	40.0	7.1
19	-	-	3	44.0	-	-	3	44.0	2.0
20	1	35.0	-	-	1	49.0	2	42.0	9.9
21	-	-	2	42.0	-	-	2	42.0	4.2
23	-	-	1	37.0	-	-	1	37.0	0.0
Total	97		63		58		218		

Table A-9. --Monthly mean lengths of male fur seals collected pelagically by the U.S.A. in the eastern Pacific in 1965

Age	April		May		June		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean length	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
1	6	81.2	2	85.0	3	85.3	11	83.0	4.9
2	3	95.0	-	-	-	-	3	95.0	4.4
3	10	104.2	-	-	-	-	10	104.2	6.7
4	2	118.5	3	110.0	-	-	5	113.4	6.6
Total	21		5		3		29		

Table A-10. --Monthly mean weights of male fur seals collected pelagically by the U.S.A. in the eastern Pacific in 1965

Age	April		May		June		Combined length		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
1	6	9.5	2	13.0	3	12.0	11	10.8	2.3
2	3	13.0	-	-	-	-	3	13.0	2.6
3	10	19.4	-	-	-	-	10	19.4	1.9
4	2	27.0	3	24.3	-	-	5	25.4	1.8
Total	21		5		3		29		

Table A-11.--Monthly mean lengths and weights of fur seal fetuses collected pelagically by the U.S.A. in the eastern Pacific in 1965

Period	Male			Female		
	Fetuses	Mean length	Mean weight	Fetuses	Mean length	Mean weight
	Number	Cm.	Kg.	Number	Cm.	Kg.
Apr.:						
1-10	5	44.3	2.0	3	43.3	1.7
11-20	14	45.8	2.2	15	43.8	1.9
21-30	17	48.9	2.6	20	47.1	2.3
May:						
1-10	6	55.7	3.8	5	45.8	2.8
11-20	5	54.3	3.7	7	52.9	3.3
21-31	21	57.2	4.2	16	54.5	3.8
June:						
1-10	21	59.5	4.7	13	56.5	4.2
21-30	1	60.0	4.8	--	--	--
Total	90			79		

Table A-12.--Reproductive condition, by month, of female fur seals collected pelagically by the U. S. A. off California in 1965

Age	Nulliparous	Primiparous			Multiparous			Total
		Nonpregnant	Pregnant		Nonpregnant	Pregnant		
Years	Number	Number	Number	Percent	Number	Number	Percent	Number
				April				
1	1	-	-	-	-	-	-	1
2	3	-	-	-	-	-	-	3
3	3	-	-	-	-	-	-	3
4	6	-	-	-	-	-	-	6
5	2	-	-	-	-	-	-	2
6	2	-	2	100.0	-	1	100.0	5
7	-	-	2	100.0	-	-	-	2
8	-	-	-	-	-	1	100.0	1
9	-	-	-	-	2	2	50.0	4
10	-	-	-	-	-	2	100.0	2
11	-	-	-	-	-	4	100.0	4
12	-	-	-	-	-	3	100.0	3
13	-	-	-	-	-	1	100.0	1
14	-	-	-	-	-	2	100.0	2
15	-	-	-	-	-	-	-	-
16	-	-	-	-	1	1	50.0	2
17	-	-	-	-	-	2	100.0	2
Total	17	-	4		3	19		43
Percent				100.0			86.4	
				May				
1	3	-	-	-	-	-	-	3
2	2	-	-	-	-	-	-	2
3	11	-	-	-	-	-	-	11
4	21	-	-	-	-	-	-	21
5	5	-	1	100.0	-	-	-	6
6	1	2	-	-	-	4	100.0	7
7	-	1	1	50.0	-	3	100.0	5
8	-	-	1	100.0	-	8	100.0	9
9	-	-	-	-	1	4	75.0	5
10	-	-	-	-	1	2	66.6	3
11	-	-	-	-	-	6	100.0	6
12	-	-	-	-	4	5	55.5	9
13	-	-	-	-	-	3	100.0	3
14	-	-	-	-	1	5	83.3	6
15	-	-	-	-	1	7	87.5	8
16	-	-	-	-	1	4	80.0	5
17	-	-	-	-	1	5	83.3	6
18	-	-	-	-	2	1	33.3	3
19	-	-	-	-	2	-	-	2
20	-	-	-	-	1	-	-	1
21	-	-	-	-	1	-	-	1
23	-	-	-	-	1	-	-	1
Total	43	3	3		17	57		123
				50.0			77.0	
				June				
1	-	-	-	-	-	-	-	-
2	1	-	-	-	-	-	-	1
3	17	-	-	-	-	-	-	17
4	19	-	-	-	-	-	-	19
5	6	-	1	100.0	-	-	-	7
6	4	-	-	-	-	3	100.0	7
7	-	1	1	50.0	-	3	100.0	5
8	-	1	-	-	3	3	50.0	7
9	-	-	-	-	1	4	80.0	5
10	-	-	-	-	-	3	100.0	3
11	-	-	-	-	1	3	75.0	4
12	-	-	-	-	-	2	100.0	2
13	-	-	-	-	-	4	100.0	4
14	-	-	-	-	-	1	100.0	1
15	-	-	-	-	1	3	75.0	4
16	-	-	-	-	-	3	100.0	3
17	-	-	-	-	1	-	-	1
18	-	-	-	-	2	1	33.3	3
20	-	-	-	-	-	-	-	-
Total	47	2	2		9	33		93
				50.0			78.6	

Table A-13.--Reproductive condition of female fur seals collected pelagically by the U.S.A. off Washington in April 1965

Age	Nulliparous	Primiparous			Multiparous			Total
		Nonpregnant	Pregnant		Nonpregnant	Pregnant		
Years	Number	Number	Number	Percent	Number	Number	Percent	Number
1	6	-	-	-	-	-	-	6
2	2	-	-	-	-	-	-	2
3	20	-	-	-	-	-	-	20
4	27	-	-	-	-	-	-	27
5	4	-	3	100.0	-	1	100.0	8
6	5	2	6	75.0	-	5	100.0	18
7	2	-	3	100.0	1	6	85.7	12
8	-	-	4	100.0	1	11	91.7	16
9	-	-	-	-	1	2	66.7	3
10	-	-	-	-	-	2	100.0	2
11	-	-	-	-	2	2	50.0	4
12	-	-	-	-	-	1	100.0	1
13	-	-	-	-	-	-	-	-
14	-	-	-	-	1	-	-	1
15	-	-	-	-	1	1	50.0	2
16	-	-	-	-	-	2	100.0	2
17	-	-	-	-	-	1	100.0	1
18	-	-	-	-	1	1	50.0	2
19	-	-	-	-	-	-	-	-
20	-	-	-	-	1	-	-	1
Total	66	2	16	88.9	9	35	79.5	128

Table A-14.--Pregnancy rates of female seals collected pelagically by the U.S.A., by area and month, in 1965

