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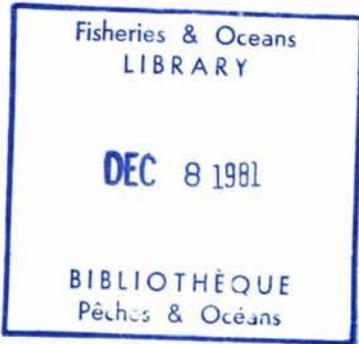


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# A Preliminary Report of Pacific Hake Studies Conducted Off the West Coast of Vancouver Island

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A PRELIMINARY REPORT OF PACIFIC HAKE STUDIES CONDUCTED  
OFF THE WEST COAST OF VANCOUVER ISLAND

by

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ABSTRACT

Beamish, R. J. 1981. A preliminary report of Pacific hake studies conducted off the west coast of Vancouver Island. Can. MS Fish. Aquat. Sci. 1610: 43 p.

Small concentrations of Pacific hake were found in the Canadian zone as early as May and as late as November, 1979. Commercial quantities were observed from June until November and a review of the commercial fishery suggests that a hake fishery could be sustained for 4-6 mo annually. The population consisted of approximately 70% females that averaged approximately 55 cm (2.5 lb) compared to an average size of 53 cm (2.3 lb) for males. Hake ranged in age from 3-19 yr, however few fish younger than age 6 were found. There was strong evidence of prominent year-classes with the 1970 year-class (age 9) accounting for 26.1% of all fish sampled in 1979.

The commercial fishery off the United States is dependent on smaller, younger fish. Only 18% of the fish sampled in 1976 were age 9 or older compared to 53% of the fish in the Canadian fishery that were age 9 or older. The larger individuals of any particular year-class were found in the Canadian zone, indicating the larger fish undergo more extensive migrations and the larger fish tend to migrate into the Canadian zone. Some caution should be exercised in harvesting these older, larger fish until more is known about their role in sustaining recruitment.

Key words: Pacific hake, groundfish, commercial fisheries, underutilized species.

RESUME

Beamish, R. J. 1981. A preliminary report of Pacific hake studies conducted off the west coast of Vancouver Island. Can. MS Fish. Aquat. Sci. 1610.

On a trouvé de faibles concentrations de merlu du Pacifique dans la zone canadienne au début de mai et à la fin de novembre 1979. On a observé des quantités commercialement exploitables de juin à novembre et, d'après une étude, la pêche commerciale du merlu pourrait être pratiquée de quatre à six mois par année. La population comprenait environ 70 pour cent de femelles d'une longueur moyenne approximative de 55 cm (2,5 lb), alors que les mâles mesuraient en moyenne 53 cm (2,3 lb). L'âge variait de 3 à 19 ans; on a cependant relevé peu de poissons de moins de 6 ans. Il y a de nombreuses preuves étayant l'importance des classes d'années, celle de 1970 (9 ans) représentant 26,1 pour cent de tout l'échantillonnage de poisson de 1979.

Des poissons plus jeunes et plus petits sont exploités dans le cadre de la pêche commerciale au large des Etats-Unis. Les poissons de neuf ans ou plus ne représentaient que 18 pour cent de l'échantillonnage de 1976, comparativement à 53 pour cent dans le cas de la pêche canadienne. Les plus grands spécimens de chaque classe d'année ont été observés dans la zone canadienne, ce qui signifie que les migrations des poissons de grande taille sont plus étendues et que les gros poissons tendent à migrer dans la zone canadienne. Pour ce qui est de l'exploitation des poissons plus âgés et plus grands, il faudrait faire preuve de circonspection jusqu'à ce qu'on en connaisse davantage sur leur rôle dans le maintien du recrutement.

Mots-clés: Merlu du Pacifique, poisson de fond, pêches commerciales, espèces sous-exploitées.

## INTRODUCTION

There is an increasing interest by Canadians in the Pacific hake (Merluccius productus) fishery off the west coast of Vancouver Island. During 1979 Canadian vessels landed 4,200 t directly to foreign vessels and the size of the Canadian catch increased in 1980 to 12,215 t.

There are resident offshore hake stocks in the Canadian zone but because few hake have been found in the offshore waters during the winter months it is believed that the size of the resident stocks is small. Thus the offshore hake migrate from the U.S. zone and it is of interest to the Canadian fishery to determine how many hake are in our zone and for how long.

This report summarizes the studies conducted on offshore hake during 1979 and some information collected in 1976. The sampling program was erratic because research on Pacific hake was a low priority. However, with the cooperation and assistance of fishermen, particularly the owners and crew of the M/V CALLISTRATUS, sufficient data were collected to describe the size, age and sex composition of stocks as well as to indicate when hake moved in and out of the Canadian zone.

## METHODS

Material for this report was assembled from one commercial charter in May, observations on board a Canadian trawler in June, samples collected aboard two foreign vessels in September and from a research cruise in November.

The purpose of the May 13-18, 1979 charter was to conduct an echo sounder survey in the area off S.W. Vancouver Island to determine if concentrations of Pacific hake were in the Canadian zone. The area was surveyed over a 5-day period (Fig. 1). Six midwater tows and three bottom tows were made in the survey area using a modified Engel trawl with a 106.8 m footrope. The M/V CALLISTRATUS is a 59 m stern ramp freezer trawler of 1,040 gross tons. An Atlas-Krupp 600 S echo sounder and a Furuno FTG 412 net sounder were used to locate concentrations of fish. The net sounder was used to identify fishing depth.

From June 22-26 samples were collected on the M/V CALLISTRATUS from the general area in the vicinity of the Canada-U.S. border (Fig. 2) during commercial fishing operations. Subsamples of lots of 20-40 fish were selected from a conveyor belt that emptied fish from a saltwater holding tank. The total weight of the catch was estimated visually and species composition was determined during sorting prior to processing.

Samples from the foreign fishery in the Canadian zone were collected aboard the M/V KAMYSHIN (USSR) and the M/V OTOL (Poland) from September 8-14 in the area S.W. of Vancouver Island (Fig. 2). Subsamples were collected by selecting lots of about 100 fish from deck bins or conveyor belts from the first, middle and final portions of the catch to be processed until 300 fish had been sampled for length, sex, maturity and otoliths. Additional details relating to sample selection and catch composition are available in an annual report of biological observations made on foreign vessels during 1979 (Leaman et al. 1980).

The final sample in 1979 was obtained on the G.B. REED on November 1 in the same general area as the other samples (Fig. 2). A hydroacoustic biomass estimate of fish stocks was made in this area over the period October 29-November 16. Additional descriptions of the hydroacoustic survey and biological information collected is available in a report of this cruise by Barner et al. (1980).

Samples collected in 1976, in 3 midwater trawl sets off southern British Columbia and one off the coasts of the States of Washington and Oregon (Beamish et al. 1981) have been included in this report. Samples were collected on the M/V ARCTIC HARVESTER using a Canadian Diamond 5-B midwater trawl with a 43.3 m headrope and 40.2 m footrope. A 3.8 cm stretched mesh codend was used on all tows.

In all of the cruises, hake were measured for fork length, sex was determined and in some cases the state of maturity was noted. Otoliths were collected in pairs, stored in a 50% glycerine solution and processed according to the procedures described by Beamish (1979). Sampled fish aged 5 and younger using otolith sections were also aged using the otolith surface to confirm that both methods were producing similar ages for young fish.

A list of common and scientific names is included in Appendix 1.

## RESULTS AND DISCUSSION

### TIMING OF MIGRATION INTO THE CANADIAN ZONE

Midwater concentrations of fish were rarely observed during the May cruise and few fish were found in the 9 midwater and bottom tows made in the areas where some concentrations of fish were observed (Table 1). The sample of 100 hake from set 8 was exclusively female (Table 2) ranging in length from 43-68 cm with a mean length of 54.9 cm. All females appeared to be in a state of recovering from or resting after spawning. It was not possible to determine if these hake were resident in the Canadian zone or had recently moved into Canadian waters after spawning in the U.S. zone but because the numbers of hake in the area increased in June it is probable that they had just recently moved into the area. It was clear that

commercially exploitable quantities of hake were not present in the survey area in mid-May.

In mid-June the M/V CALLISTRATUS commenced fishing hake commercially and the first samples were obtained on June 22 (Table 3). It was evident from the size of the catches (Table 3) that commercially exploitable stocks were present in the Canadian zone immediately west of Swiftshore Bank (Fig. 2). Females continued to be more abundant than males and averaged 54.3 cm in length compared to 52.6 cm for males (Table 4).

In November, Pacific hake were observed in the area off S.W. Vancouver Island (Fig. 2). While concentrations were not large, it was estimated that the area contained small commercial quantities (F. Taylor, pers. comm.). It was obvious that these concentrations could not sustain a major fishery but they could support the catch requirement of some smaller vessels. Males accounted for 22% of the catch (Table 5) indicating that the disproportionate number of females remained constant throughout the period of residence in the Canadian zone. The average size of males (54.5 cm) and females (56.6 cm) was slightly larger than in previous samples.

In summary it appears that small concentrations of hake may have moved into the Canadian zone as early as May but commercial quantities were not present until June. Since small quantities still remained in the Canadian zone in early November it appears that a commercial fishery could have operated for 5-6 mo. The high percentage of females (72%) indicates that females probably undergo more extensive migrations than males and this may be related to their larger size.

The Canadian and Foreign fishery for Pacific hake, started in the Canadian zone on August 6 and continued until October 1. During this period there was no indication that the size of the stocks had declined to levels that would not support a commercial fishery. The total Canadian and Foreign catch during this period was 12,215 t. Females continued to be more abundant in the catch, averaging 70% of the combined samples collected from the M/V KAMYSHIN and M/V OTOL (Tables 6, 7). The high percentage of females in the catch at this time of year again indicates that either the total population contains a high percentage of females or more probably, that more females move into the Canadian zone. The mean size of males (52.4 cm) and females (54.5 cm) was similar to previous samples.

#### SIZE COMPOSITION AND MATURITY

Hake sampled from May to November ranged in size from 42-75 cm (Table 8). The mean size for combined lengths of males and females ranged from 52-57 cm with the average mean length from all samples 54 cm. Of the total of 7,643 hake measured 29% were males and 71% were females. The mean length of males ranged from 52-55 cm while females ranged from 54-57 cm. The largest male measured was 66 cm but few males were larger than 60 cm. The largest female was 75 cm and only 10% of the females were 60 cm or larger. The mean length of all males and females sampled was 53 and 55 cm, respectively. These lengths can be converted to weights of 1,022 g (2.3 lb) and 1,145 g (2.5 lb) using the formula  $W = 0.0052670 L^{3.06682}$  (Best 1962)

It is obvious from Table 8 that the size composition of the stock remained constant throughout the period of residence. Variation in sex composition occurred only during the initial and final periods of residence in the Canadian zone and, as mentioned, females predominated at all times.

