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**MANUSCRIPT REPORT SERIES**

**No. 1226**

**The Offshore Herring Survey off Southwest  
Vancouver Island in 1971.**

**Report on *A. P. Knight* Cruises APK 71-1  
(January 18-February 4) and APK 71-2  
(March 16-April 1)**

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**L. W. Barner and F. H. C. Taylor**

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## INTRODUCTION

The efficient management of the herring stock requires that each year catch be adjusted so that a spawning stock remains, which under average conditions of survival will maintain the population at a high level. To adjust catch effectively an estimate of the expected recruitment is needed. Estimates of abundance prior to recruitment are possible at several life history stages. The earlier the estimate of abundance is made the less reliable the resulting estimate of recruitment is likely to be because of mortality during the intervening period, but the more time industry and management will have for planning.

In southern British Columbia at least, estimates of pre-recruit abundance might be possible while the herring are offshore between the ends of their first and third summers. Offshore surveys could be carried out at two periods: (1) in late winter and early spring for abundance estimates of the 0+ and 1+ age groups, while the older mature age groups were inshore spawning; (2) in summer immediately before the prespawning migration for abundance estimates of the 1+ age group, the newly recruiting 2+ age group and also of the older age groups. The 0+ age group would not be fully represented offshore at this time.

Echo-sounder surveys using a target-integrating technique will be used to estimate abundance in conjunction with midwater trawling to identify the schools and determine their composition.

The soundings are recorded on magnetic tape for later detailed analysis and integration in the laboratory.

In 1971 two exploratory offshore cruises were made with the C.G.S. A. P. Knight to obtain information on the distribution, abundance and age, size and maturity composition of herring offshore in midwinter for comparison with that provided by the 1969-70 herring survey conducted under contract to the Industrial Development Branch (I.D.B.) of the Fisheries Service (FRBC Technical Reports 174, 177, 183, 190). A second purpose was to develop techniques for estimating size and numbers of herring schools from echo-sounder records. The first cruise (APK 71-1) was from January 18 to February 4, the second (APK 71-2) from March 16 to April 1.

## METHODS

### A. Coverage

#### 1. Areas

Both of these cruises covered the Strait of Juan de Fuca, Barkley

Sound and La Pérouse Bank with a more intense and detailed survey being done on the southeast and southwest corners of La Pérouse Bank, Cape Beale Spit, Finger Bank and Swiftsure Bank (Fig. 1).

## 2. Duration

Each cruise lasted about 17 days. Most time was spent on La Pérouse Bank. The Strait of Juan de Fuca was investigated while the A. P. Knight was en route to and from the west coast of Vancouver Island. Barkley Sound was surveyed when weather or other circumstances prevented work offshore.

## B. Equipment

### 1. Nets and fishing gear

During the 1968, 1969 and 1970 I.D.B. herring surveys with the Royal Canadian and Sharlene K, Engel trawls of 1400 meshes and Canadian Diamond trawls of 1160 meshes in circumference, all of 8-inch stretched measure (between knot centres), were used. These nets were too large for the 76 ft A. P. Knight and were replaced with 434-mesh Engel trawls. In these trawls the mesh tapers from 16 inches (stretched mesh) in the wings and forward section of the body to  $1\frac{1}{2}$  inches in the codend. The codend was lined with  $\frac{3}{4}$ -inch knotless web, and was rigged with a splitting strap and at the forward end with a choker. The headline had 55 8-inch trawl floats. The footrope was weighted with 100 lb of chain with an additional 220 lb on each wing-corner. Suberkrub otter boards  $3^2$  meters in area were attached to the net by 40-fm sweepelines of  $\frac{1}{2}$ -inch cable. During operation the vertical opening of the net was 7-9 fm depending upon speed of vessel.

Several problems were at first encountered handling the large mesh (16 inch) in the body and wings of the trawl. When the net was hauled in on the trawl drum the 8-inch plastic floats tended to break the meshes near the headrope or pass right through them. This created major "hang-ups," requiring considerable time to "clear" when resetting the net. To avoid this problem the plastic floats were wrapped in a netting tube of  $3\frac{1}{2}$ -inch polypropylene webbing and as a further precaution against "hang-ups" the chains and shackles on the footrope were covered with small mesh netting.

### 2. Electronic equipment

The same Elac net-sounder system (30 kHz) was used as during the 1968, 1969 and 1970 I.D.B. herring surveys (Technical Report No. 140). It is possible to select by a switch either an upward or a downward sounding transducer mounted on the headline of the trawl.

A Simrad scientific sounder (EK38A) was installed which operated at 38 kHz with a pulse power output of 1000 watts. The sounder system was calibrated to determine its amplification characteristics on transmission and reception so that target strength estimates were possible.

The Simrad sounder was connected through an interface unit to a Tandberg, Model 3000 × 4 track stereo tape recorder. This made it possible to record echo soundings on magnetic tape for later integration and analysis. In addition the sounder and tape recorder were connected to a S54A Teleequipment Oscilloscope. The oscilloscope was used to monitor signal characteristics and check equipment performance.

A Walker Trident log was installed to measure speed and distance travelled. The log was also connected to the sounder through a timer unit which generated both 1/10-mile and minute marks for automatic display on the sounder paper.

### 3. Fishing technique

The midwater trawling technique described by Johnson (MS presented at the Second Commercial Fish Exposition, Boston, Mass., October 16, 1968) was followed, but modified because of vessel limitations. The main winch, mechanically driven, could not be engaged while towing at full speed, therefore it was necessary to slow the ship before hauling gear. This can result in a loss of fish. Also, the hydraulic trawl drum when under any strain would not winch in at a satisfactory speed. This drum and its hydraulic motor were eventually replaced.

### 4. Weight of catch

The same technique as in the 1968 and 1969-70 herring surveys was used in handling the catch. If the catch was small then the entire catch was brought aboard and sorted into species. Total weight of each species was obtained using a platform scale. If the catch was large each split was brought aboard, sorted for incidental (non-herring) species which were retained, and the remainder was discarded. A representative split was retained, sorted and the species weighed. The total weight of the haul and of each species was then estimated from the number of splits and the contents of the split sorted. In some cases where the catch was too large or there was danger to personnel from heavy seas only the first split of fish was retained. The remainder was estimated from the size of the net and previous experience. The details of each tow and the catch by species are given in Appendix Tables 1-2.