Age	California									Washington			Combined data		
	April			May			June			April			Calif. 1965	Wash. 1965	1958-65 pelagic collections 1/
	Number	Number pregnant	Percent pregnant	Number	Number pregnant	Percent pregnant	Number	Number pregnant	Percent pregnant	Number	Number pregnant	Percent pregnant	Percent pregnant	Percent pregnant	Percent pregnant
3	3	0	0	11	0	0	17	0	0	20	0	0	0	0	0.4
4	6	0	0	21	0	0	19	0	0	27	0	0	0	0	3.4
5	2	0	0	6	1	16.7	7	1	14.3	8	4	50.0	13.3	50.0	39.5
6	5	3	60.0	7	4	57.1	7	3	42.8	18	11	61.1	52.6	61.1	73.2
7	2	2	100.0	5	4	80.0	5	4	80.0	12	9	75.0	83.3	75.0	81.4
8	1	1	100.0	9	9	100.0	7	3	42.8	16	15	93.8	76.5	93.8	87.3
9	4	2	50.0	5	4	80.0	5	4	80.0	3	2	66.7	71.4	66.7	89.8
10	2	2	100.0	3	2	66.6	3	3	100.0	2	2	100.0	87.5	100.0	89.9
11	4	4	100.0	6	6	100.0	4	3	75.0	4	2	50.0	92.8	50.0	90.4
12	3	3	100.0	9	5	55.6	2	2	100.0	1	1	100.0	71.4	100.0	88.0
13	1	1	100.0	3	3	100.0	4	4	100.0	-	-	-	100.0	-	87.3
14	2	2	100.0	6	5	83.3	1	1	100.0	1	0	0	88.8	0	83.4
15	-	-	-	8	7	87.5	4	3	75.0	2	1	50.0	83.3	50.0	81.5
16	2	1	50.0	5	4	80.0	3	3	100.0	2	2	100.0	80.0	100.0	78.7
17	2	2	100.0	6	5	83.3	1	0	0	1	1	100.0	77.7	100.0	68.6
18	-	-	-	3	1	33.3	3	1	33.3	2	1	50.0	33.3	50.0	68.5
19	-	-	-	2	0	0	-	-	-	-	-	-	0	-	55.7
20	-	-	-	1	0	0	-	-	-	1	0	0	0	0	47.3
21	-	-	-	1	0	0	-	-	-	-	-	-	0	-	66.7
23	-	-	-	1	0	0	-	-	-	-	-	-	0	-	14.3

1/ Data from Fiscus and Kajimura (1965).

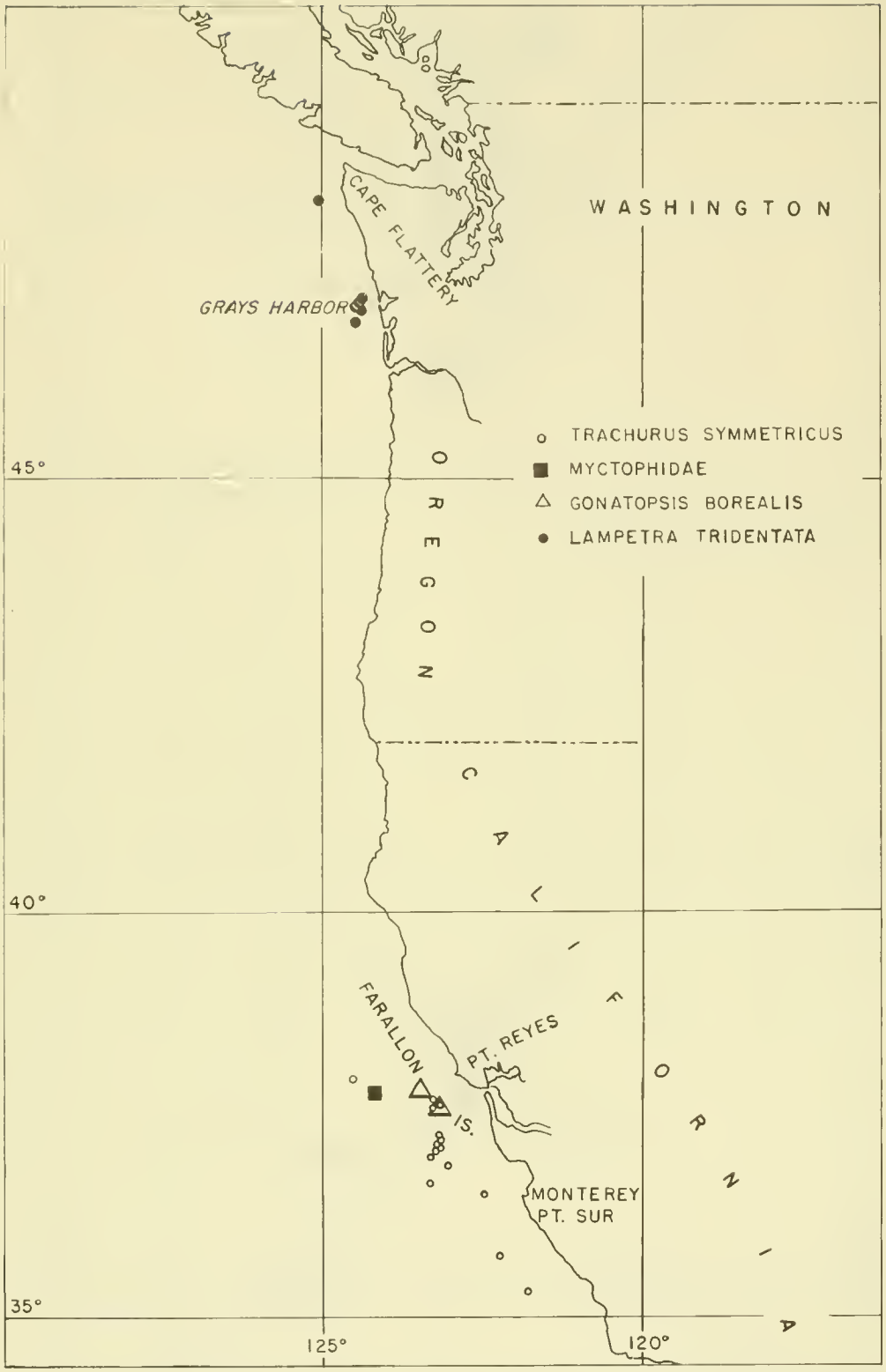

Figure A-1.--Locations where fur seal stomachs collected in 1965 contained the following fishes and squid (State and number of occurrences in parentheses): Trachurus symmetricus (California, 15); Myctophidae (California, 1); Gonatopsis borealis (California, 2); and Lampetra tridentata (Washington, 6).