No mature fish were found but some hake sampled in November showed signs of early gonad development.

#### AGE COMPOSITION AND SIZE AT AGE

Samples of hake collected in 1979 ranged in age from 3-19 yr (Table 9). In 1979 the 1970 year-class dominated the distribution as 9-yr-olds accounting for 26.1% of all fish sampled (Fig. 3). This year-class was a dominant feature of the 1978 and 1976 samples (Fig. 3), and was prominent in a stock survey in 1977 (Dark et al. 1980). In the 1976 sample, other modes appeared at age 9, the 1967 year-class; age 12, the 1964 year-class; and age 15, the 1961 year-class. Dark et al. (1980) reported that the 1973 and 1970 year-classes were strong and Stauffer and Smith (1977) report indices of hake larval abundance that suggest strong year-classes occurred in the early 1970s, mid-1960s and early 1960s.

The age frequency histograms (Fig. 3) indicate the relative abundance of each year-class at the time of sampling. A more appropriate comparison would include a correction for total annual mortality suffered by each cohort. This correction can be approximated by assuming that fish age 5 were fully recruited to the fishery and had undergone 1 year of fishing and natural mortality. Each age group was then corrected for accumulated total mortality. A total annual mortality estimate of  $A = 0.35$  was used and considered to be constant. The estimate was the average of estimates obtained by comparing the change in relative abundance of the 1970 year-class in the 1976 and 1979 samples ( $A = 0.32$ ) and from the slopes of the descending limbs of the catch curves (Jackson 1939) for fish age 9-17 in 1976 ( $A = 0.34$ ) and 8-19 in 1979 ( $A = 0.39$ ).

While there are a number of problems with the assumptions used to estimate cohort strength, such as; that relative abundance in the catch is representative of relative abundance in the population, the use of a constant mortality rate that is influenced by fluctuating year-class strengths and does not consider the early history of the fishery, and the small numbers of older fish in the samples, the comparison (Table 10), particularly in 1976, suggests that there have been strong year-classes in 1970, 1967, possibly in 1964 and in the early 60s. These same year-classes are prominent in the 1979 sample except that the strength shows up as the 1968 year-class rather than the 1967 year-class. While there appears to be some periodicity in year-class abundance, the samples and the analysis are not sufficient to permit such a comparison. However, there is no doubt that strong year-classes are an important component of this population.

A commercial sample collected in 1979 off the states of California, Oregon and southern Washington by United States scientists (Robert French, pers. comm.) did not contain a major mode representing the 1970 year-class. The 1973 year-class was dominant in the distribution and there was some indication of a prominence of the 1971 year-class. The three Canadian samples were aged using otolith sections (Beamish 1979) while the

United States scientists examined the otolith surface (Dark 1975). Use of the otolith surface to identify annuli appears satisfactory for most hake up to age 11 (Beamish 1979) thus the ages estimated by the U.S. scientists should be comparable to ages estimated by Canadian scientists. Also, a small sample of 35 hake otoliths collected in 1979 that was age 11 yr and younger was aged by Canadian and United States scientists. Seventy-six percent of ages were  $\pm$  one year and 42% were identical suggesting that the determinations are comparable.

The method of employing sections of otoliths to age Pacific hake has not been validated. However, the prominence of the 1970 year-class as 6-yr-olds in 1976, 8-yr-olds in 1978 and 9-yr-olds in 1979 indicates that some confidence up to the age of 9 yr can be placed in the ages estimated from otolith sections (Fig. 3).

Approximately 95% of the fish aged in 1979 ranged in age from 5-11 yr and the difference in mean size of fish of similar sexes in this age range was approximately 5 cm. Mature males averaged approximately 3 cm smaller than similar age females. The mean size of females age 8 and 9 increased by approximately 2-5 cm during the period May-November (Table 9) but sample sizes were too small to suggest that this was an estimate of increase in length during the residence period. Annual growth in length as indicated from the mean sizes of all year-class present in the fishery would be less than 1 cm per year. The mean size of males and females from the 1970 year-class in 1976, 1978, and 1979 was 51.7, 54.7, and 56.6 cm, respectively. The calculated annual increment in length of 1.6 cm/yr is slightly larger than the increment of less than 1 cm estimated from the mean sizes of each age-group in the population for any sample period. Thus the growth increments during the period of residence in the Canadian zone, are relatively small.

A comparison of the mean size of similar age fish sampled in 1976 in Canadian waters off the west coast of Vancouver Island and in United States off the coasts of the States of Oregon and Washington (Table 11), shows that not only do more of the larger fish occur in the Canadian zone but the individuals of any particular year-class <sup>that</sup> move into Canadian waters are the larger fish in that year-class. The differences in the mean size of similar aged males and females from the two zones were highly significant (t test  $P < .01$ , only sample sizes larger than 10 tested). These differences in size clearly demonstrate that the larger individuals undergo more extensive migrations and that larger individuals of each year-class (after age 4 or 5) and large individuals in the population tend to migrate into the Canadian zone.

#### THE COMMERCIAL FISHERY

The age sample of hake from the U.S. commercial fishery indicated that 6-yr-olds were the dominant age class and only 18% of the fish were age 9 or older. In contrast, 53% of the fish in the Canadian fishery were

age 9 or older. Fish younger than age 6 are commonly found in the U.S. fishery (Dark et al. 1980) while few fish younger than age 6 are found in the Canadian zone. Thus dominant year-classes will be fished off the U.S. coast before they are found in the Canadian fishery however they persist in the Canadian fishery for longer periods as evidenced by the relative abundance of 9-yr-olds off Canada in 1979 (Fig. 3).

The behaviour of these older and larger fish is not well known. If their annual behaviour is such that aggregations occur only during the summer months and these aggregations are found primarily in northern U.S. waters and southern Canadian waters then a fishery for older fish may be distinctive from the fishery for younger fish. The size composition of the hake in the Foreign catch from 1973-1976 (Fig. 4) indicates that in the summer months, larger fish ( $\geq 54$  cm) were captured primarily at the northern range of their distribution however it was not possible to estimate the relative biomass of larger fish in this northern zone.

There is some indication that the relative numbers of large fish caught in all areas are declining. The reported catch by all nations in the Canadian zone and off the west coast of North America has fluctuated from a high of 64,959 t in 1969 to a low of 5,191 t in 1977 (Fig. 5a, 5b). The fluctuation in catch undoubtedly is related both to abundance and migratory habits of hake and to the fishing pattern and strategies of foreign nations.

A summary of USSR catches from 1967 to 1975 (Table 12) indicates that hake were in commercial concentrations in the Canadian zone as early as February in 1968 and as late as December in 1971. Thus, while the timing of the movement in and out of the Canadian zone varies and the abundance is unknown, it does appear that commercial quantities of larger size hake are present in the Canadian zone for a minimum period of 4-5 mo and a maximum period that may exceed 6 mo.

While there is little doubt that the numbers of hake present can support a commercial fishery, there is an unanswered and unstudied question about the desirability of overfishing the larger, older and predominantly female fish in the Canadian zone. It is possible that the apparent healthy state of the offshore Pacific hake population is related to reduced fishing pressure on older fish as a consequence of their northern migration out of the area of intensive foreign effort. Preservation of these older, larger hake that are predominantly females may be maintaining the reproductive potential of the populations particularly if the population encounters unfavourable environmental conditions. Excessive removal of these older fish coupled with continued fishing pressure on younger fish might reduce the populations ability to maintain recruitment, resulting in major declines in abundance. Older fish should be harvested conservatively until more is known about their relative importance in maintaining reproductive potential.

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and Mrs. Keni Weir collected the June samples aboard the M/V CALLISTRATUS. Mr. Doug Davenport and Mr. Jim Selsby obtained the September hake samples aboard the foreign trawlers. Dr. Fred Taylor kindly allowed me to use the data he collected on the G.B. REED during November. Miss Shayne MacLellan, Miss Karen Charles and Mrs. Wendy Mitton processed and aged the hake otoliths. Cecile Houle assisted in the analysis and Mr. Robert French kindly allowed me to use data collected by United States foreign observers.

I sincerely appreciate the cooperation of the crew and owners of the M/V CALLISTRATUS for passing on information about hake and allowing their records and positions of commercial catches to be published.

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Table 1 (cont'd)

Set	6		7		8		9	
Estimated depth	Midwater		Bottom		Bottom		Bottom	
Total catch (kg)	182		182		1955		4545	
Duration (min)	15		60		195		35	
	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.
<u>Species</u>								
Pacific hake			3	2	182			
Walleye pollock			909		1136			
Shortspine thornyhead							4	3
Redbanded rockfish							59	12
Widow rockfish							91	
Yellowtail rockfish					455		4091	
Yellowmouth rockfish								
Yelloweye rockfish	909		41		45			
Pacific herring	45							
Petrale sole								
Sablefish	1	1			0.5	1	8	1
Arrowtooth flounder					5	10	36	
Spiny dogfish	36		4	3	114			
Pacific cod	2	1						
American shad					1	1		
Chinook salmon	7	1			9	1		
Chum salmon			14	6	6	2		
Ribbon barracudina								
Glass shrimp					>0.5			
Eulachon			32		7			
Squid					>0.5			
Jellyfish	<0.5	1						

Table 2. Length frequency of Pacific hake, May 13-18, 1979, M/V CALLISTRATUS.

Fork length (cm)	Set no.		
	83		
	M	F	T
39			
40			
41			
42			
43		1	1
44			
45			
46		1	1
47		4	4
48		4	4
49		2	2
50		9	9
51		6	6
52		10	10
53		8	8
54		9	9
55		10	10
56		7	7
57		6	6
58		6	6
59		2	2
60		7	7
61		1	1
62		2	2
63		1	1
64		1	1
65		2	2
66			
67			
68		1	1
69			
Total		100	100

Table 3. Species composition, June 22-26, 1979, M/V CALLISTRATUS.