### 5. Sampling of age and length composition

Only herring were sampled for age, maturity and length composition. From each catch a random sample was taken. This sample was frozen for later examination in the laboratory. From each sample of herring a random subsample of 100 fish was taken. From each of these fish a scale was removed and mounted, the standard length measured to the nearest millimeter, and the sex and degree of maturity was recorded. The remainder of herring in the sample were sexed and measured by 3-mm length groups. A single scale was taken from each of the first 10 fish in each length group. These scales, together with those in the serially ordered 100-fish sample, formed the basis of an age-length key. As in the 1968 and 1969-70 I.D.B. herring cruises, age-length keys were prepared for each area of concentration on each cruise.

The number of fish of each age in each sample was calculated from the total measured using the age-length key for the area of concentration to which the sample belonged. The percentage age composition for an area of concentration was obtained by averaging the percentage age compositions of all samples within that area. Only the 100 fish samples in each area of concentration were summed for each age, and the average length, standard deviation and standard error of the mean calculated.

#### 6. Estimation of herring abundance

The same method as in the 1968 I.D.B. herring survey (Technical Report 140) was adopted to provide a very rough estimate from echo-sounder records of relative herring abundance. To put the results on the same basis as on previous cruises it was necessary to divide the sizes of all the schools measured in 1971 by a factor of  $2\frac{1}{2}$  to compensate for the faster paper speed of the scientific sounder (EK38A). A second estimate of abundance may be possible when the tape recordings of echo-soundings from the schools located are analysed at a later date by the echo-integrator.

#### 7. Stomach contents

The stomach contents of a few dogfish (Squalus acanthias) and hake (Merluccius productus) were examined as time permitted. Only the presence of a food item was recorded; no estimate was made of the quantity or the proportion each item formed of the stomach contents. The results were expressed as the percentage each food item formed of the number of stomachs containing food.

## RESULTS

### A. Coverage

The cruise tracks and areas showing more detailed coverage on each of the two cruises are shown in Fig. 2 and 3. On each cruise tows were made whenever concentrations of fish were located by echo-sounder. The positions of the tows are shown in Fig. 4 and 5; the amount of the herring (in pounds) in each tow appears above the tow number. Details on date, time, depth, and species composition of each haul are given in the Appendix Tables 1 and 2.

### B. Catch

#### 1. Effectiveness of the net

The size of the herring catches does not reflect herring abundance. Hauls were made primarily to identify the schools encountered and to provide an adequate sample. Using a net sounder one could "see" the fish entering the net. To avoid large catches tows were hauled when it was felt there was enough in the net for an adequate sample.

The 434-mesh Engel trawl fished as effectively as the larger trawls. It towed through the water much more easily than any net used previously. If there was any decrease in fishing effectiveness, it was because of vessel limitations rather than net limitations.

## 2. Composition of the catches

(a) On the first cruise, 23 tows were made, 2 in the Strait of Juan de Fuca, 9 along the outer 50-fm edge of La Pérouse Bank (5 on the southeast corner and 4 on the southwest corner) (Fig. 4) and 12 in Barkley Sound (when the weather offshore was too bad for fishing). The predominant species were herring Clupea pallasii, whiting Theragra chalcogrammus, hake Merluccius productus and dogfish Squalus suckleyi. Herring were taken in 20 of the 23 tows, whiting in 8, hake in 4, dogfish in 8 and salmon in 4. Rockfish and eulachon occurred in relatively small numbers in 5 and 2 tows, respectively. Herring catches varied from a trace (less than 1 lb) to 13,056 lb (in a 17-minute tow); whiting from 3 to 3604 lb (in 2 minutes); hake from 3 to 240 lb (in 20 minutes); and dogfish from 8 to 468 lb (in 12 minutes). Salmon catches varied from a trace to 7 lb. The largest catch of rockfish was 30 lb (20 lb of Sebastes paucispinis and 10 lb of Sebastes flavidus) and of eulachon, 15 lb.

(b) On the second cruise, 26 tows were made, 6 in the Strait of Juan de Fuca, 3 tows in Barkley Sound and 17 tows in 30-60 fm on La Pérouse Bank (primarily on the southeast and southwest corners and on the Finger Bank) (Fig. 5). The predominant species were herring, dogfish and hake. Herring were taken in 21 of 26 tows, dogfish in 5, hake in 3 and salmon in 8. Whiting were taken in 8 tows; all either in the Strait of Juan de Fuca or Barkley Sound. Rockfish and eulachons were taken, in relatively small numbers, in 6 tows each. Herring catches varied from a trace to 3423 lb (in 9 minutes), hake 165 to 828 lb (in 30 minutes) and dogfish catches 15 to an estimated 100,000 lb<sup>1</sup> (in 11 minutes). The few rockfish catches ranged from 1 to 16 lb. Eulachon catches ranged from 1 to 80 lb.

On these two cruises to the west coast of Vancouver Island, herring occurred more often alone than in combination with other fish. Where mixed catches were made, salmon occurred with herring on more hauls than did dogfish, although not in as large quantities. On cruise APK 71-1, dogfish occurred in 4 of the 9 tows made offshore. On cruise APK 71-2, herring occurred in 14 of the 17 offshore tows, but never with dogfish. However, 1 tow contained 100,000 lb of only dogfish.

In the inside areas (the Strait of Juan de Fuca and Barkley Sound) herring occurred most often alone; in offshore areas the most frequent combination was herring and hake, then herring and dogfish (Table 1).

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<sup>1</sup>The vessel was unable to haul such a large quantity of fish and it was necessary to estimate the weight of catch from the amount of the net filled.

### 3. Depth distribution

On the two cruises to the west coast of Vancouver Island most of the herring were caught at 30 to 60 fm (Tables 2 and 3) with the majority of the herring concentrating on the edge of banks or gullies near or very close to the 50-fm edge. In the Strait of Juan de Fuca herring were in much deeper water, up to 100 fm; catches, however, were small. It was interesting to note that when the gear was towed near the bottom almost anywhere within the Strait of Juan de Fuca at least a trace of herring (generally juveniles) would be caught. They did not seem to be in definite schools, but rather were distributed over and near the bottom.

### C. Distribution of herring schools

Delineation of areas of herring concentration was made from echo-sounder records. These estimates indicate in a rough way differences in abundance between locations and between cruises. No quantitative estimate of abundance (tons) of fish was attempted.

The estimates of herring abundance, mileage and time spent were summed in rectangles of 5 minutes of latitude by 5 minutes of longitude. These rectangles were grouped into major areas of concentration. The total amount of herring, the total mileage, the time spent searching in minutes, and the mileage with herring are given in Table 4 for each area of concentration both directly and as a percentage.