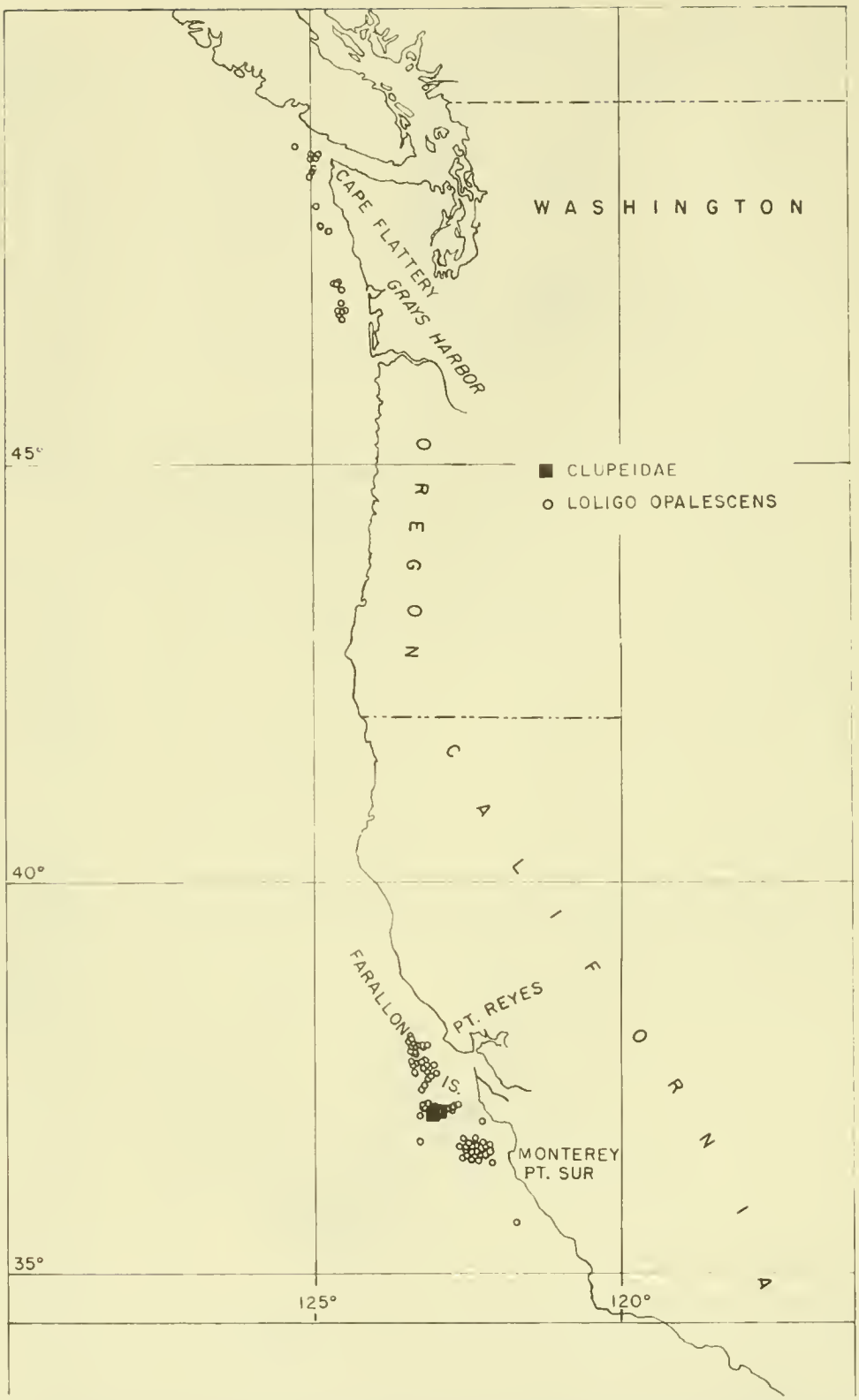

Figure A-2.--Locations where fur seal stomachs collected in 1965 contained the following fishes and squid (State and number of occurrences in parentheses): Clupeidae (California, 2); and Loligo opalescens (California, 85; Washington, 21).

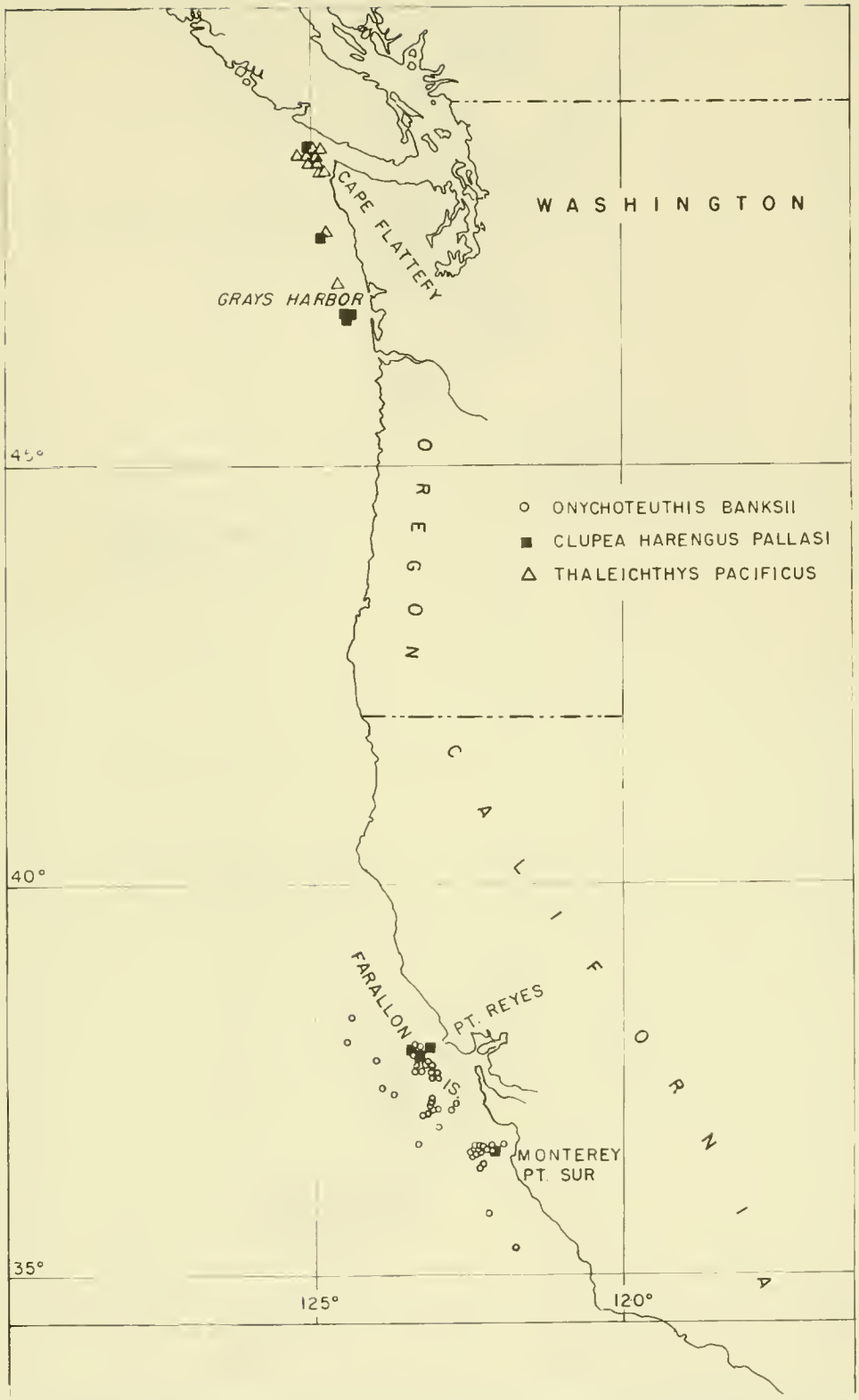

Figure A-3.--Locations where fur seal stomachs collected in 1965 contained the following fishes and squid (State and number of occurrences in parentheses): Onychoteuthis banksii (California, 49); Clupea harengus pallasi (California, 4; Washington, 5); Thaleichthys pacificus (Washington, 11).