Set	1		2		3		4		5		6		7	
Estimated total catch (kg)	9,000		3,600		6,800		2,300		900		4,500		11,000	
Duration (min)	180		65		90		65		60		90		75	
Species	Wt. <sup>a</sup>	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.
Pacific hake	6,700	-	3,300	-	6,600	-	1,800	-			3,200	-	7,000	-
Walleye pollock	1,800	-	290	-	68	-	455	-	270	-	910	-	2,700	-
Spiny dogfish	45	-	36	-	136	-	<20	-	635	-	455	-	1,100	-
Longnose skate					-	1								
Northern smoothtongue	+ <sup>b</sup>	-	+	-	+	-	+	-	+	-	+	-	+	-
Chinook salmon									2	1				
King-of-the-salmon														
Sablefish			-	1	-	3								
Copper rockfish														
Pacific ocean perch														
Redstripe rockfish					-	1								
Widow rockfish														
Yelloweye rockfish													-	1
Yellowtail rockfish	90	-	36	-									110	-

Table 3 (cont'd)

Set	8		9		10		11		12		13		14	
Estimated total catch (kg)	11,400		5,500		1,800		6,800		9,000		-		6,800	
Duration (min)	60		75		45		60		120		-		100	
Species	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.
Pacific hake	9,100	-	5,100	-	1,600	-	4,000	-	1,800	-	Gear		6,100	-
Walleye pollock	1,100	-	275	-	90	-	2,700	-	7,300	-	fouled		680	-
Spiny dogfish	1,100	-	55	-	90	-	70	-	<100	-				
Longnose skate														
Northern smoothtongue	+	-			+	-	+	-	+	-			+	-
Chinook salmon														
King-of-the-salmon													-	1
Sablefish									<100	-			<70	-
Copper rockfish			-	1										
Pacific ocean perch														
Redstripe rockfish														
Widow rockfish														
Yelloweye rockfish														
Yellowtail rockfish			55	-	<20	-	<45	-	<100	-			<70	-

Table 3 (cont'd)

Set	15		16		17		18		19		20		Total	
Estimated total catch (kg)	22,700		2,300		9,000		1,400		3,600		13,600		132,000	
Duration (min)	135		90		60		75		15		45		1505	
Species	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.
Pacific hake	9,100	-	2,000	-	8,200	-	1,100	-	3,300	-	13,000	-	93,000	-
Walleye pollock	2,300	-	160	-	910	-	270	-	365	-	680	-	23,323	-
Spiny dogfish	<225	-	70	-	<45	-	<12	-	<35	-	<130	-	<4,359	-
Longnose skate													-	1
Northern smoothtongue	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Chinook salmon													2	1
King-of-the-salmon													-	1
Sablefish													<174	-
Copper rockfish													-	1
Pacific ocean perch	<225	-											<225	-
Redstripe rockfish													-	1
Widow rockfish	5,700	-											5,700	-
Yelloweye rockfish											-	1	-	2
Yellowtail rockfish	5,700	-	<20	-					<35	-			<6,171	-

<sup>a</sup>All weights are estimates only. Weights were determined as a percentage of the total estimated catch.  
<sup>b</sup>+ = present in catch <10 kg. Found in mesh in the intermediate of the net.

Table 4. Length frequency of Pacific hake, June 22-26, 1979, M/V CALLISTRATUS.

Set no. Length (cm)	1			3			7			15			20			Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
43											1	1		1	1		2	2
44								1	1		0	0		1	1		2	2
45								1	1		0	0		0	0		1	1
46								0	0		0	0		2	2		2	2
47	1		1				2	2	4	2	2	4	1	5	6	6	9	15
48	0	1	1		1	1	0	6	6	7	7	14	7	8	15	14	23	37
49	1	1	2	1	3	4	5	2	7	12	5	17	3	6	9	22	17	39
50	5	15	20	1	4	5	11	15	26	18	22	40	10	13	23	45	69	114
51	7	14	21	2	8	10	8	19	27	6	20	26	13	21	34	36	82	118
52	8	22	30	1	9	10	9	12	21	11	25	36	9	19	28	38	88	126
53	6	17	23	1	6	7	12	23	35	23	24	47	13	26	39	55	96	151
54	16	28	44	2	8	10	9	20	29	9	28	37	8	32	40	44	116	160
55	7	27	34	3	7	10	5	16	21	4	12	16	7	19	26	26	81	107
56	1	29	30	1	8	9	3	20	23	4	19	23	5	18	23	14	94	108
57	3	16	19	1	5	6	1	9	10	2	8	10	5	14	19	12	52	64
58	2	21	23	0	5	5	0	8	8	3	10	13	2	7	9	7	51	58
59	0	10	10	0	5	5	1	9	10	0	3	3	1	8	9	2	35	37
60	3	12	15	3	9	12		7	7	0	4	4	0	7	7	6	39	45
61	0	5	5		0	0		2	2	1	0	1	0	3	3	1	10	11
62	0	5	5		2	2		0	0		1	1	2	2	4	2	10	12
63	1	6	7		1	1		1	1		3	3		1	1	1	12	13
64	1	2	3		1	1		1	1		1	1		0	0	1	5	6
65		2	2		1	1					1	1		1	1		5	5
66		4	4		0	0					0	0					5	5
67		0	0		0	0					0	0					0	0
68		1	1		1	1					1	1					3	3
69		0	0								0	0					0	0
70		0	0								0	0					0	0
71		0	0								0	0					0	0
72		1	1								1	1					2	2
Total	62	239	301	16	84	100	66	174	240	102	198	300	86	214	300	322	911	1,243

Table 5. Length frequency of Pacific hake, November 1-14, 1979, G.B. REED.

Length (cm)	Set no.											
	2			3			5			9		
	M	F	T	M	F	T	M	F	T	M	F	T
45										2		2
6										0		0
7										0		0
8	1	1	2	1		1				0		0
9	1	1	2	0		0	1		2	0	2	2
50	5	5	10	1		1	1	3	4	1	0	1
1	6	12	18	1	3	4	2	2	4	1	0	1
2	9	20	29	3	3	6	1	5	6	0	2	2
3	9	24	33	5	3	8	5	6	11	2	1	3
4	4	34	38	3	6	9	2	11	13	1	3	4
5	11	27	38	3	4	7	0	7	7	1	5	6
6	5	28	33	3	5	8	6	16	22	1	5	6
7	3	16	19	1	4	5	2	7	9	1	7	8
8	5	11	16	1	2	3	3	16	19	0	4	4
9	4	17	21		4	4	0	10	10	1	6	7
60	2	13	15		3	3	1	8	9		3	3
1	1	7	8		1	1	0	8	8		3	3
2	0	4	4		0	0	0	9	9		2	2
3	1	4	5		0	0	0	4	4		0	0
4		5	5		0	0	0	5	5		0	0
5		1	1		0	0	0	1	1		0	0
6		1	1		0	0	1		1		1	1
7		0	0		1	1	0		0			
8		1	1				1		1			
9												
Total	67	232	299	22	39	61	26	119	145	11	44	55

Table 5 (cont'd)

Length (cm)	Set no.														
	21			23			24			26			Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	Total
45													2		2
6													0		0
7													0		0
8													2	1	3
9													2	4	6
50										1		1	9	8	17
1	1		1		3	3	1		1	0	3	3	12	23	35
2	1		1	1	1	2	0	1	1	0	2	2	15	34	49
3	0	2	2	1	2	3	0	1	1	0	1	1	22	40	62
4	0	2	2	3	1	4	0	1	1	1	1	2	14	59	73
5	0	3	3	0	1	1	0	2	2	1	1	2	16	50	66
6	1	4	5	0	4	4	1	1	2	2	2	4	19	65	84
7	1	8	9	0	2	2	1	0	1	0	3	3	9	47	56
8	0	2	2	0	0	0		0	0	0	0	0	9	35	44
9	1	2	3	1	4	5		2	2	0	3	3	7	48	55
60	0	4	4	0	1	1		1	1	0	3	3	3	36	39
1	0	2	2	1	0	1		0	0	0	5	5	2	26	28
2	0	1	1	0	1	1		3	3	0	3	3	0	23	23
3	1	0	1	0	0	0		1	1	1	1	2	3	10	13
4		1	1	1	1	2		0	0	1	0	1	2	12	14
5		2	2					0	0		2	2	0	6	6
6								2	2		1	1	1	5	6
7														1	1
8														1	1
9															
Total	6	33	39	8	21	29	3	15	18	7	31	38	149	534	683

Table 6. Length frequency of Pacific hake, September 8-14, 1979, M/V KAMYSHIN.

Length (cm)	Set no.									
	1		2		3		5		6 <sup>a</sup>	
	M	F	M	F	M	F	M	F	M	F
40										
1										
2		1								
3	1	0								
4	3	2								
5	2	3								
6	6	2	1	1			2		1	2
7	1	6	0	0	2		0		2	3
8	11	14	1	1	4	3	3	2	4	2
9	26	15	1	1	6	6	1	4	10	7
50	16	20	2	4	3	3	5	12	14	6
1	15	23	1	6	8	14	4	16	17	19
2	16	32	2	10	5	24	8	22	7	19
3	10	21	0	9	8	19	12	19	8	29
4	7	12	1	12	5	18	6	25	7	25
5	0	10	2	10	8	15	10	33	5	21
6	0	4	1	4	5	17	6	25	5	22
7	5	5	0	7	4	10	2	18	1	11
8	4	8	1	7	1	11	1	13	3	14
9	0	2		4	2	6	2	6		13
60	1	2		3	0	9		6		5
1		3		1	1	3		3		4
2		2		1		1		5		6
3		0		2		2		2		3
4		2		2		1		2		2
5		2		0		1		1		3
6		1		0		1		1		1
7		0		0						
8		0		1						
9		0		1						
70		0								
1		1								
2										
3										
4										
5										
Total	124	193	13	87	62	164	62	215	84	217

<sup>a</sup>0tolith sample.

Table 6 (cont'd)

Length (cm)	Set no.						Total		
	11		13		16		M	F	Total
	M	F	M	F	M	F			
40									
1									
2								1	1
3							1	0	1
4			1				4	2	6
5			0				2	3	5
6	1		0			1	11	6	17
7	0	2	0	3	1	0	6	14	20
8	2	1	2	1	1	3	28	27	55
9	4	5	8	10	2	2	58	50	108
50	5	5	9	15	6	4	60	69	129
1	8	12	13	18	6	18	72	126	198
2	6	20	19	12	10	12	73	151	224
3	6	12	7	20	6	24	57	153	210
4	5	20	9	21	10	19	50	152	202
5	5	24	9	32	5	16	44	161	205
6	5	8	8	23	9	16	39	119	158
7	1	11	4	14	3	13	20	89	109
8	1	14	1	15	3	8	15	90	105
9	0	6	0	9	0	5	4	51	55
60	2	3	0	9	1	4	4	41	45
1	0	4	1	4		1	2	23	25
2	0	5	0	2		2	0	24	24
3	1	1	1	1		1	2	12	14
4		1		1		3		14	14
5		1		1		0		9	9
6		1		1		0		6	6
7		1				1		2	2
8						1		2	2
9						1		2	2
70								0	0
1								1	1
2									
3									
4									
5									
<b>Total</b>	<b>52</b>	<b>157</b>	<b>92</b>	<b>212</b>	<b>63</b>	<b>155</b>	<b>552</b>	<b>1,400</b>	<b>1,952</b>

Table 7. Length frequency of Pacific hake, September 9-13, 1979, M/V OTOL.