The main areas of concentration were the southeast and southwest corners of La Pérouse Bank, Firing Range and Cabbage Patch, Cape Beale Spit and Swiftsure Bank (Fig. 1). During cruise APK 71-1, the largest concentrations occurred on the southwest and southeast corners of La Pérouse Bank (Fig. 6 and Table 4). Smaller concentrations were found on the Cabbage Patch and Cape Beale Spit. No herring concentrations were found on Swiftsure Bank. On this cruise herring were found offshore in much the same areas as in January, 1970 but in larger numbers. Fewer herring were found in Barkley Sound than in 1970 (Technical Report No. 190). During the early part of the cruise there was little evidence of herring in Barkley Sound. However, in the latter part herring began to appear in large schools (Fig. 6 and Table 4). It would appear that the herring were later migrating inshore to spawn in 1971 than 1970. It is worth considering that in 1971 some severe storms occurred just before the herring started to move into Barkley Sound.

During cruise APK 71-2, the largest concentrations occurred again on the southeast and southwest corners of La Pérouse Bank (Fig. 7 and Table 4); smaller concentrations occurred on Cape Beale Spit, Firing Range, Cabbage Patch, and on Swiftsure Bank (Table 4). Very small concentrations were found in Barkley Sound, however the herring had just spawned as milt was observed in the water covering approximately a 2-mile area off Lyall Point on March 22. No fish were observed around the area although they may have been in very shallow water.

The concentrations of herring occurred in very much the same areas as

they had in March of 1970, however the concentrations on the southeast corner and on the Finger Bank were larger. Herring on the southwest corner were found in slightly shallower water in 1971 than 1970, possibly moving with the tide or feed.

The amount of herring on Swiftsure Bank in 1971 was less than 1970. The timing of the cruises in relation to the time of migration may be such that herring are missed in some years.

While travelling to the west coast of Vancouver Island on cruise APK 71-1 two tows were made in the Strait of Juan de Fuca. The first tow was made off Trial Island on a distinct fish school in 50 fm of water. The catch consisted of 14 lb of juvenile herring (less than 120 mm), 28 lb of whiting and 8 lb of dogfish. The second tow was made on a deep layer of single-fish echoes, 87-103 fm in the middle of the Strait of Juan de Fuca and contained 4 lb of juvenile herring, 157 lb of dogfish, 15 lb of eulachon and 9 lb of whiting.

During cruise APK 71-2 six tows were made in the Strait of Juan de Fuca. All were made at 80-110 fm on single-fish echoes. Herring catches were small and were about evenly split between adults and juveniles. The total catch for the six tows was: herring, 26 lb; dogfish, 2022 lb; ratfish, 229 lb; eulachons, 177 lb; whiting, 158 lb; and rockfish, 41 lb.

While catches were small, some herring were taken in all tows made in the Strait of Juan de Fuca. Thus, it would appear herring may be widely but very thinly distributed over the Strait, with juveniles being perhaps a little more numerous than adults.

#### D. Age and length composition of herring concentrations

The percentage age composition of each of the various concentrations of herring encountered on the two cruises is shown in Tables 5 and 6 together with at each age, the average length, standard error, and standard deviation. The length frequency distributions, by 3-mm length groups, are given in Appendix Tables 3 and 4 by hauls for the obvious areas of concentration.

#### E. Stomach contents

The occurrence of food items in the stomachs of dogfish is shown in Appendix Tables 4 and 5. The dogfish have been grouped by 5-cm intervals of total length. Only 44 stomachs were examined from offshore waters; all from the southwest corner of La Pérouse Bank. The dogfish were large, ranging in size from 90 to 112 cm. Herring formed 66% of the diet, and sand lance were found in 4% of the stomachs with food. Digested material occurred in 23% and unidentifiable fish fragments in 7%.

There were 132 dogfish stomachs examined from the Strait of Juan de Fuca. The main item was eulachons (44% of stomachs containing food); herring in 3%, euphausiids in 6%; digested material in 38%; and jellyfish in 9%. The greater abundance of eulachon than herring is thus reflected not only proportionally

in the catches but also in the food of a major predator in the Strait of Juan de Fuca.

F. Hake length frequency

On cruise APK 71-2, 114 young hake from Effingham Inlet were measured. The size ranged from 27 cm to 48 cm. The mode was at 30 cm. No stomach analysis was undertaken because most of the hake had regurgitated their food.

G. Salmon

Details of the length, weight, and age of the various species of salmon caught are given by haul in Appendix Tables 7 and 8.

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The captain and crew of the C.G.S. A. P. Knight have all contributed much to the success of the cruises by their knowledge and generally helpful attitude. The excellent efforts of the electronic section headed by Mr. J. S. Ford, ably assisted by Mr. M. C. Armstrong, have been deeply appreciated as they were responsible for all electronic calibrations, interfacing of various components necessary for magnetic tape-recording of fish schools. Mr. R. S. K. Isaacson conducted the herring age determinations assisted by Mrs. Margaret Burke. Mr. E. A. R. Ball completed the age determinations for the salmon collected.

Table 1. The number of tows on each cruise in which herring, hake, dogfish and salmon occurred alone or in combination with one another.

	APK 71-1	APK 71-2
Herring	7	9
Hake	0	0
Dogfish	0	1
Salmon	0	0
Herring, hake	3	2
Herring, dogfish	5	2
Herring, salmon	2	7
Herring, hake, dogfish	1	0
Herring, hake, salmon	0	0
Herring, dogfish, salmon	2	1
Herring, hake, dogfish, salmon	0	0
Hake, dogfish	0	1
Hake, salmon	0	0
Hake, dogfish, salmon	0	0
Dogfish, salmon	0	0
Total	20	23

Table 2. The depth distribution of each of the main species caught on cruise APK 71-1 to the west coast of Vancouver Island, showing catch in pounds and in parentheses the number of hauls in which each species occurred. Figures not underlined represent depths of capture; figures underlined, depth of water.