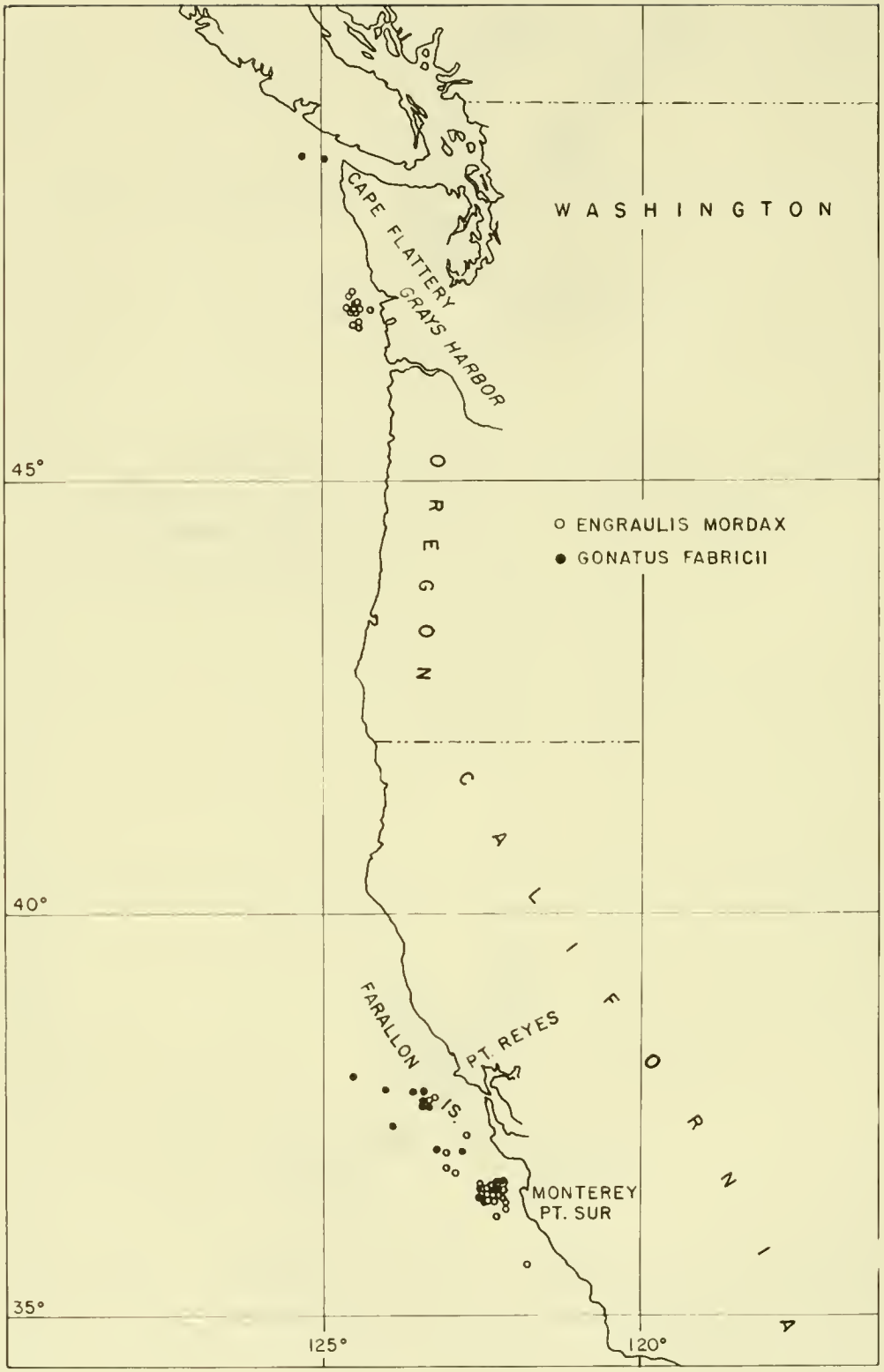

Figure A-4.--Locations where fur seal stomachs collected in 1965 contained the following fishes and squid (State and number of occurrences in parentheses): Engraulis mordax (California, 39; Washington, 20); and Gonatus fabricii (California, 17; Washington, 2).

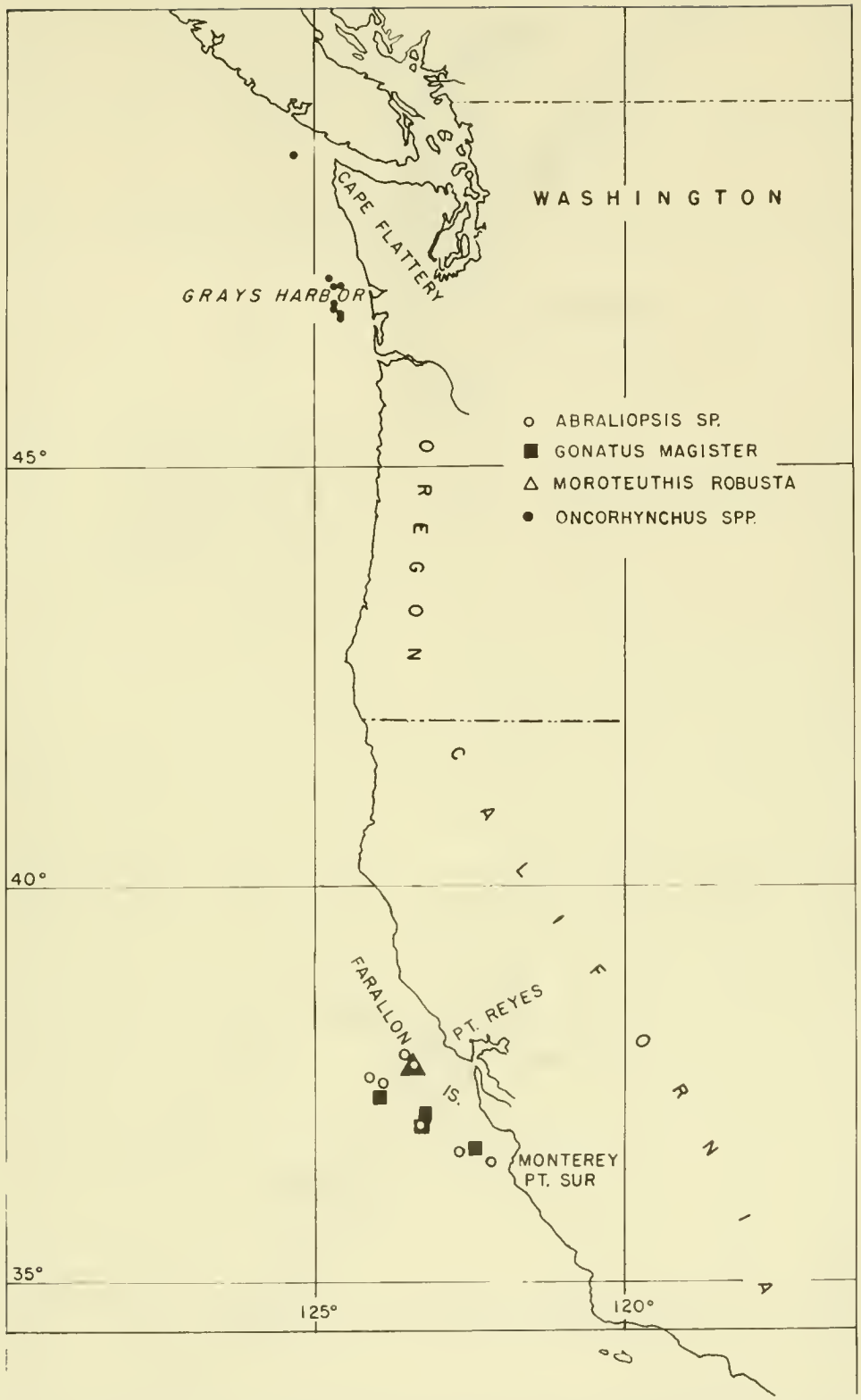

Figure A-5.--Locations where fur seal stomachs collected in 1965 contained the following fishes and squid (State and number of occurrences in parentheses): Abraliopsis sp. (California, 7); Gonatus magister (California, 4); Moroteuthis robusta (California, 4); and Oncorhynchus spp. (Washington, 8).