Length (cm)	Set no.									
	1A		1		2		3		4	
	M	F	M	F	M	F	M	F	M	F
40										
1										
2										
3										
4										
5										
6			1	2			1	1		
7	1		4	1		1	5	0	1	3
8	3	3	1	3	1	3	3	5	1	2
9	7	3	5	5	10	4	6	6	3	3
50	4	7	7	11	6	6	10	10	11	9
1	8	9	12	14	14	10	14	22	13	20
2	7	17	14	15	10	25	18	31	16	17
3	5	20	15	23	11	18	14	18	14	25
4	12	14	11	26	11	22	6	16	13	34
5	4	11	7	27	4	23	13	23	8	26
6	4	13	8	21	5	20	2	14	5	17
7	3	9	5	13	3	12	2	7	4	10
8	2	7	2	9	2	9	3	10	0	6
9	0	15		9	1	11	0	6	0	6
60	1	8		3	0	9	1	3	0	3
1		4		5	0	4	0	6	0	4
2		0		0	1	1	1	2	1	2
3		2		1		1		1		0
4		1		1		2		0		2
5		1		0		2		1		1
6		2		4		1				0
7		1		2						0
8		1		1						0
9										1
70										
1										
2										
3										
4										
5										
<b>Total</b>	<b>61</b>	<b>148</b>	<b>92</b>	<b>196</b>	<b>79</b>	<b>184</b>	<b>99</b>	<b>182</b>	<b>90</b>	<b>191</b>

Table 7 (cont'd)

Length (cm)	Set no.									
	5		6a		9		11		12	
	M	F	M	F	M	F	M	F	M	F
40										
1										
2										
3										
4										
5							1			
6				1			1	1	2	
7	2	1		1	1	1	0	1	1	
8	6	4	1	3	4	3	2	0	8	3
9	4	3	6	4	4	3	1	7	5	2
50	14	6	9	11	8	9	8	8	1	16
1	8	17	12	16	11	13	9	12	15	21
2	12	18	14	20	6	24	7	30	21	22
3	8	19	14	33	12	23	10	28	15	28
4	8	26	11	23	6	23	12	30	15	31
5	8	14	8	31	8	16	11	23	7	23
6	2	21	4	20	5	12	3	25	6	22
7	6	12	3	24	3	12	5	14	1	12
8	1	8	1	9	2	17	1	9	4	5
9	1	6	2	10	1	9	1	8	2	3
60		4		8	2	2	2	1	1	5
1		2		1	0	5		3		3
2		1		1	0	0		2		2
3		1		2	0	1		2		0
4		0		1	1	1		2		0
5		0		1		1		1		1
6		0		0				0		
7		0		0				0		
8		0		0				1		
9		1		1						
70				0						
1				1						
2										
3										
4										
5										
Total	80	164	85	222	74	175	74	208	104	199

<sup>a</sup>Otolith sample.

Table 7 (cont'd)

Length (cm)	Set no.										
	13		14		16		18		Total		
	M	F	M	F	M	F	M	F	M	F	Total
40											
1											
2											
3											
4											
5				1					1	1	2
6		1	3	1			1		9	7	16
7	1	0	2	1	1		0	1	19	11	30
8	3	0	5	2	5	7	2	1	45	39	84
9	8	4	10	5	6	1	6	6	81	56	137
50	8	10	9	12	13	12	7	10	115	137	252
1	15	13	12	19	15	19	9	18	167	223	390
2	9	13	10	21	16	22	11	15	171	290	461
3	13	27	14	24	12	24	11	19	168	329	497
4	9	25	11	26	14	23	8	21	147	340	487
5	10	21	13	24	6	15	3	9	110	286	396
6	4	16	6	13	3	16	5	18	62	248	310
7	3	18	5	7	1	15	1	11	45	176	221
8	1	10	3	11	0	4	3	9	25	123	148
9	0	9		7	1	3	0	11	9	113	122
60	2	4		3	1	5	0	0	10	58	68
1		2		4	1	2	0	5	1	50	51
2		4		3	0	0	1	1	4	19	23
3		4		3	1	1		3	1	22	23
4		3		0		2		0	1	15	16
5		0		1		1		0		11	11
6		2		0				1		10	10
7		0		0						3	3
8		0		0						3	3
9		1		0						4	4
70				0						0	0
1				0						1	1
2				0						0	0
3				0						0	0
4				0						0	0
5				1						1	1
<b>Total</b>	<b>86</b>	<b>187</b>	<b>103</b>	<b>189</b>	<b>96</b>	<b>172</b>	<b>68</b>	<b>159</b>	<b>1,191</b>	<b>2,576</b>	<b>3,767</b>

Table 8. Length frequency of all hake samples from all cruises, 1979.

Length (cm)	Table 2			Table 4			Table 5		
	M	F	T	M	F	T	M	F	T
42									
3		1	1		2	2			
4		0	0		2	2			
5		0	0		1	1	2		2
6		1	1		2	2	0		0
7		4	4	6	9	15	0		0
8		4	4	14	23	37	2	1	3
9		2	2	22	17	39	2	4	6
50		9	9	45	69	114	9	8	17
1		6	6	36	82	115	12	23	35
2		10	10	38	88	126	15	34	49
3		8	8	55	96	151	22	40	62
4		9	9	44	116	160	14	59	73
5		10	10	26	81	107	16	50	66
6		7	7	14	94	108	19	65	84
7		6	6	12	52	64	9	47	56
8		6	6	7	51	58	9	35	44
9		2	2	2	35	37	7	48	55
60		7	7	6	39	45	3	36	39
1		1	1	1	10	11	2	26	28
2		2	2	2	10	12	0	23	23
3		1	1	1	12	13	3	10	13
4		1	1	1	5	6	2	12	14
5		2	2		5	5	0	6	6
6		0	0		5	5	1	5	6
7		0	0		0	0		1	1
8		1	1		3	3		1	1
9					0	0			
70					0	0			
1					0	0			
2					2	2			
3									
4									
5									
Total		100	100	332	911	1,243	149	534	683

Table 8 (cont'd)

Length (cm)	Table 6			Table 7			Total all fish		
	M	F	T	M	F	T	M	F	T
42		1	1					1	1
3	1	0	1				1	3	4
4	4	2	6				4	4	8
5	2	3	5	1	1	2	5	5	10
6	11	6	17	9	7	16	20	16	36
7	6	14	20	19	11	30	31	38	69
8	28	27	55	45	39	84	89	94	183
9	58	50	108	81	56	137	163	129	292
50	60	69	129	115	137	252	229	292	521
1	72	126	198	167	223	390	287	460	747
2	73	151	224	171	290	461	297	573	870
3	57	153	210	168	329	497	302	626	928
4	50	152	202	147	340	487	255	676	931
5	44	161	205	110	286	396	196	588	784
6	39	119	158	62	248	310	134	533	657
7	20	89	109	45	176	221	86	370	456
8	15	90	105	25	123	148	56	305	361
9	4	51	55	9	113	122	22	249	271
60	4	41	45	10	58	68	23	181	204
1	2	23	25	1	50	51	6	110	116
2	0	24	24	4	19	23	6	78	84
3	2	12	14	1	22	23	7	57	64
4		14	14	1	15	16	4	47	51
5		9	9		11	11	0	33	33
6		6	6		10	10	1	26	27
7		2	2		3	3		6	6
8		2	2		3	3		10	10
9		2	2		4	4		6	6
70		0	0		0	0		0	0
1		1	1		1	1		2	2
2					0	0		2	2
3					0	0		0	0
4					0	0		0	0
5					1	1		1	1
Total	552	1,400	1,952	1,191	2,576	3,767	2,224	5,521	7,745

Table 9. Mean size and sample size (in parentheses) of Pacific hake for each age found off the south west coast of Vancouver Island in 1979.

Age	May			June		
	M	F	T	M	F	T
3						
4		47.0(4)	47.0(4)	48.0(2)	52.0(5)	50.9(7)
5		53.6(5)	53.6(5)	50.6(3)	50.3(4)	50.4(7)
6		53.2(21)	53.2(21)	50.8(16)	52.1(26)	51.6(42)
7		52.7(11)	52.7(11)	51.8(9)	52.5(16)	52.2(25)
8		53.4(5)	53.4(5)	51.7(14)	52.8(32)	52.5(46)
9		54.4(30)	54.4(30)	51.8(34)	54.0(49)	53.1(83)
10		54.0(9)	54.0(9)	51.8(10)	53.9(25)	53.3(35)
11		60.4(5)	60.4(5)	55.4(5)	55.9(14)	55.8(19)
12		65.0(1)	65.0(1)	52.5(2)	56.0(3)	54.6(5)
13		60.0(3)	60.0(3)	56.0(1)	58.3(3)	57.7(4)
14		58.5(2)	58.5(2)		54.3(4)	54.3(4)
15		56.0(1)	56.0(1)		56.5(2)	56.5(2)
16						
17						
18					72.0(1)	72.0(1)
19						

Table 9 (cont'd)

Age	September			November		
	M	F	T	M	F	T
3		53.0(1)	53.0(1)	45.0(1)	56.0(1)	50.5(2)
4	49.0(1)	53.6(5)	52.8(6)		53.5(12)	53.5(12)
5	50.1(8)	53.0(23)	52.3(31)	52.3(9)	54.3(28)	53.8(37)
6	51.5(21)	52.5(49)	52.2(70)	53.6(11)	55.9(27)	55.2(38)
7	52.7(21)	53.6(51)	53.3(72)	54.7(11)	55.8(48)	55.6(59)
8	52.1(32)	54.8(80)	54.0(112)	53.6(32)	56.3(84)	55.6(116)
9	51.8(37)	54.9(92)	54.0(129)	53.0(32)	56.6(127)	55.9(159)
10	52.8(16)	55.9(43)	55.0(59)	54.9(8)	58.8(34)	58.6(42)
11	53.7(7)	57.0(33)	56.4(40)	56.9(14)	57.5(27)	57.3(41)
12	53.2(6)	57.7(12)	56.2(18)	53.0(5)	60.2(19)	58.7(24)
13	53.5(2)	57.8(12)	57.2(14)	56.0(2)	57.7(10)	57.4(12)
14	55.0(3)	54.7(6)	54.8(9)		58.6(8)	58.6(8)
15	57.0(1)	56.0(3)	56.3(4)		58.3(9)	58.3(9)
16	51.5(2)	62.0(1)	55.0(3)	63.0(1)	54.0(1)	58.5(2)
17		56.0(1)	56.0(1)	53.5(2)	59.0(2)	56.3(4)
18	53.0(1)	63.5(2)	60.0(3)		55.0(1)	55.0(1)
19					57.5(2)	57.5(2)

Table 10. Relative year class strength after correcting for total mortality.