Depth (fm)	Whiting	Adult herring	Hake	Dogfish	Salmon	Total
0-20	3,604 (1)	1,802 (4)	-	-	4 (1)	5,410
	<u>3,604</u> ( <u>1</u> )	<u>1,802</u> ( <u>4</u> )	-	-	<u>4</u> ( <u>1</u> )	<u>5,410</u>
21-30	-	-	-	-	-	-
31-40	-	10,102 (3)	-	48 (2)	-	10,150
	-	<u>10,001</u> (2)	-	<u>40</u> (1)	-	<u>10,041</u>
41-50	10 (1)	18,195 (5)	-	72 (2)	8 (2)	18,285
	<u>10</u> (1)	<u>18,296</u> (6)	-	<u>80</u> (3)	<u>8</u> (2)	<u>18,394</u>
51-60	-	1 (1)	10 (1)	-	-	11
	-	<u>1</u> (1)	<u>10</u> (1)	-	-	<u>11</u>
61-70	50 (2)	132 (3)	240 (1)	550 (3)	-	972
	<u>50</u> (2)	<u>132</u> (3)	<u>240</u> (1)	<u>550</u> (3)	-	<u>972</u>
71-80	13 (3)	6 (3)	9 (2)	-	-	28
	<u>13</u> (3)	<u>6</u> (3)	<u>9</u> (2)	-	-	<u>28</u>
81-90	-	-	-	-	-	-
91-100	9 (11)	4 (1)	-	157 (1)	Tr (1)	170
	<u>9</u> (11)	<u>4</u> (1)	-	<u>157</u> (1)	<u>Tr</u> (1)	<u>170</u>
>100	-	-	-	-	-	-
Total catch by species	3,686 (8)	30,242 (20)	259 (4)	827 (8)	12 (4)	35,026
	<u>3,686</u> (8)	<u>30,242</u> (20)	<u>259</u> (4)	<u>827</u> (8)	<u>12</u> (4)	<u>35,026</u>

Table 3. The depth distribution of each of the main species caught on cruise APK 71-2 to the west coast of Vancouver Island, showing catch in pounds and in parentheses the number of hauls in which each species occurred. Figures not underlined represent depths of capture; figures underlined, depth of water.

Depth (fm)	Whiting	Adult herring	Hake	Dogfish	Salmon	Total
0-20	-	-	-	-	-	-
21-30	-	265 (1)	-	-	8 (1)	273 (2)
	-	<u>265</u> (1)	-	-	<u>8</u> (1)	<u>273</u> (2)
31-40	-	2,232 (7)	-	-	13 (3)	2,245 (10)
	-	<u>2,232</u> (7)	-	-	<u>13</u> (3)	<u>2,245</u> (10)
41-50	-	3,683 (4)	-	-	15 (3)	3,698 (7)
	-	<u>3,667</u> (3)	-	-	<u>11</u> (2)	<u>3,678</u> (5)
51-60	44 (1)	3,513 (3)	252 (1)	100,000 (1)	-	103,809 (6)
	<u>44</u> (1)	<u>3,529</u> (4)	<u>252</u> (1)	<u>100,000</u> (1)	<u>4</u> (1)	<u>103,829</u> (8)
61-70	-	-	-	-	-	-
71-80	53 (4)	15 (3)	165 (1)	502 (2)	-	740 (10)
	<u>10</u> (1)	-	<u>165</u> (1)	<u>52</u> (1)	-	<u>227</u> (3)
81-90	75 (2)	8 2	828 (1)	15 (1)	-	926 (6)
	<u>44</u> (3)	<u>18</u> (3)	-	<u>470</u> (2)	-	<u>532</u> (7)
91-100	41 (1)	3 (1)	-	724 (1)	5 (1)	773 (4)
	<u>Tr</u> (1)	<u>2</u> (1)	-	-	-	<u>2</u> (2)
>100	<u>115</u> (2)	<u>6</u> (2)	<u>828</u> (1)	<u>724</u> (1)	<u>5</u> (1)	<u>1,678</u> (7)
Total catch by species	213 (8)	9,719 (21)	1,245 (3)	101,246 (5)	41 (8)	112,464
	<u>213</u> (8)	<u>9,719</u> (21)	<u>1,245</u> (3)	<u>101,246</u> (5)	<u>41</u> (8)	<u>112,464</u>

Table 4, The amount of herring (in square centimeters) the vessel mileage travelled (in miles) and the extent of searching time (in minutes) are shown for the major areas of herring concentrations, both directly and as a percentage, for cruise APK 71-1, January 21-February 3, and cruise APK 71-2, March 17-31, west coast of Vancouver Island.

	Firing Range	Cabbage Patch	S.W. Corner	S.E. Corner	Cape Beale Spit	Swiftsure	Other areas (<50 fm)	Barkley Sound	Total
<u>APK 71-1</u>									
Miles	20	140	72	117	95	68	87	144	743
Minutes	126	994	715	1000	597	462	749	1335	5978
Herring	-	7	75	40	2	-	2	21	147
% miles	3	19	9	16	13	9	12	19	100
% herring	-	4.8	51.0	27.2	1.4	-	1.4	14.3	100
Herring/mile	-	.05	1.04	0.34	0.02	-	0.02	0.15	0.20
<u>APK 71-2</u>									
Miles	40	72	87	200	112	40	75	148	774
Minutes	308	476	1031	2182	882	294	522	1137	6832
Herring	1	3	17	127	17	1	-	3	169
% miles	5	9	11	26	15	5	10	19	100
% herring	0.6	1.8	10.0	75.2	10.0	0.6	-	1.8	100
Herring/mile	0.02	0.04	0.20	0.64	0.15	0.03	-	0.02	0.22

Table 5. Percentage age composition by haul for cruise APK 71-1 to the west coast of Vancouver Island January 18 to February 4, 1971 and for each area of concentration the average percentage age composition, average length at each age with standard deviation and standard error