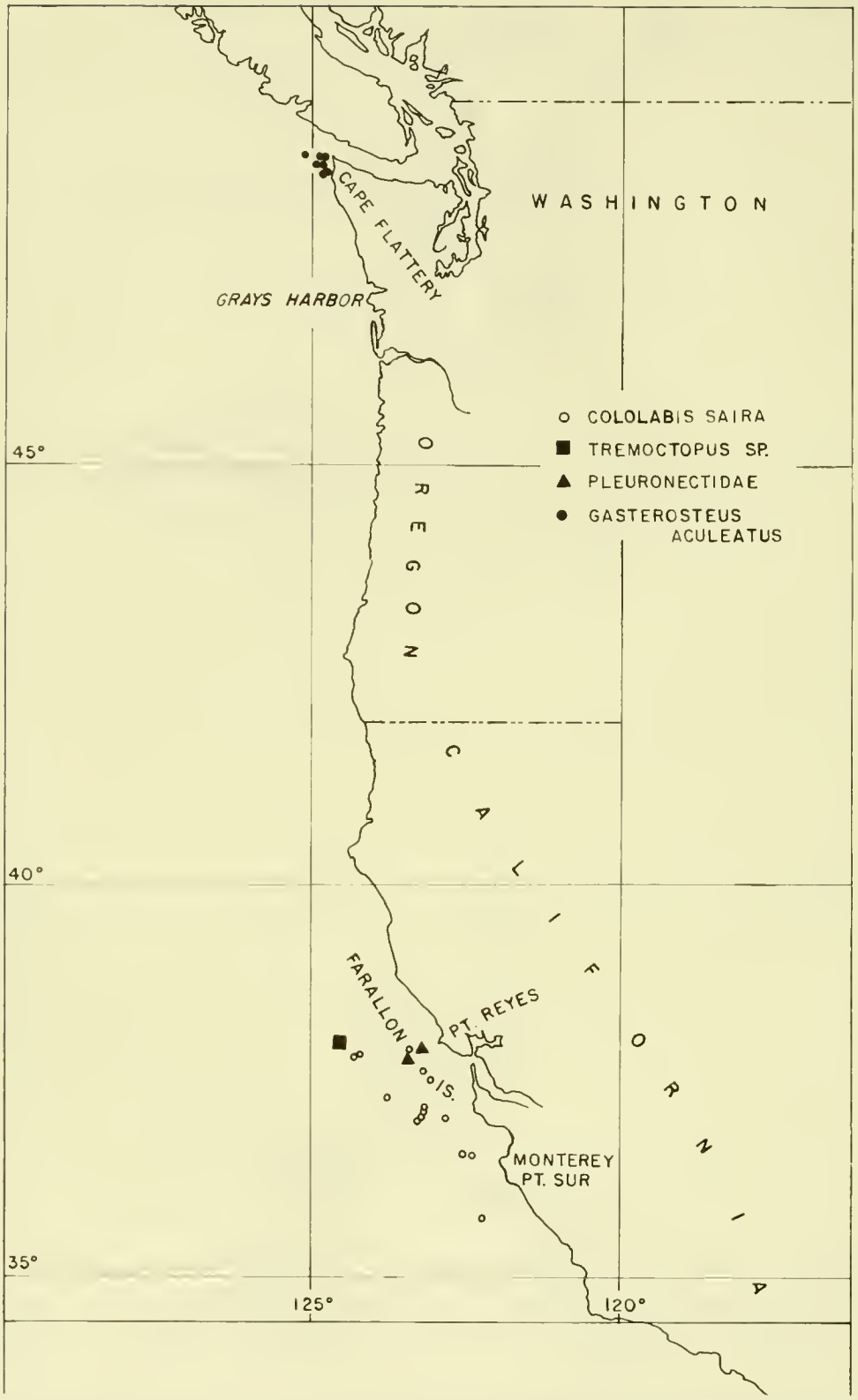

Figure A-6.--Locations where fur seal stomachs collected in 1965 contained the following fishes and octopus (State and number of occurrences in parentheses): Cololabis saira (California, 14); Tremoctopus sp. (California, 1); Pleuronectidae (California, 2); and Gasterosteus aculeatus (Washington, 7).

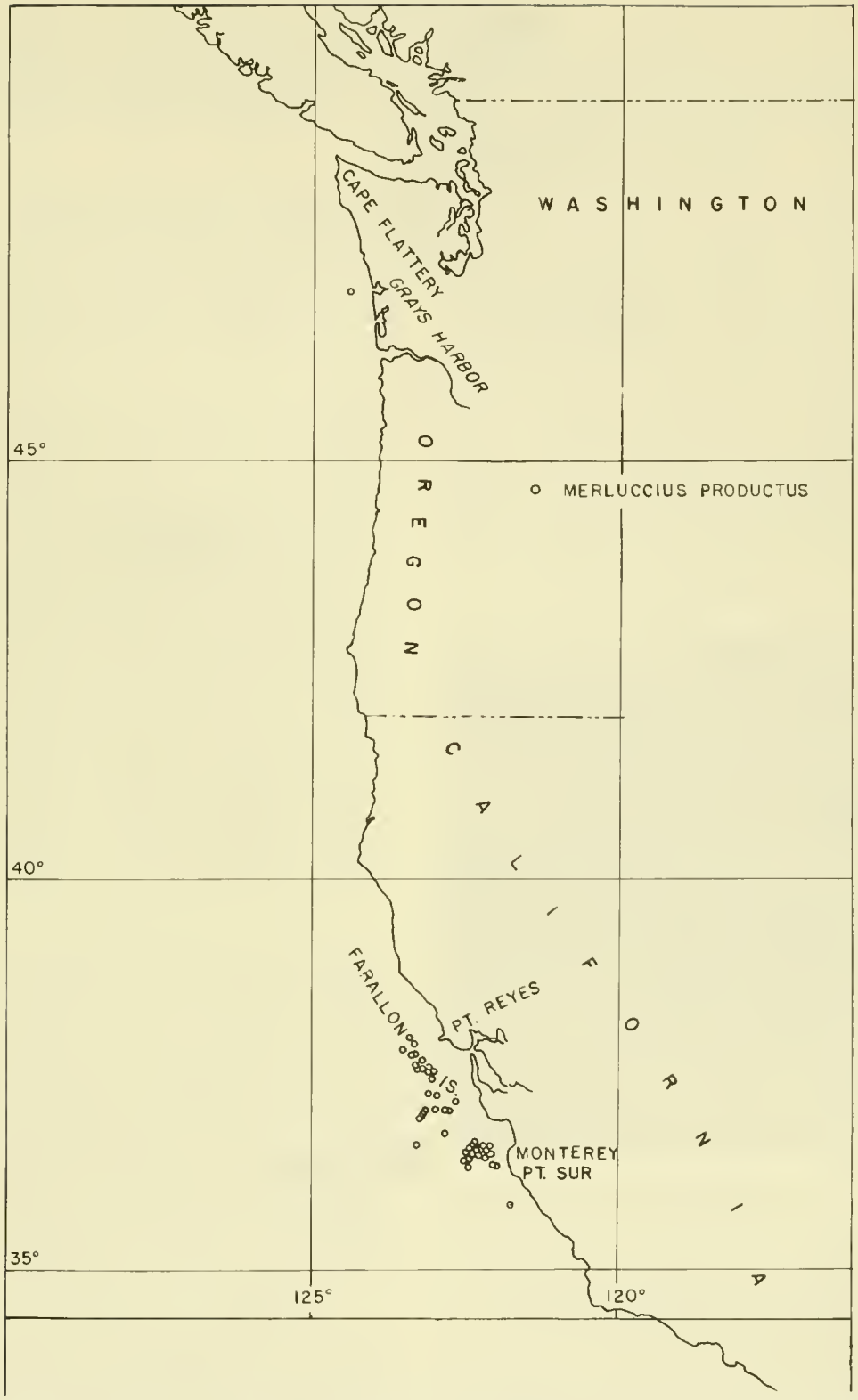

Figure A-7.--Locations where fur seal stomachs collected in 1965 contained Merluccius productus (70 occurrences off California and 1 off Washington).