Age	1976		1979	
	n	n corrected for total mortality	n	n corrected for total mortality
5	70	108	85	131
6	535	1,266	262	620
7	137	499	156	568
8	103	577	303	1,697
9	164	1,413	263	2,267
10	67	888	74	981
11	30	612	60	1,224
12	58	1,183	31	973
13	32	1,004	12	579
14	28	2,080	10	743
15	60	6,856	10	1,143
16	33	5,802	2	352
17	11	2,975	4	1,082
18			1	416
19			2	1,280

Table 11. Mean size (cm) and age (yr) of Pacific hake found of Canada and the United States in 1976. (Sample size in parentheses.)

Age	Canada		United States	
	Male	Female	Male	Female
3	43.8 (5)	45.0 (3)	43.0 (1)	45.9 (7)
4	44.8 (5)	46.0 (4)	43.8 (4)	46.6 (7)
5	50.0 (7)	53.5 (19)	48.8 (18)	49.3 (26)
6	49.4 (60)	52.4 (140)	48.4 (126)	49.2 (209)
7	50.7 (13)	54.0 (44)	48.1 (26)	49.6 (54)
8	53.6 (16)	58.4 (46)	50.3 (18)	52.1 (23)
9	57.0 (28)	58.8 (89)	51.9 (21)	53.1 (28)
10	54.7 (9)	59.3 (36)	52.4 (8)	53.4 (14)
11	56.6 (8)	60.3 (14)	51.6 (5)	54.0 (3)
12	59.0 (12)	62.3 (35)	50.8 (4)	54.4 (7)
13	60.5 (4)	63.5 (20)	53.0 (3)	55.8 (5)
14	57.0 (3)	60.2 (16)	51.0 (1)	51.6 (8)
15	55.5 (7)	61.5 (37)	50.4 (5)	55.0 (11)
16	59.7 (3)	61.2 (19)	51.5 (4)	54.3 (7)
17	67.0 (1)	64.5 (7)	51.7 (3)	-
Total	(181)	(529)	(247)	(409)

Table 12. USSR catch of Pacific hake (t) off the west coast of North America by PMFC and/or INPFC area<sup>a,b</sup>.

Year	Area <sup>a</sup>	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1967													
	2A,B,C,D,3A,B	—	146	—	—	43,600	—	—	57,082	—	—	31,328	—
	1A,B,C	—	2,750	—	—	15,070	—	—	20,279	—	—	2,694	—
1968													
	3C,D,5A,B,C,D	—	423	—	—	14,455	—	—	25,825	—	—	614	—
	2A,B,C,D,3A,B	—	140	—	—	23,328	—	—	24,786	—	—	18,399	—
	1A,B,C	—	—	—	—	3,950 <sup>c</sup>	—	—	—	—	—	125 <sup>c</sup>	—
1969													
	3C,D,5A,B,C,D	—	—	—	—	266	—	—	61,741	—	—	2,922	—
	2A,B,C,D,3A,B	—	—	—	—	54,184	—	—	25,752	—	—	13,706	—
1970													
	3C,D,5A,B,C,D	—	—	—	—	19,119	—	—	6,372	—	—	—	—
	2A,B,C,D,3A,B	—	—	—	—	58,092	—	—	94,755	—	—	47,907	—
	1A,B,C	—	—	—	—	4,352	—	—	1,167	—	—	471	—
1971													
	Charlotte	—	—	—	—	—	—	—	—	446	24	120	—
	Vancouver	—	—	—	—	4,741	1,355	3,844	4,321	1,028	6,820	3,290	72
	Columbia	—	—	—	5,419	18,965	18,965	19,385	20,877	19,385	11,345	11,345	—
1972													
	Charlotte	—	—	—	—	—	—	—	—	2,874	76	—	—
	Vancouver	—	—	—	—	1,879	6,888	5,018	11,574	6,769	4,119	4,102	—
	Columbia	—	—	—	—	9,393	13,149	19,222	9,611	10,985	5,221	—	—
	Eureka	—	—	—	—	2,249	—	d	—	—	—	2,831 <sup>e</sup>	—
	Monterey and Conception	—	—	—	—	1,125	—	—	—	—	—	2,831 <sup>e</sup>	—

Table 12 (cont'd)

Year	Area <sup>a</sup>	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1973	5A,B,E							1,094	2,644	1,626	3,778		
	3C,D							1,054	798	920	1,925		
	2B,C,D,3A,B				3,304	826	10,899	30,475	29,768	15,444	7,811		
	2A,1C					5,310	3,081						
	1B				1,961	8,431	9,215	4,890	4,638	3,008			
1974	Vancouver							d	1,867	15,144			
	Columbia			743	4,481	4,768	2,487	13,077	5,408	13,944			
	Eureka					15,456	13,351	d	6,651	2,519			
	Monterey and Conception				d	14,962	11,114	d	13,759	17,631	1,145		
1975	Vancouver								3,493				
	Columbia					1,780	8,574	24,867	5,499				
	Eureka					3,752	9,906	2,478	1,503				
	Monterey and Conception				18,048	30,386	25,112	18,629	4,871				
1976	Vancouver							280	3,638				
	Columbia					14,865	24,380	20,662	19,770	16,655			
	Eureka					3,827	4,642	3,975	3,070				
	Monterey				8,021	11,474	11,278	10,279	1,231				

<sup>a</sup>See Appendix Fig. 1 for area boundaries.

<sup>b</sup>Catch estimates were obtained from a number of unpublished and uncitable documents from the International North Pacific Fisheries Commission, Pacific Marine Fisheries Commission (Data series-groundfish section), Morski Instytut Rybacki (Activities of the Polish fishing fleet in the Northeast Pacific), and meetings of scientists and experts of Canada and the USSR on Fisheries Investigations in the Northeastern Pacific Ocean as well as Ketchen (1977) and Dark (1975). Catches should be considered to be best estimates and are significant to the number of digits indicated.

<sup>c</sup>Does not include 524 t taken during 1968 in these areas.

<sup>d</sup>Unreported but probably some catch at this time.

<sup>e</sup>Unreported by USSR.

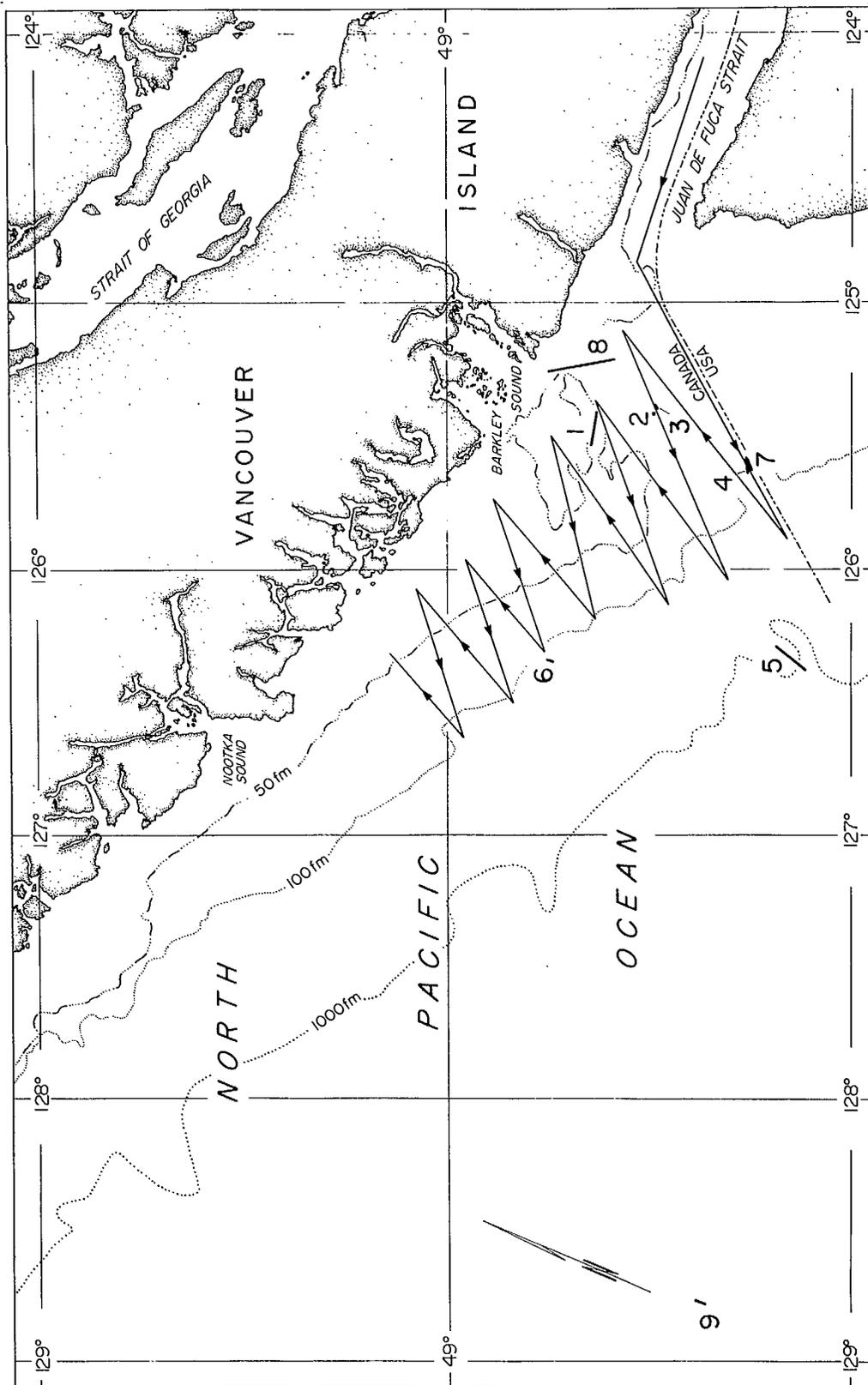


Fig. 1. Survey pattern and set locations for the May 13-18 cruise.