Area of Concentration		Haul # APK 71-1	Assigned Sample #	Age - years completed and additional growth								
				0+	1+	2+	3+	4+	5+	6+	7+	8+
Trial Island 19	% age composition	1	880	87.92	10.40	1.68	-	-	-	-	-	-
	average			87.92	10.40	1.68	-	-	-	-	-	-
	average length			98.22	145.29	179.8	-	-	-	-	-	-
	standard deviation			7.92	8.21	15.53	-	-	-	-	-	-
	standard error			0.49	1.474	6.94	-	-	-	-	-	-
Strait of Juan de Fuca 20	% age composition	2	881	79.17	16.67	4.17	-	-	-	-	-	-
	average			79.17	16.67	4.17	-	-	-	-	-	-
	average length			97.87	150.06	183.25	-	-	-	-	-	-
	standard deviation			8.32	6.45	11.84	-	-	-	-	-	-
	standard error			0.95	1.61	5.92	-	-	-	-	-	-
Southwest Corner	% age composition	6	885	-	.48	47.21	39.60	9.08	1.12	2.50	-	-
		7	886	.36	25.96	63.62	9.33	.73	0	-	-	-
		9	887	-	5.82	61.48	27.53	4.96	.20	-	-	-
	average			.12	10.75	57.44	25.49	4.92	.44	.83	-	-
	average length			119.5	163.27	194.90	211.34	219.83	225.4	236.8	-	-
	standard deviation			0	9.34	10.82	7.86	6.26	3.79	2.68	-	-
	standard error			0	1.04	0.58	0.67	1.22	2.40	1.20	-	-
Southeast Corner	% age composition	11	888	-	16.67	73.33	10.00	-	-	-	-	-
		17	890	-	8.42	70.21	18.38	2.35	.37	.27	-	-
		18	891	-	2.03	73.84	21.58	2.37	-	.21	-	-
	average			-	9.04	72.46	16.65	1.57	.12	.16	-	-
	average length			-	166.93	193.67	207.31	214.23	235.0	220.00	-	-
	standard deviation			-	12.69	7.84	7.99	9.91	0	0	-	-
	standard error			-	2.36	0.41	0.79	2.86	0	0	-	-
Barkley Sound	% age composition	3	882	-	21.19	51.20	20.55	4.13	.29	.88	.88	.88
		4	883	97.22	2.78	-	-	-	-	-	-	-
		5	884	89.47	3.16	7.37	-	-	-	-	-	-
		12	889	100.00	-	-	-	-	-	-	-	-
		19	892	-	13.47	58.60	20.83	3.72	.85	1.27	-	1.27
		20	893	-	2.50	50.88	33.39	7.73	1.00	4.50	-	-
		21	894	96.21	3.03	.67	.08	-	-	-	-	-
		23	895	65.90	23.52	9.10	1.34	.13	-	-	-	-
	average			56.10	8.71	22.23	9.52	1.96	.27	.83	.11	.27
	average length			93.31	160.70	193.81	209.18	219.23	226.0	234.31	-	244.00
standard deviation			10.01	12.28	11.85	10.32	7.18	0	5.60	-	4.24	
standard error			0.39	1.20	0.88	1.18	1.81	0	2.20	-	3.00	

Table 6. Percentage age composition by haul for cruise APK 71-2 to west coast of Vancouver Island March 16 to April 1, 1971 and for each area of concentration the average percentage age composition, average length at each age with standard deviation and standard error.

Area of Concentration		Haul # APK 71-2	Assigned Sample #	Age - years completed and additional growth								
				0+	1+	2+	3+	4+	5+	6+	7+	8+
Strait of Juan de Fuca	% age composition	1	973	87.50	5.00	6.65	0.82	-	-	-	-	-
		2	974	68.00	32.00	-	-	-	-	-	-	-
		3	972	58.00	32.00	8.32	1.16	-	0.50	-	-	-
		24	975	62.50	18.75	14.92	2.77	-	1.04	-	-	-
		25	976	43.43	41.67	14.05	0.84	-	-	-	-	-
		26	977	50.00	17.50	25.16	4.32	-	1.00	-	2.00	-
	average			61.57	24.49	11.52	1.65	-	0.42	-	0.33	-
	average length			100.21	149.67	192.63	205.00	-	219.00	-	242.00	-
	standard deviation			8.69	8.90	11.70	12.72	-	-	-	-	-
	standard error			0.77	1.03	2.13	6.36	-	-	-	-	-
Barkley Sound	% age composition	15	986	14.50	70.02	14.81	0.67	-	-	-	-	-
	average length			120.50	157.76	175.13	196.00	-	-	-	-	-
	standard deviation			3.53	10.40	10.04	-	-	-	-	-	-
	standard error			2.50	1.40	2.59	-	-	-	-	-	-
Cape Beale Spit	% age composition	4	978	4.23	72.60	23.17	-	-	-	-	-	-
	average length			111.00	161.95	183.72	-	-	-	-	-	-
	standard deviation			10.42	11.97	9.08	-	-	-	-	-	-
	standard error			5.21	1.76	2.14	-	-	-	-	-	-
Southwest Corner	% age composition	5	980	-	55.53	33.18	10.00	1.28	-	-	-	-
		6	982	0.65	30.94	55.19	12.12	1.10	-	-	-	-
		9	984	14.00	62.45	20.18	2.82	0.53	-	-	-	-
		10	985	17.78	60.20	18.67	3.33	-	-	-	-	-
	average			8.11	52.28	31.81	7.07	0.73	-	-	-	-
	average length			110.00	161.63	184.01	199.50	202.00	-	-	-	-
standard deviation			7.85	10.01	10.62	6.76	-	-	-	-	-	
standard error			1.90	0.86	1.05	1.69	-	-	-	-	-	
Southeast Corner	% age composition	16	988	22.33	53.64	20.27	3.25	0.39	0.05	0.05	-	-
		17	990	4.86	18.64	55.01	17.94	2.37	0.92	0.23	-	-
		18	992	22.93	56.57	18.41	1.98	0.10	-	-	-	-
		19	994	6.88	35.77	44.34	11.25	1.13	0.32	0.32	-	-
		20	996	-	18.07	66.46	14.52	0.92	-	-	-	-
		21	997	2.75	40.00	51.12	5.88	0.22	-	-	-	-
		22	998	3.50	46.15	42.29	6.19	0.80	0.53	0.53	-	-
		23	798	-	8.89	58.66	23.30	4.41	2.37	2.37	-	-
	average			7.91	34.72	44.57	10.54	1.29	0.52	0.44	-	-
	average length			114.10	162.27	190.19	205.30	211.70	(230.32)	232.00	-	-
	standard deviation			6.40	11.63	10.92	9.92	8.26	-	18.52	-	-
	standard error			1.02	0.80	0.66	1.25	2.61	-	10.69	-	-

Note: The average length for the 5+ age fish on the Southeast Corner was calculated from the length frequency sample.