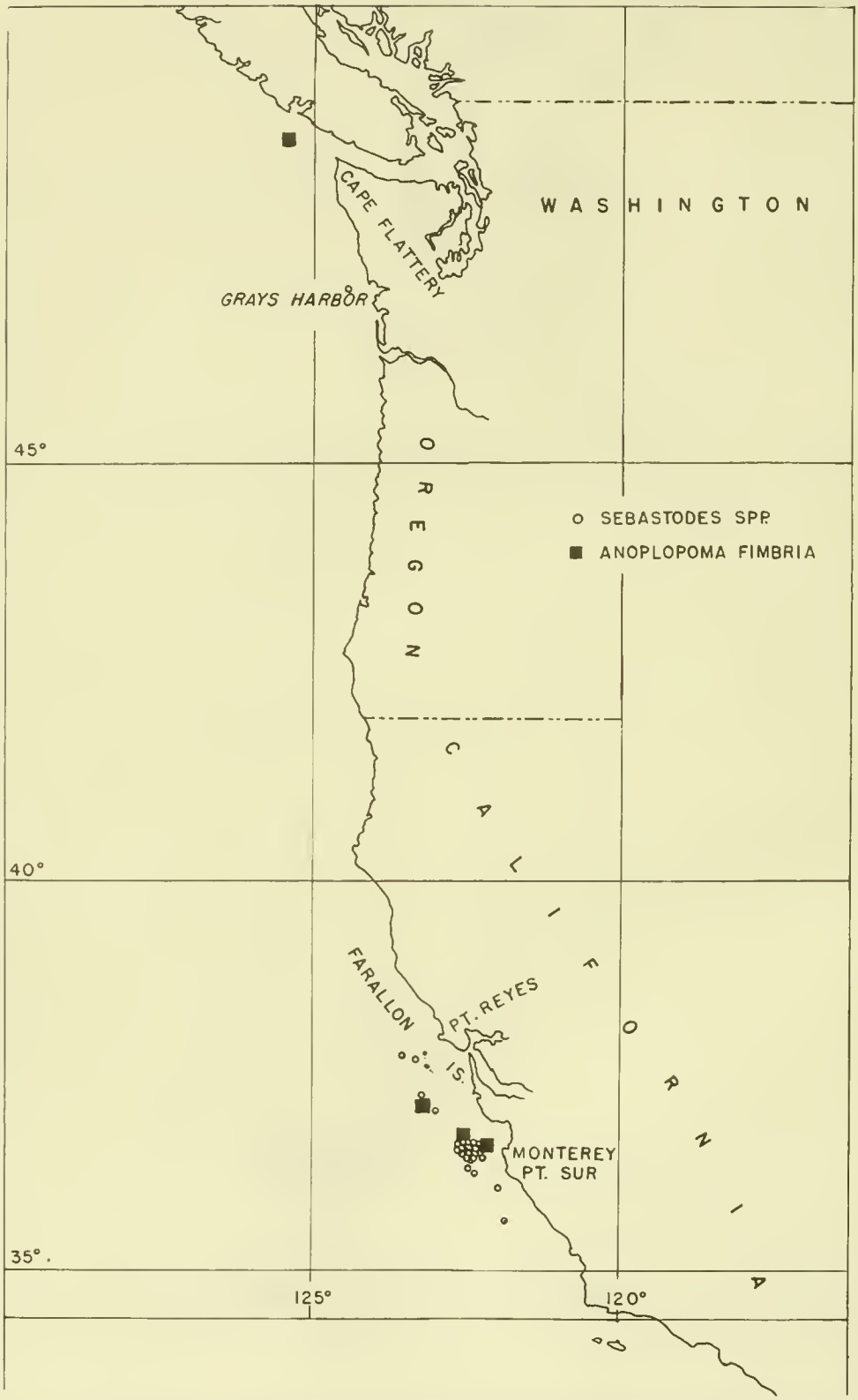

Figure A-8.--Locations where fur seal stomachs collected in 1965 contained the following fishes (State and number of occurrences in parentheses): Sebastodes spp. (California, 45; Washington, 1); and Anoplopoma fimbria (California, 3; Washington, 1).

OBSERVATION OF JAPANESE PELAGIC FUR SEAL RESEARCH, 1965

By

Hiroshi Kajimura

Under Article II, paragraph 5, of the Interim Convention on Conservation of North Pacific Fur Seals, member countries agreed to exchange scientific personnel by mutual consent of the parties concerned. The last U.S. observer sent to Japan under this provision was G. K. Tanonaka, who visited in April and May 1958.

In February 1963 the North Pacific Fur Seal Commission agreed to conduct research on the quality of sealskins by sex, age, and time and method of collection. I went to Akahama (Ozuchi), Japan, in 1965 to observe Japanese pelagic fur sealing, particularly in regard to selection of seals, methods of collecting to reduce damage to skins, and skin-handling techniques aboard vessels and on shore.

I arrived in Tokyo, Japan, 7 April and visited the Tokai Fisheries Laboratory, where the marine mammal specialists are headquartered, before going by train to the field station at Ozuchi on 10 April. During my stay at the field station from 10 April to 10 May I spent 15 days aboard a vessel. Because of bad weather, seals were hunted on only 6 days.

I would like to thank the biologists of the Tokai Fisheries Laboratory, Tokyo, and the members of the research vessels for making my stay in Japan rewarding as well as enjoyable.

PERSONNEL

The four biologists of the Marine Mammal Section, Tokai Fisheries Laboratory, Tokyo, Japan, handle the various aspects of fur seal research conducted by Japan. Each biologist has a tour of duty at the field station at Akahama during the sealing season (fig. B-1).

Temporary employees at the field station were three biological aids and four office clerks. One biological aid is assigned to each vessel to collect data at sea and assist at the field station when the vessels are in port. The office clerks transfer field notes to final data sheets and punchcards, and do miscellaneous tasks.

FIELD STATION LABORATORY

The Akahama field station is the base for Japanese pelagic fur seal research. Akahama, in Iwate Prefecture, is a small fishing village about 1.5 miles from the town of Ozuchi (Otsuchi) on the Pacific Ocean side of Honshu Island (fig. B-2). Akahama-Ozuchi has been one of the main ports used by Japanese pelagic sealers since earliest sealing times and is considered by the Japanese as the harpoon vessel capital of the world.

VESSELS AND EQUIPMENT

Three vessels were chartered by the Japanese Government in 1965 to conduct pelagic fur seal research (table B-1). These chartered vessels, known as "tsukimbo-sen" or harpoon vessels, were described by Austin and Wilke (1950). They are designed mainly for collecting fur seals, porpoises, and swordfish, but are also used for miscellaneous fishing. The only difference between the vessels used now and those described by Austin and Wilke is size; present vessels are larger and have more modern equipment (35 gross tons compared with 20 gross tons). Because the vessels are not equipped with radar, navigation is by compass, radio direction finder, and the captain's knowledge of the locality.

Figure B-1.--Biologist, in front of field station laboratory at Akahama.

Table B-1.--Harpoon vessels chartered for fur seal research by Japan in 1965

Vessel name	Tonnage	Horse-power	Max. speed	Length	Beam	Draft
			Knots	Ft.	Ft.	Ft.
No. 3 Hachiman Maru	34.14	160	8	60.1	13.7	6.2
No. 5 Tenyu Maru	29.95	120	8	59.3	13.3	5.9
No. 5 Nikko Maru	35.71	140	8	63.4	13.8	6.6

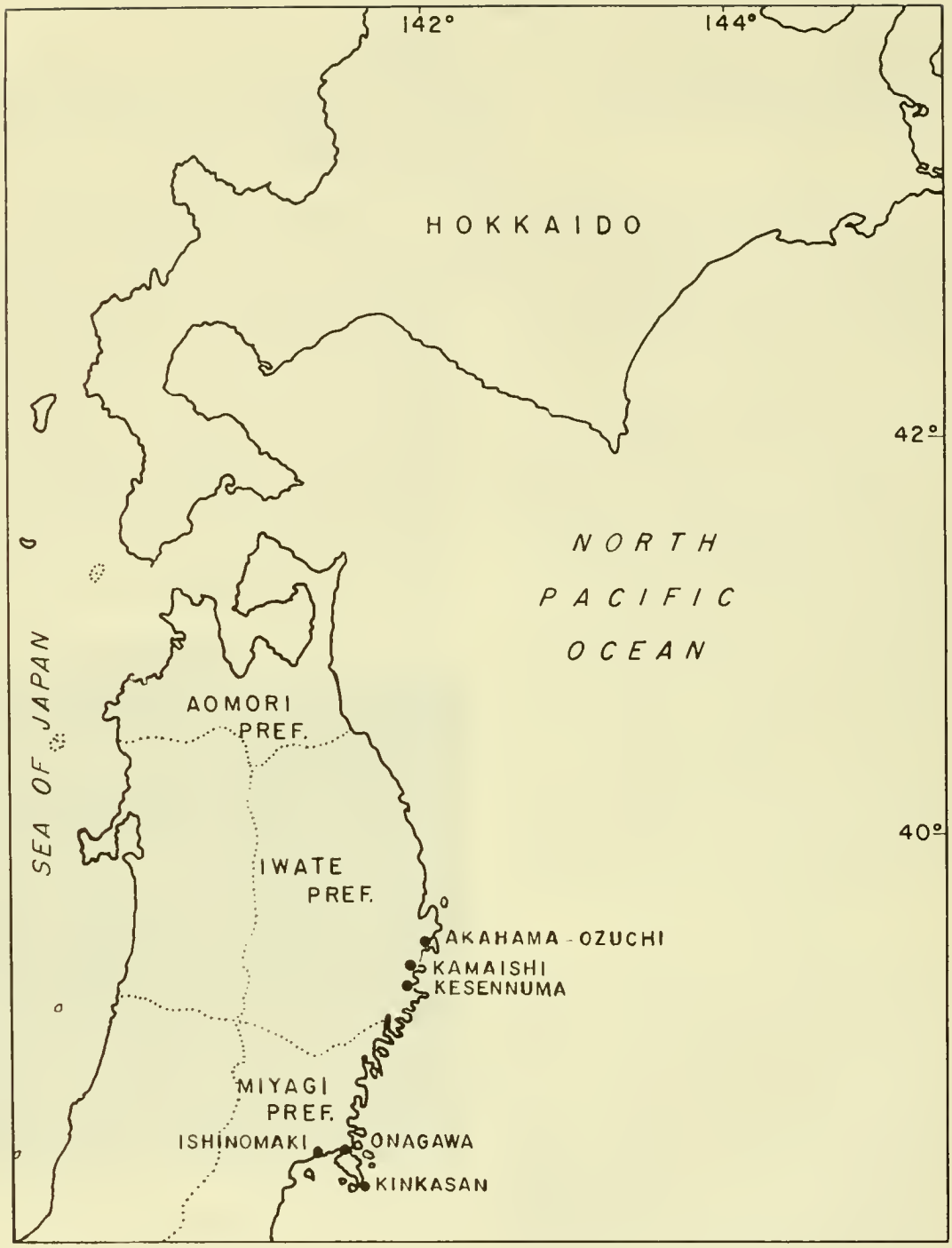

Figure B-2.--Fishing villages visited by the Nikko Maru, 10 April to 10 May 1965.