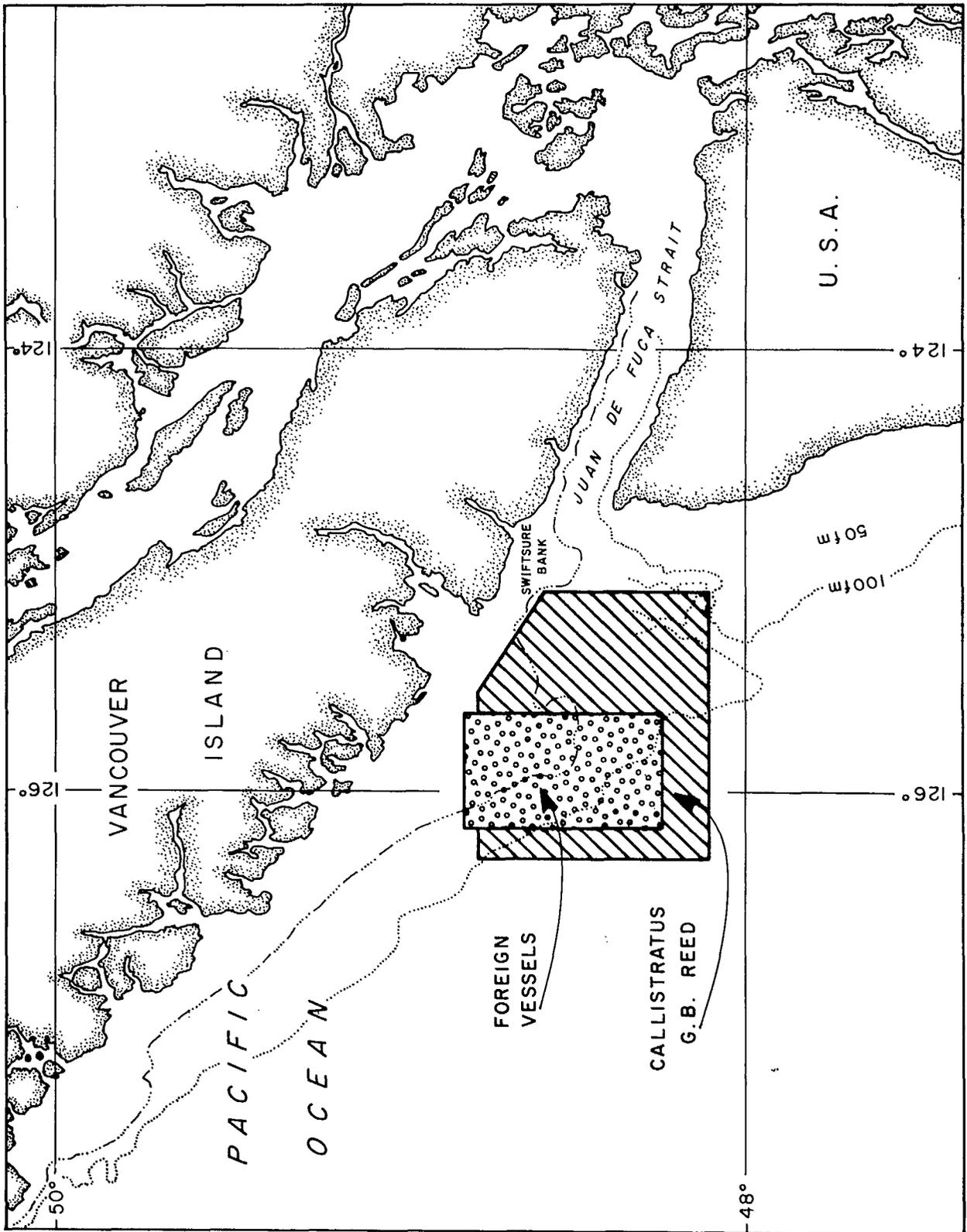
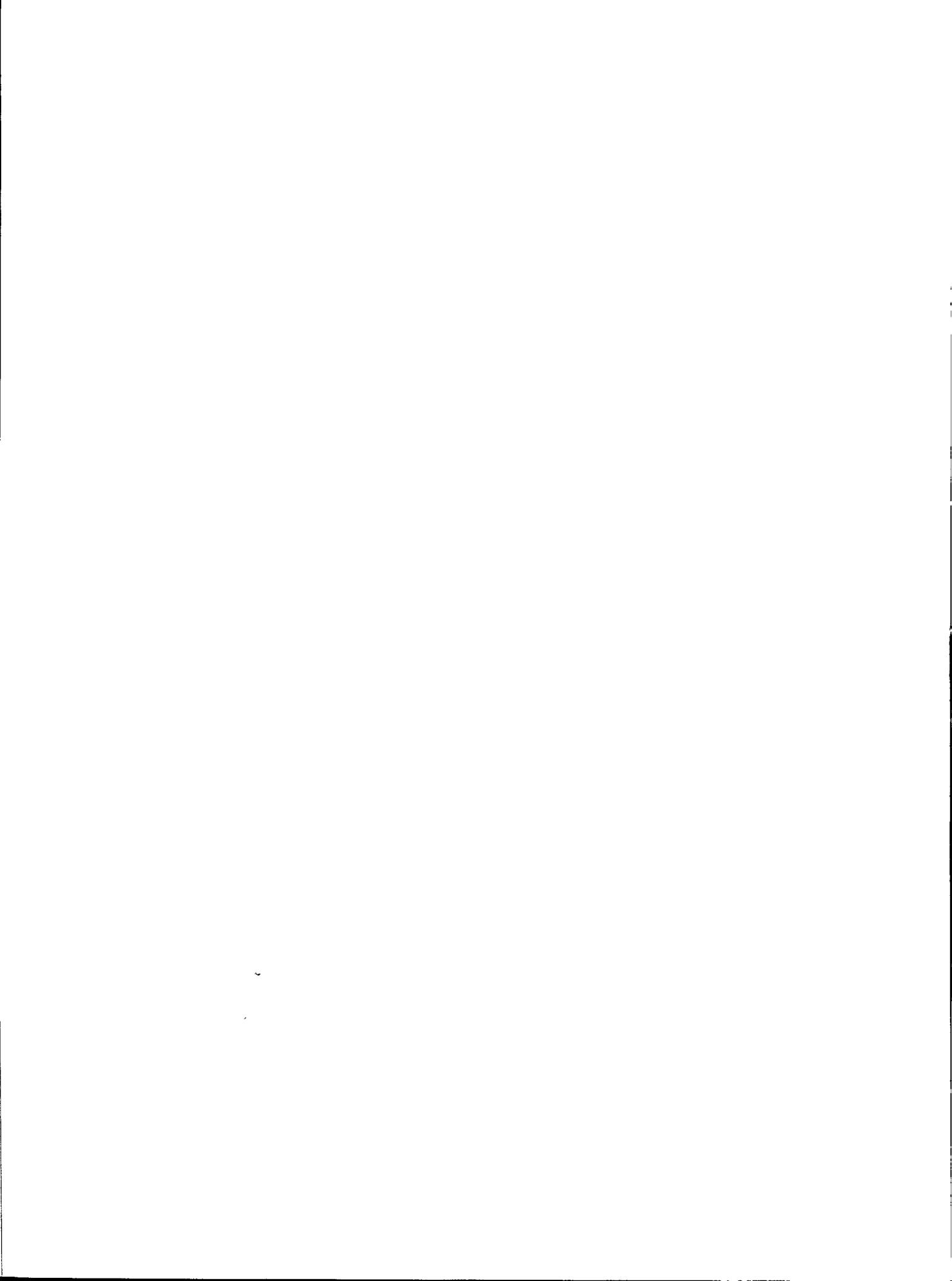


Fig. 2. General sampling locations for samples collected on Foreign Vessels and aboard the G.B. REED in November 1979.



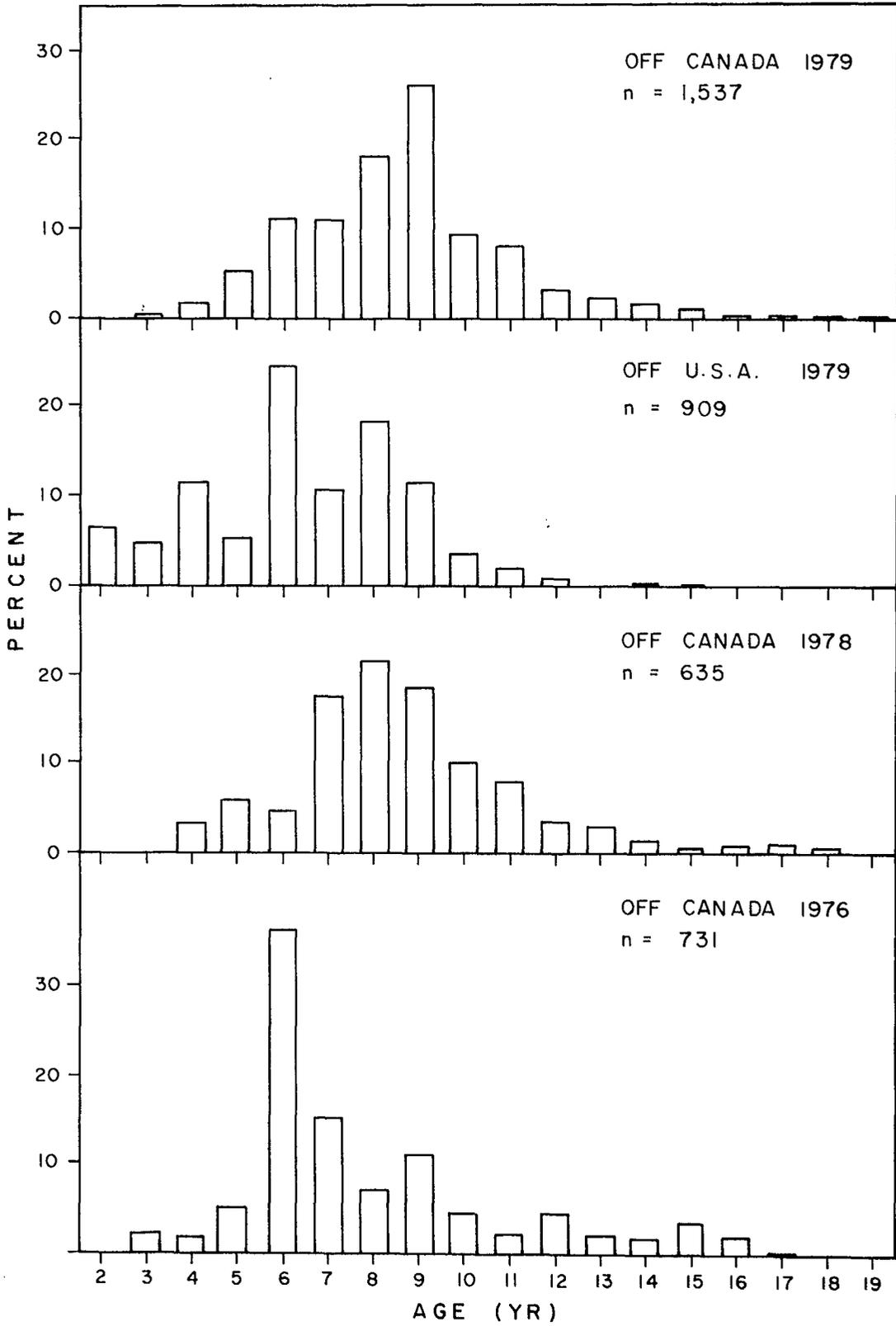


Fig. 3. Age compositions of Pacific hake catches, 1978 sample obtained on foreign vessels (Leaman et al. 1980).