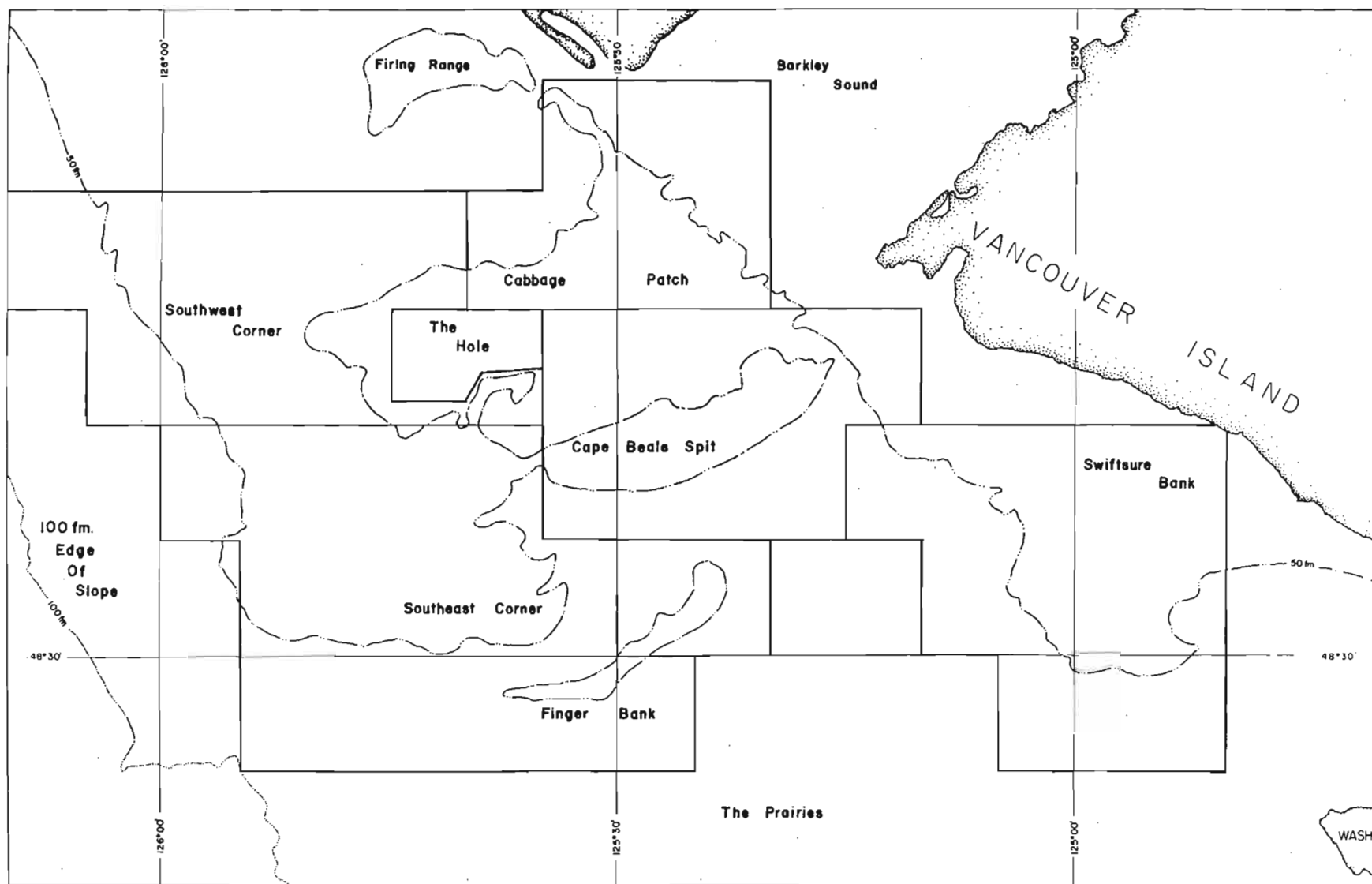


Fig. 1. The southwest coast of Vancouver Island showing place names and boundaries used for the major areas of herring concentration.

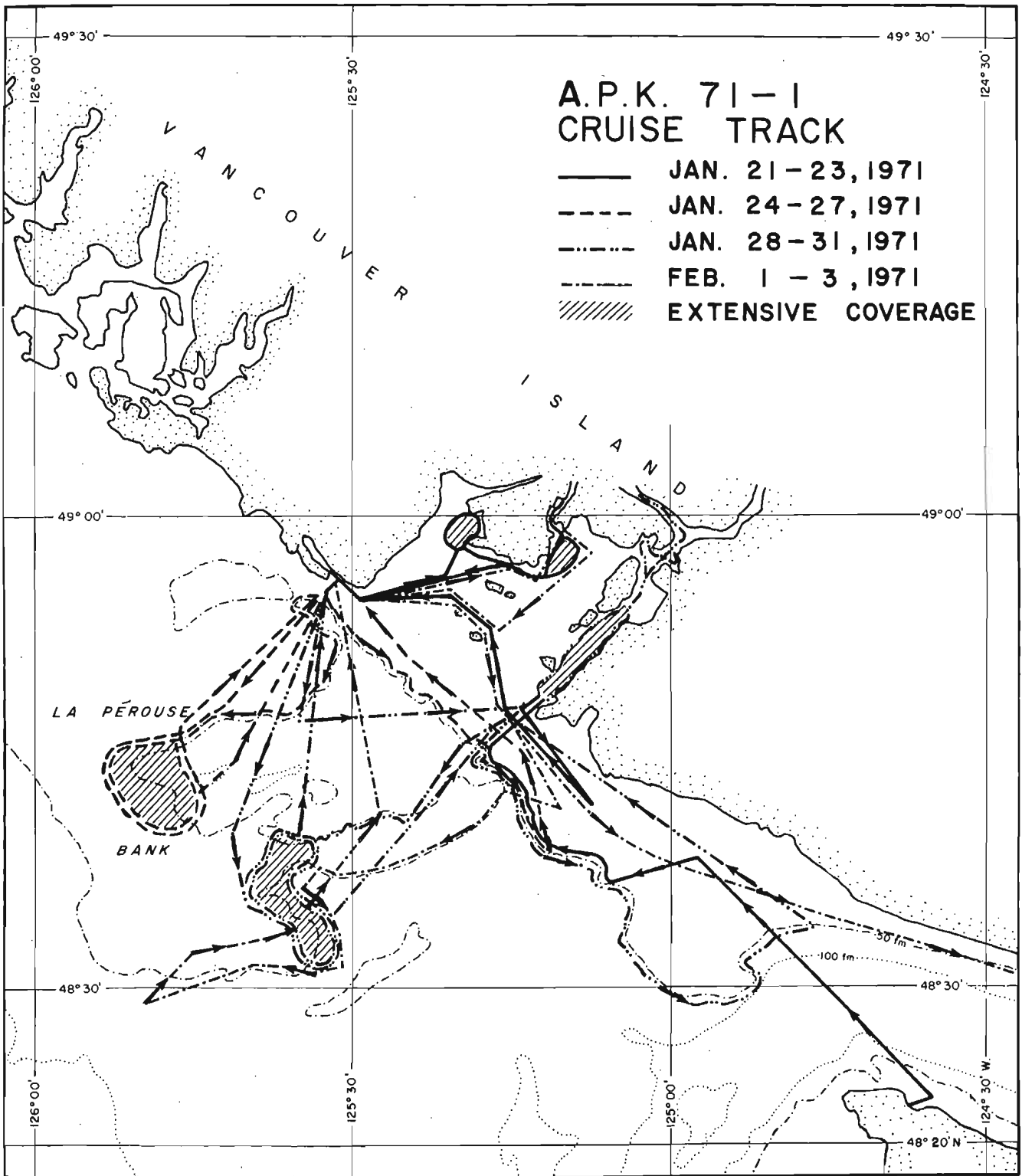


Fig. 2. Track of cruise APK 71-1, west coast of Vancouver Island, January 21-February 3, 1971.