One of these vessels, No. 5 Nikko Maru (fig. B-3), has been under charter since the beginning of the present pelagic fur seal research program, which is now in its eighth consecutive year. The other two vessels are in their fifth and sixth consecutive years of pelagic research.

The normal vessel complement of 13 to 15 (fig. B-4) includes a captain who usually is the chief hunter, an engineer, a radio operator, 2 to 4 hunters, 5 deck hands, and 3 boys (1 a cook).

The extremely large crews of these vessels are not needed for fur seal work, but after they finish sealing they hunt for porpoise and fish for saury and swordfish. Such work requires a crew of 14 to 15 men. If the men are not hired for a full year, they will seek employment elsewhere. It is difficult to hire a crew for only half a season.

Figure B-3.--A harpoon vessel, the No. 5 Nikko Maru, of the type chartered for fur seal research.

Figure B-4.--Crew members of the chartered fur seal research vessel, No. 5 Nikko Maru.

RELATION OF WEATHER TO SEAL MIGRATION OFF JAPAN

Owing to an unusually cold spring in 1965 and abnormal oceanographic conditions off the coast of Japan, the fur seal migration off northern Honshu and Hokkaido was delayed about 3 to 4 weeks. Sealing off the coast of Iwate Prefecture normally occurs during late April and early May. By the middle of May and in early June, migrating seals are usually farther north, off Aomori Prefecture and Hokkaido. As late as 10 May 1965, however, migrating seals were still in the warmer waters off Miyagi Prefecture near Kinkasan, about 240 miles south of Hokkaido.

OBSERVATIONS OF JAPANESE PELAGIC SEALING

Because of their relatively small size, the harpoon vessels enter harbor each night (or drift offshore when the sea is calm). The hunting range is, therefore, limited to a distance of about 100 miles per day; hunting usually extends only 10 to 50 miles offshore. The vessels leave port each morning between 0200 and 0400, depending on the area to be covered.

On reaching the hunting area, hunters and lookouts take their places on the harpoon (shooting) platforms and in the crow's-nest to watch for seals. When a seal is sighted, the vessel approaches it at full speed (fig. B-5). Two hunters are stationed on the platform with single- or double-barrel 12-gage shotguns loaded with No. 00 buckshot. The chief hunter (gunner) stands up forward at the bow; the second hunter stands behind him, on the side of the vessel that is nearest the seal. Shooting seals from harpoon vessels is difficult, not only because of engine vibrations but because the shooting platform has no protective railing. The shin-high railing shown in figure

Figure B-5.--Hunters shooting fur seal from bow platform. (Note shin-high railing on bow platform.)

B-5 offers little protection if the hunters lose their balance. Sealing is, therefore, limited to periods of favorable weather when the hunters are able to stand on the platform to shoot.

During the approach to a seal, a lookout standing behind the gunners controls the direction of the vessel by arm signals to the helmsman and the speed by signals to the engineroom. The ship, which is normally steered with the conventional ship's wheel from the pilothouse, is manually steered during sealing by two men with a tiller attached directly to the rudder. Tiller steering is quicker, making the vessel more maneuverable than when under conventional steering (fig. B-6).

A 15- to 18-foot bamboo pole with a four-pronged gaff on one end and a long line on the other (fig. B-7) is used to recover dead fur seals. A deckhand throws the retrieving pole toward the seal, drags it over the seal until the skin is hooked, and then pulls the animal aboard. The seal is normally recovered while the vessel runs at reduced speed. This method of recovering seals is very efficient but requires great skill, attained only after many years of experience. Seven of the crew members on the Nikko Maru have sailed on this vessel for the past 14 years; vessel personnel has changed little during 8 consecutive years of pelagic fur seal research. The long experience of the crew working as a unit has contributed much to the vessel's marked success in sealing. The numbers of seals seen and collected by the Nikko Maru, from 10 April to 10 May 1965, are shown in table B-2.

Figure B-6.--The tiller, located on the stern, improves the maneuverability of the vessel.

Figure B-7.--Deckhands ready to throw retrieving pole to recover dead seal.

Table B-2.--Number of seals seen and collected by the Nikko Maru, 10 April to 10 May 1965

Date	Total seals seen	Total seals collected
	Number	Number
Apr.:		
13.....	5	0
17.....	3	3
2.....	1	0
25.....	10	7
26.....	15	10
May:		
1.....	70	30
2.....	36	24
Total.....	140	74

Field Data Collection Methods

Preliminary data taken for each fur seal brought aboard the vessels were: time seal was sighted and brought aboard vessel; number of seals in a group; and behavior (swimming or sleeping).

As soon as a seal is brought aboard the vessel, the surface water temperature is recorded (as read directly off a temperature gage mounted in the pilothouse) and a numbered plastic tag is affixed on the front flipper for identification.

Each animal is measured (from tip of snout to tip of tail) on a calibrated measuring board

(fig. B-8), and weighed on a graduated beam scale (fig. B-9). The metric system of measurement is used.

The sex of each animal is recorded and, for pregnant females, the weight, length, and sex of the fetus are recorded. The genital tract of each female is tagged and placed in 10 percent formalin for examinations in the laboratory.

Both upper canine teeth are collected by cutting off the snout with a meat cleaver (fig. B-10). The snout is placed in a cloth bag with an identifying tag. Subsequent work on the snouts is done at the field station laboratory.

Figure B-8.--Calibrated board for measuring seals on vessel.

Figure B-9.--Weighing fur seal with a graduated beam scale.

Figure B-10.--Cutting off snout to preserve upper canine teeth for age determination.

Stomachs are tagged, tied, cut off above the cardiac sphincter and below the pyloric sphincter, and placed in barrels containing 10 percent formalin. (Formalin is not injected into the stomach to stop digestion, as is done aboard U.S. research vessels.)

When fur seals are skinned aboard the vessels, the animals are first slit open along the ventral surface from the lower jaw to the anus and a cut is made around each flipper. The skins are then carefully removed with a knife. The skins are washed and cooled by towing them alongside the vessel for 15 to 20 minutes while hunting is continued. They are soaked in a concentrated brine solution overnight and salted down in bins the following morning, for a minimum of 2 weeks. The crew unloads the skins on the dock whenever a shipment is made; workers hired by the processing firm fold and pack the salted skins in burlap bags for shipment (figs. B-11 to B-13). The bundled skins are shipped by truck to a Tokyo factory where they are fleshed and processed.

In February 1965, the North Pacific Fur Seal Commission approved a plan to standardize preliminary processing of sealskins (skinning, washing, fleshing, curing, packing, shipping, and storage) to be used for research on quality by each member nation. The summary of instructions for preliminary processing of sealskins was as follows:

1. Remove skins without cuts or flay marks.
2. Wash and soak in sea water 4 hours.
3. Scrape blubber from the skin within 2 hours after washing. If there is a delay of 24 hours or more between soaking and fleshing,

Figure B-11.--Sealskins being unloaded from vessel.