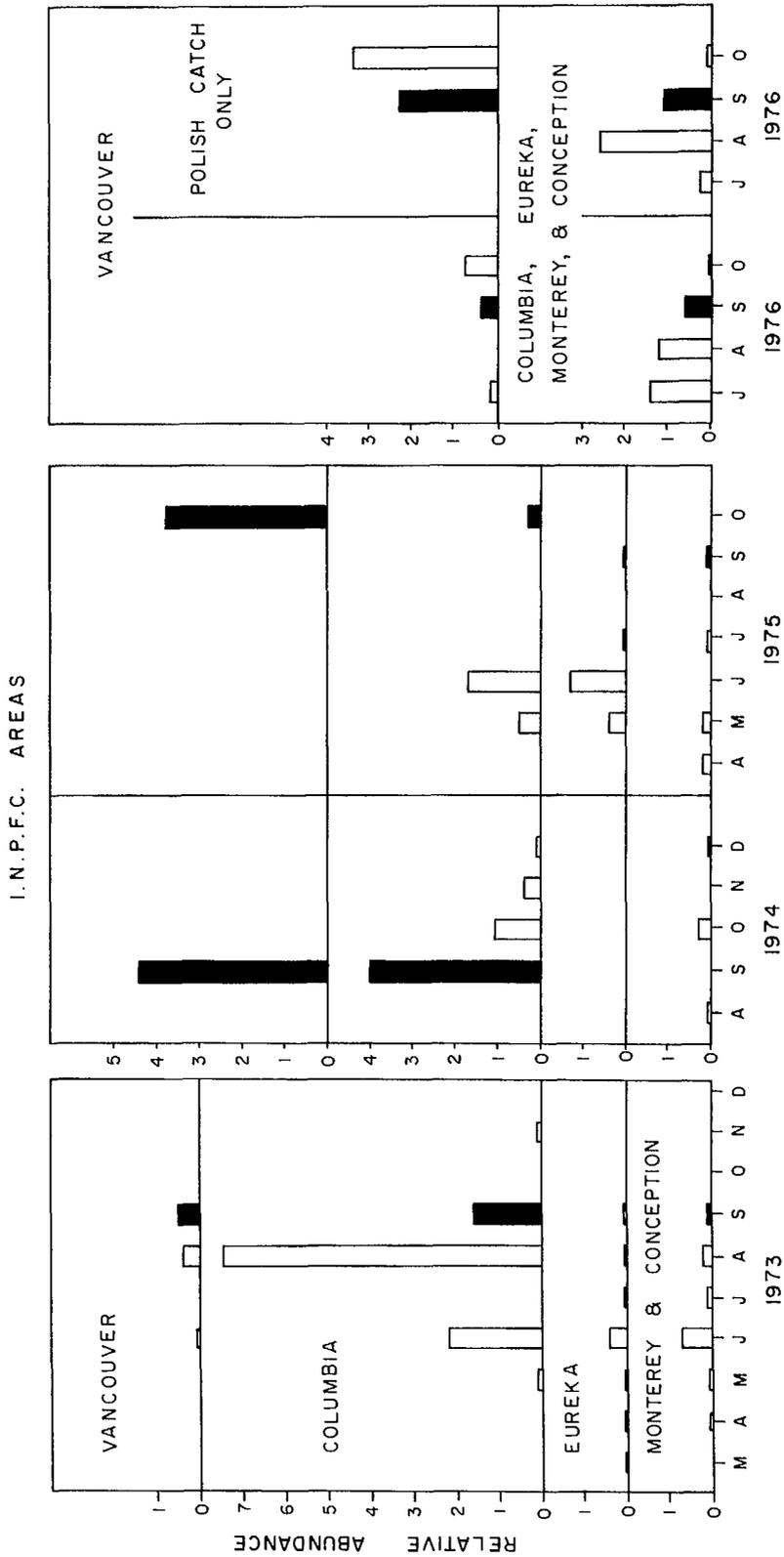
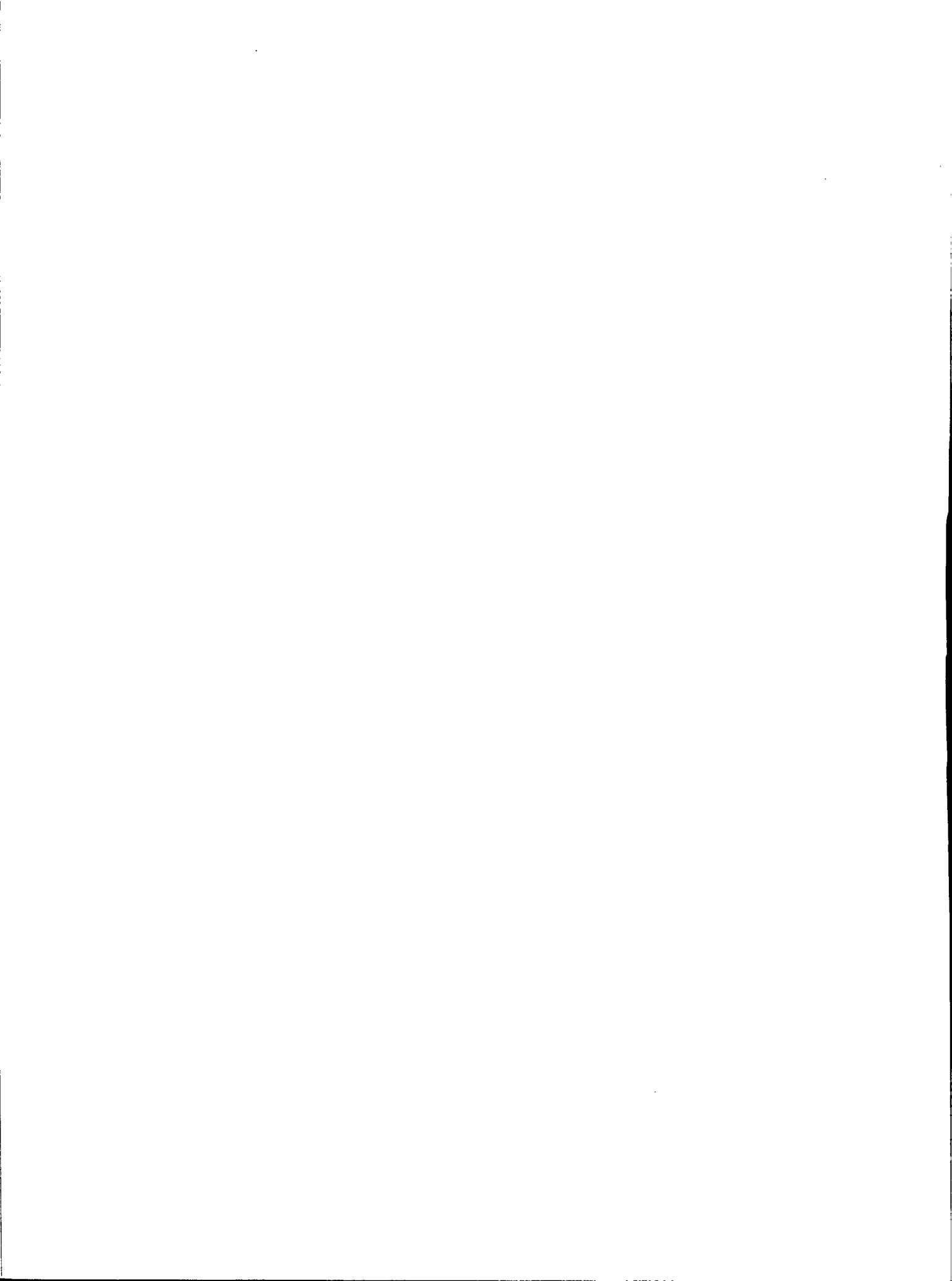


Fig. 4. Relative abundance of catches of hake  $\geq 54$  cm by the foreign fishery by INPFC area from 1973 to 1976. The catches during September are shown in black for reference. Size data from sources identified in footnote b, Table 10.