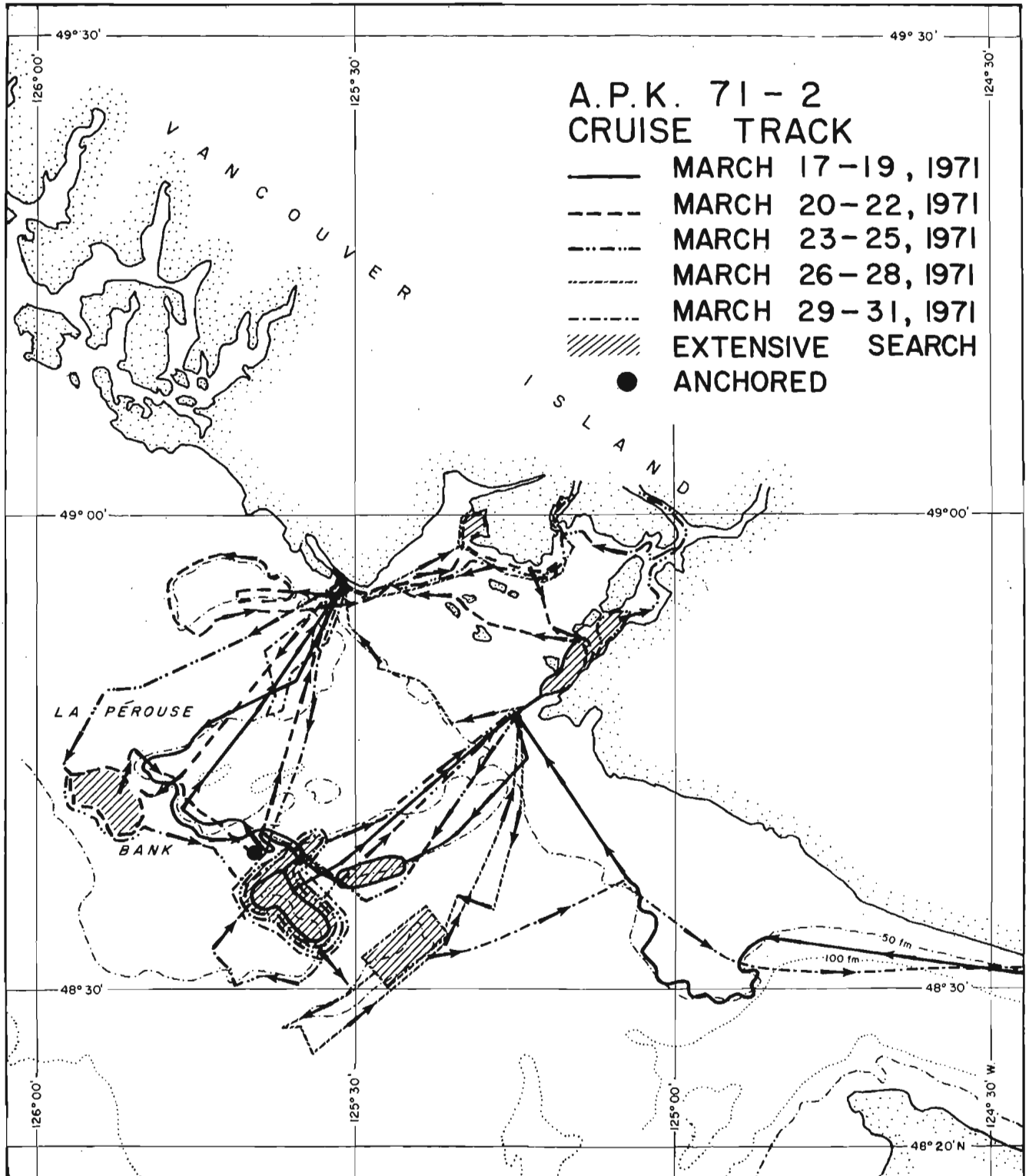


Fig. 3. Track of cruise APK 71-2, west coast of Vancouver Island, March 17-31, 1971.