Figure B-12.--Salted skins being folded and placed in burlap bags.

cover the skins with salt until the blubber can be removed, or obtain a substitute sample if the above conditions are not satisfied.

4. Cure skin in salt for two 7-day periods, using fresh salt for each period. Lay skin flat, fur side down, to cure. Make certain there are no rolled edges that are not salted.

5. Rub with a mixture of 10 percent powdered boric acid and 90 percent salt, roll tightly, and pack in wooden barrels, or other noncorrodible, watertight container.

6. Keep skins cool during shipping and storage; refrigerate between 0° and 5° C., if possible.

All deviations from the above instructions on preliminary processing of sealskins were to be recorded, along with the date and locality of capture, sex, age, length, and weight of each animal.

Figure B-13.--Bundles of sealskins being prepared for shipment to processing plant.

Sealskins collected by Japan for research on skin quality deviated from the above methods owing to conditions aboard the vessel and the lack of storage facilities on land. These deviations, although not actually observed, were as follows:

Steps 1 and 2 to be followed as in the instructions.

Step 3. All skins to be salted, and the vessel to return to port (Akahama-Ozuchi) each day to flesh skins because of lack of space aboard the vessel.

Step 4. Skins to be salted aboard the vessel during the first 7-day period. Skins to be salted in barrels (skins laid out flat) and shipped to processing plant in Tokyo during the second 7-day period.

Steps 5 and 6 will be handled by the processing firm in Tokyo because refrigeration is not available during shipping and storage.

Laboratory Examinations

In the laboratory stomachs, teeth, and genital tracts were examined.

Stomachs.--Each fur seal stomach was preserved in 10 percent formalin aboard the vessel. The stomachs are soaked overnight in fresh water when examining stomachs at the laboratory. The stomach is then cut open, and the contents are identified and separated by species whenever possible. The volume of each species is measured by water displacement.

Teeth.--Snouts containing both upper canine teeth are cooked at the laboratory by one of the biological aids. The teeth are pulled, cleaned,

identified, and placed in envelopes. The teeth are ground lengthwise by holding the tooth against a mechanically turned grinding wheel. When the desired thickness (center of tooth) is reached, the work is finished manually on a grinding stone. The internal annuli of the tooth are then counted, using natural transmitted light, to determine age.

Genital tracts.--The condition of female genital tracts collected is noted at the laboratory, rather than at the time of collection.

APPENDIX C

BEHAVIOR NOTES

The actions of seals when first seen were recorded during the running of transects off California in 1965. These actions were classified as: (1) active--including swimming and feeding, (2) sleeping, and (3) resting but awake.

If the sea was calm, most seals were sleeping during the morning, but in the afternoon most would be active or awake and only a few asleep. During stormy weather most seals were active.

Other observations are listed in table C-1.

Table C-1.--Observations by the U.S.A. of unusual fur seal behavior in the eastern Pacific in 1965

Date of observation	Seals	Tag number, if animal collected	Locality where observed	Observation
	Number	Washington		
Apr.:				
2	1		Off Cape Flattery	In kelp patch
9	1	418	.....do.....	On kelp
16	6		Off Westport	All in and around large kelp patch
21	2	483	.....do.....	One growled
22	1		.....do.....	In kelp patch
		California		
18	4		Off Farallon Is., transect no. 4	Near kelp patch
19	1		Transect no. 5	Sleeping next to log
21	1		Off Monterey, transect no. 7	On log
21	1		.....do.....	On kelp
23	1	42	Off New Year I.	In kelp
May:				
8	1		.....do.....	Do.
13	1		End transect no. 2	Lying on kelp
26	4		Monterey Seavalley	Possibly medium-size bull with 3 females
27	1	150	North of Pt. Sur	Growled
29	2	159	Off San Simeon	Near kelp
29	1	161	.....do.....	In kelp
June:				
23	1	283	Off Farallon Is.	On kelp

APPENDIX D

Table D-1.--Injured, sick, and diseased fur seals collected pelagically by the U.S.A. in the eastern Pacific in 1965

Seal number	Date collected	Locality	Remarks
US65-425	11 Apr.	Off Cape Flattery, Wash.	Age 1, wt. 6 kg., guard hair absent from back, generally poor condition, scar tissue on stomach
US65-102	20 May	Off Farallon Is., Calif.	Small round scar (1-1/2" diam.) on back 6" above tail; some scars behind lower nipples
US65-104	20 May	.....do.....	Small rubbed spot or scar on back, 2" diam.
US65-169	31 May	Monterey Seavalley	Tip of flipper sliced off (not checkmark)
US65-175	31 May	.....do.....	Small rubbed spot 1" diam. on belly
US65-185	31 May	.....do.....	Two rubbed spots, lower belly
US65-186	31 May	.....do.....	Half of belly matted with grease, two healed scars on right hind flipper, one healed scar rear left flipper.
US65-199	2 June	.....do.....	Large scar on back, photos taken
US65-255	19 June	Off Monterey	Very thin

APPENDIX E

FETAL MORTALITY DURING THE LAST 6 MONTHS OF GESTATION

by

Victor B. Scheffer and Ancel M. Johnson

This section deals with the question: "Can fetal mortality be estimated from study of the pregnancy rates of seals taken at sea?"

According to Niggol (1960), fetal mortality between 11 January and 19 July is nearly equal for the sexes. He tabulated sex ratios by 10-day periods for 3,081 fetuses and found that "no shift in mortality rate by either sex was evident" (p. 428).

We have now studied pregnancy rates by month and by age of the pregnant female, between January and June, in 8 years between 1952 and 1964 (table E-1). The sample includes 5,817 females, of which 4,321 (74.3 percent) were pregnant. ("Pregnant" means that the female was carrying a live fetus; not that she was recently post partum, an extended meaning used by Abegglen and Roppel (1959).)

The study is based on three assumptions: (1) that pregnancy rates are consistent from year to year, (2) that pelagic sampling is random, and (3) that a decrease in pregnancy rate with time for each age class reflects the loss of fetuses through absorption or abortion.

Findings.--The regression of pregnancy rate on time for each of the age classes indicated by the nine columns of table E-1 is highly variable, and the slope is not significant. We concluded that fetal mortality cannot be estimated from these data because their variability is too great.

Table E-1.--Eight-year summary of pregnancy rates of seals collected pelagically by the U.S.A. from California to Alaska[1]

Month		Age in years							Total
		4	5	6	7	8	9	10	10+	
Jan.[2].....	N	26	22	21	47	61	49	55	241	522
	Np	1	8	19	39	47	43	51	197	405
	%	3.9	36.4	90.5	83.0	77.1	87.8	92.7	81.7	77.6
Feb.....	N	61	86	100	122	122	108	111	545	1,255
	Np	4	44	82	98	111	101	99	441	980
	%	6.6	51.2	82.0	80.3	91.0	93.5	89.2	80.9	78.1
Mar.....	N	61	56	65	70	66	55	66	546	985
	Np	1	24	48	51	54	45	58	430	711
	%	1.6	42.9	73.9	72.9	81.8	81.8	87.9	78.8	72.2
Apr.....	N	109	88	79	91	126	110	82	532	1,217
	Np	2	32	49	72	102	101	66	436	860
	%	1.8	36.4	62.0	79.1	81.0	91.8	80.5	82.0	70.7
May.....	N	43	48	59	64	93	69	90	507	973
	Np	0	12	50	53	77	62	82	406	742
	%	0	25.0	84.7	82.8	82.8	89.9	91.1	80.1	76.2
June.....	N	95	60	70	79	94	89	71	306	864
	Np	3	27	52	64	81	81	60	255	623
	%	3.2	45.0	74.3	81.0	86.2	91.0	84.5	83.3	72.1
Total.....	N	395	360	394	473	562	480	475	2,677	5,816
	Np	11	147	300	377	472	433	416	2,165	4,321
	%	2.8	40.8	76.1	79.9	84.0	90.2	87.6	80.9	74.3

[1] Samples taken in various months between January and June in years 1952, 1955, 1958-62, and 1964. N = number in sample; Np = number pregnant; percent = % of sample pregnant.

[2] Includes two seals taken in December 1960.

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