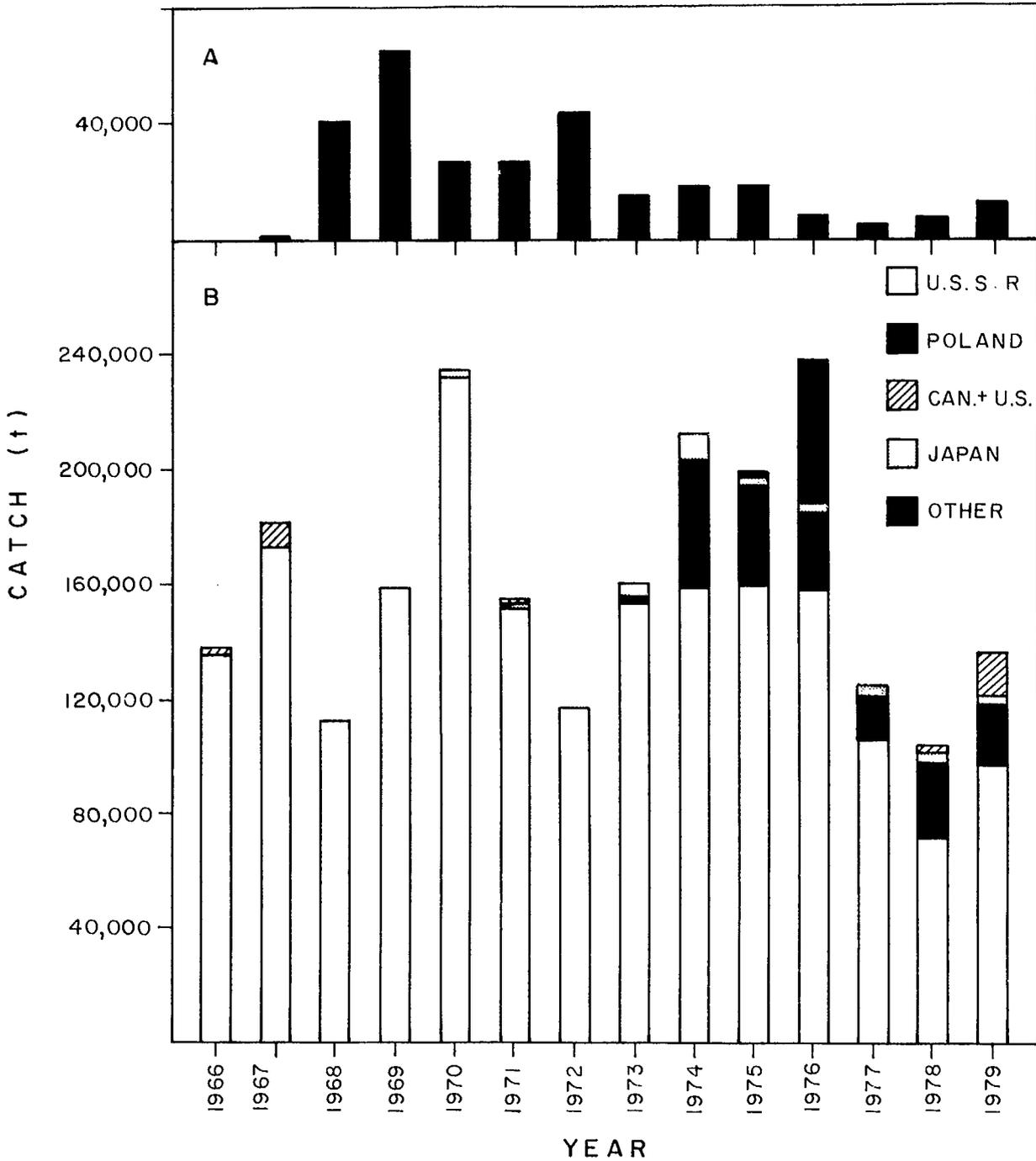
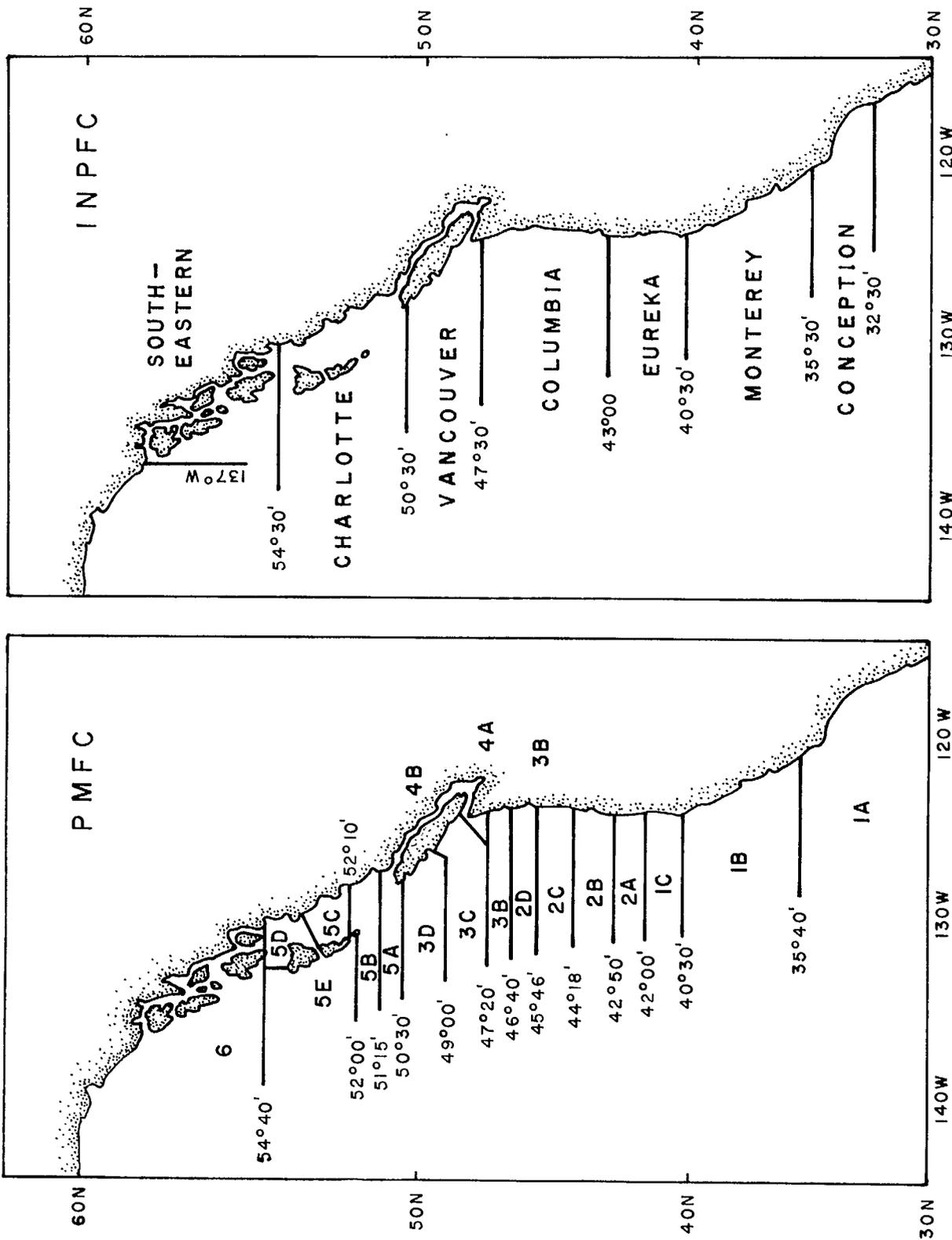


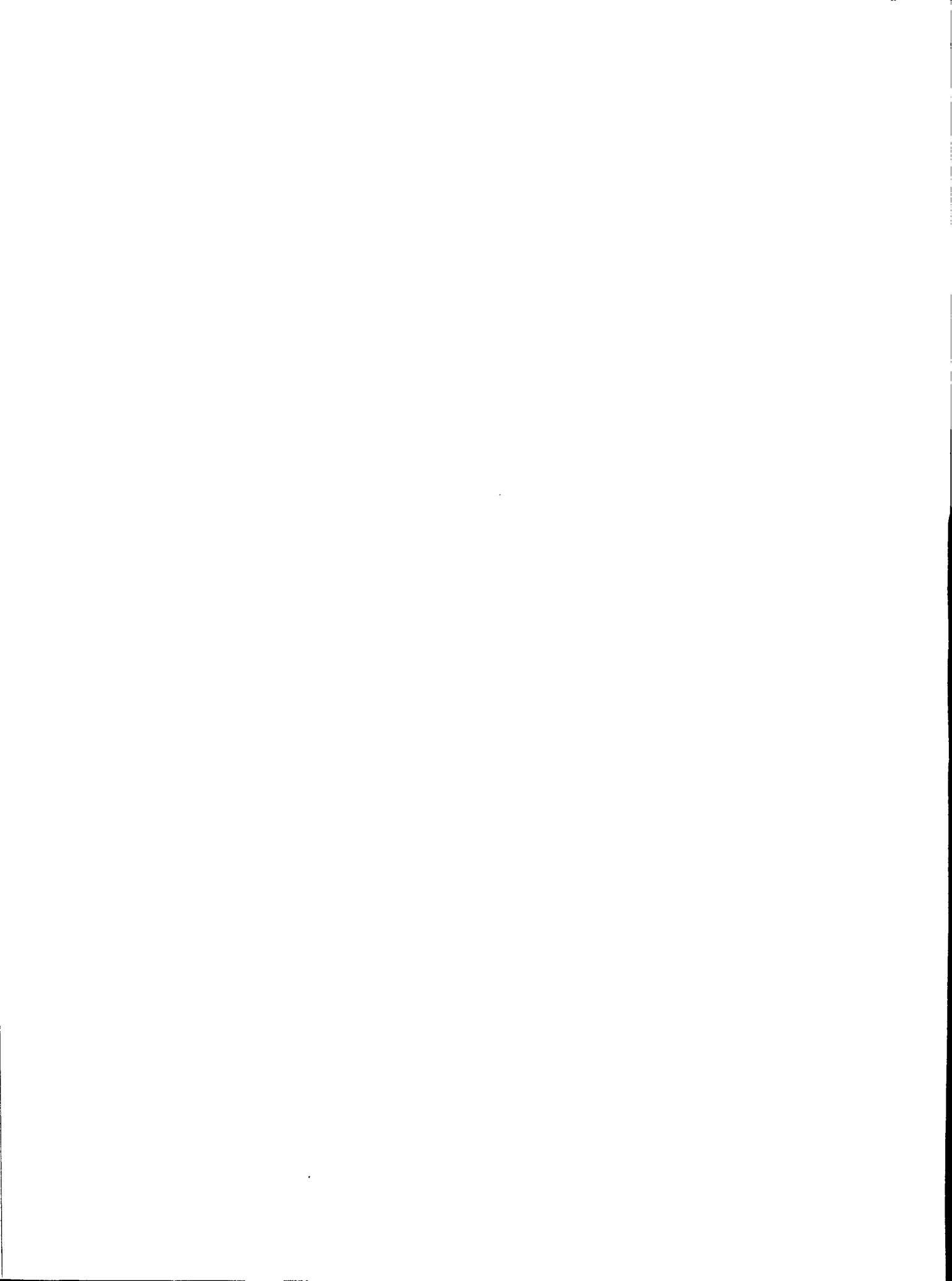
Fig. 5. A. Pacific hake catch off the west coast of Canada and the State of Washington to 47°30'N. 1966-79.

B. All nation catch of Pacific hake off the west coast of North America 1966-79.





Appendix Fig. 1. Pacific Marine Fisheries Commission (PMFC) and International North Pacific Fisheries Commission (INPFC) international statistical areas.



Appendix Table 1. Scientific and common names of species captured, May 13-18, 1979 and June 22-26, 1979.

Common name	Scientific name
Pacific hake	<u>Merluccius productus</u>
Walleye pollock	<u>Theragra chalcogramma</u>
Spiny dogfish	<u>Squalus acanthias</u>
Longnose skate	<u>Raja rhina</u>
Northern smooth tongue	<u>Leuroglossus stilbius schmidti</u>
Chinook salmon	<u>Oncorhynchus tshawytscha</u>
Chum salmon	<u>Oncorhynchus keta</u>
King-of-the-salmon	<u>Trachipterus altivelis</u>
Sablefish	<u>Anoplopoma fimbria</u>
Copper rockfish	<u>Sebastes caurinus</u>
Pacific ocean perch	<u>Sebastes alutus</u>
Redstripe rockfish	<u>Sebastes proriger</u>
Widow rockfish	<u>Sebastes entomelas</u>
Yelloweye rockfish	<u>Sebastes ruberrimus</u>
Yellowtail rockfish	<u>Sebastes flavidus</u>
Yellowmouth rockfish	<u>Sebastes reedi</u>
Redbanded rockfish	<u>Sebastes babcocki</u>
Shortspine thornyhead	<u>Sebastolobus alascanus</u>
Pacific herring	<u>Clupea harengus pallasii</u>
Petrale sole	<u>Eopsetta jordani</u>
Arrowtooth flounder	<u>Atheresthes stomias</u>
Pacific cod	<u>Gadus macrocephalus</u>
American shad	<u>Alosa sapidissima</u>
Ribbon barracudina	<u>Notolepis rissoi rissoi</u>
Eulachon	<u>Thaleichthys pacificus</u>
Glass shrimp	<u>Pasiphaea pacifica</u>
Squid (unidentified)	
Jellyfish (unidentified)	