A.P.K. 71-1  
 FISHING POSITIONS  
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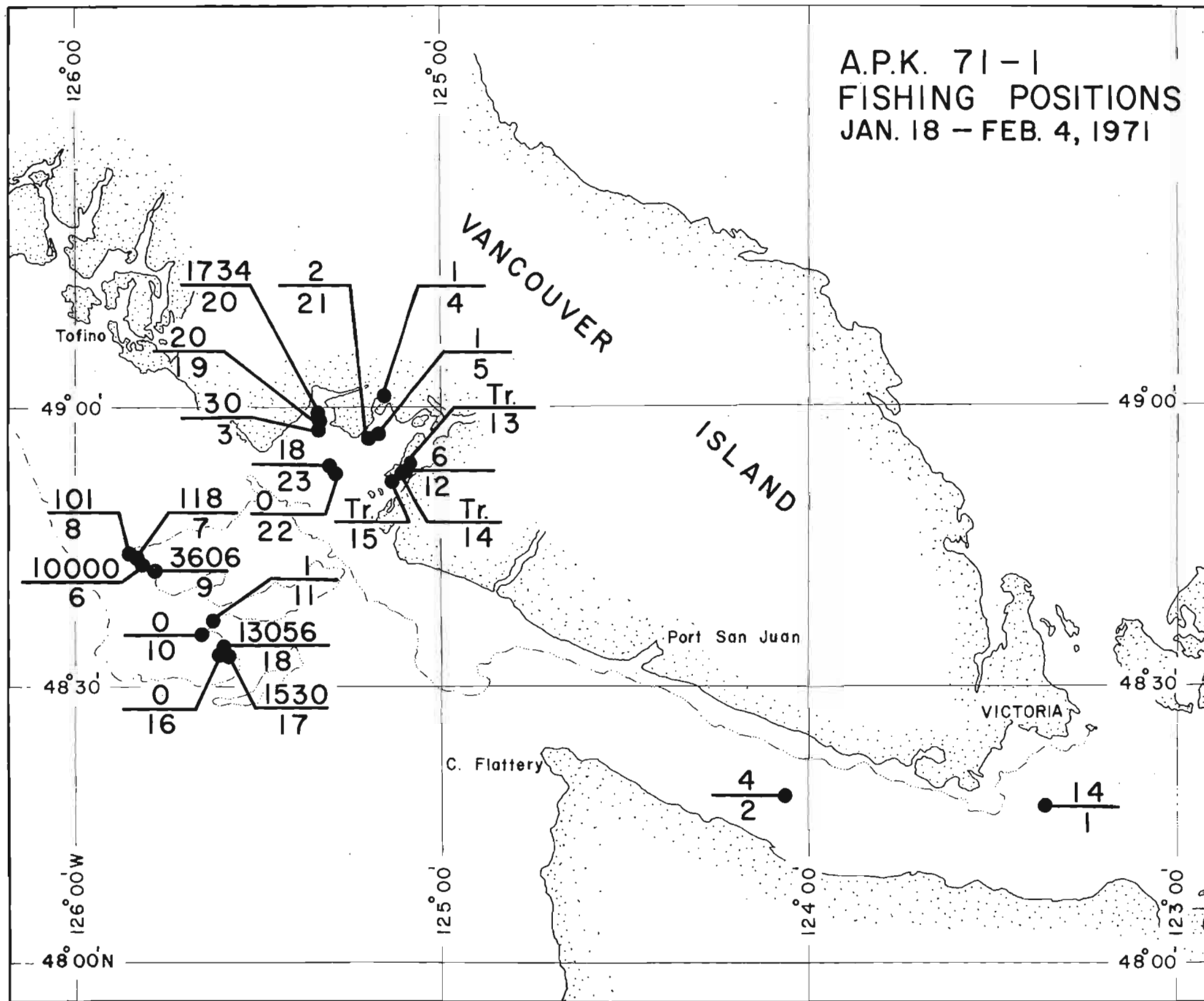


Fig. 4. Location of midwater tows on cruise APK 71-1, west coast of Vancouver Island, January 18-February 4, 1971. For each tow, tow number is shown below the line, catch in pounds above.

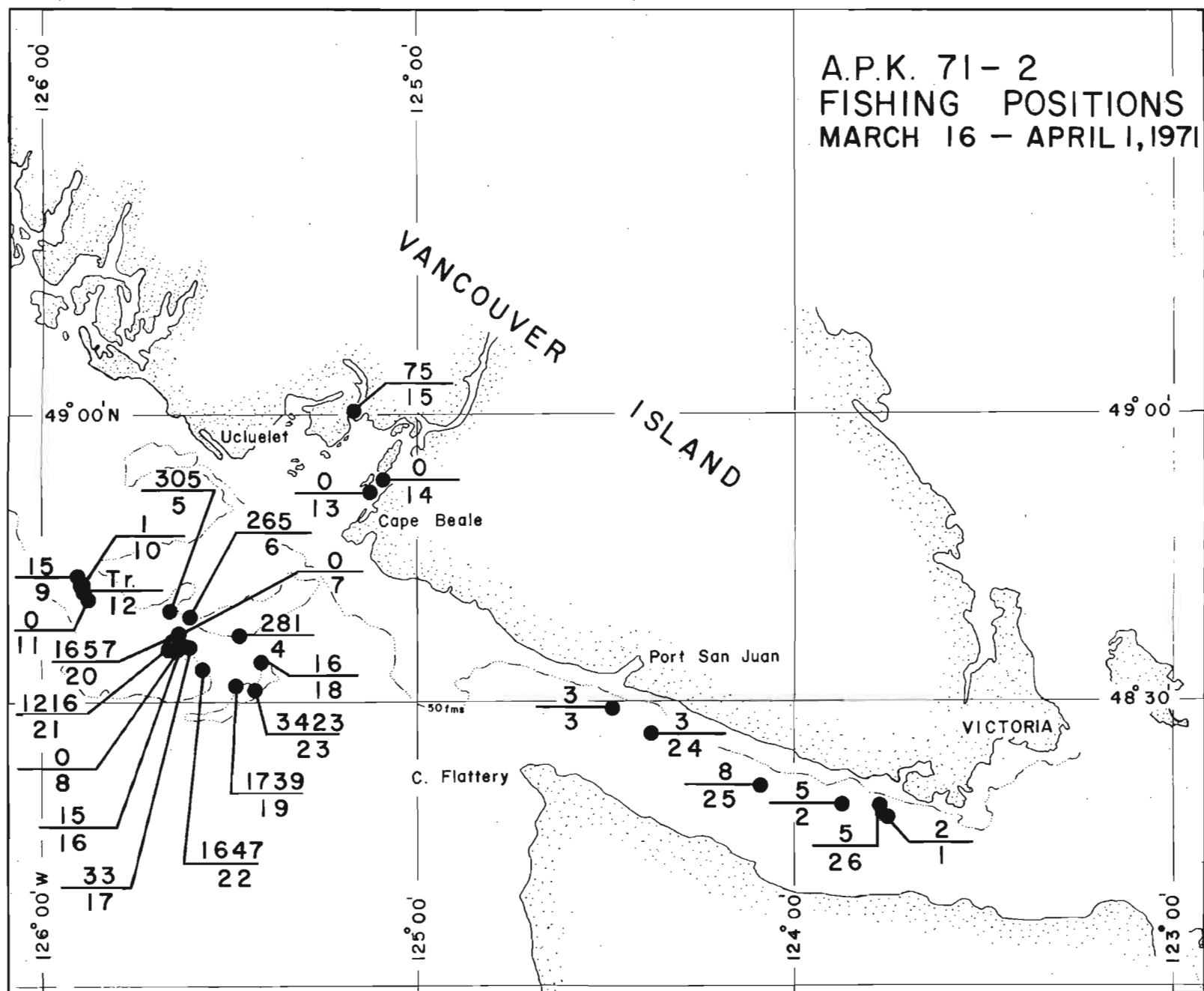


Fig. 5. Location of midwater trawl tows on cruise APK 71-2, west coast of Vancouver Island, March 16-April 1, 1971. For each tow, tow number is shown below the line, catch in pounds above.

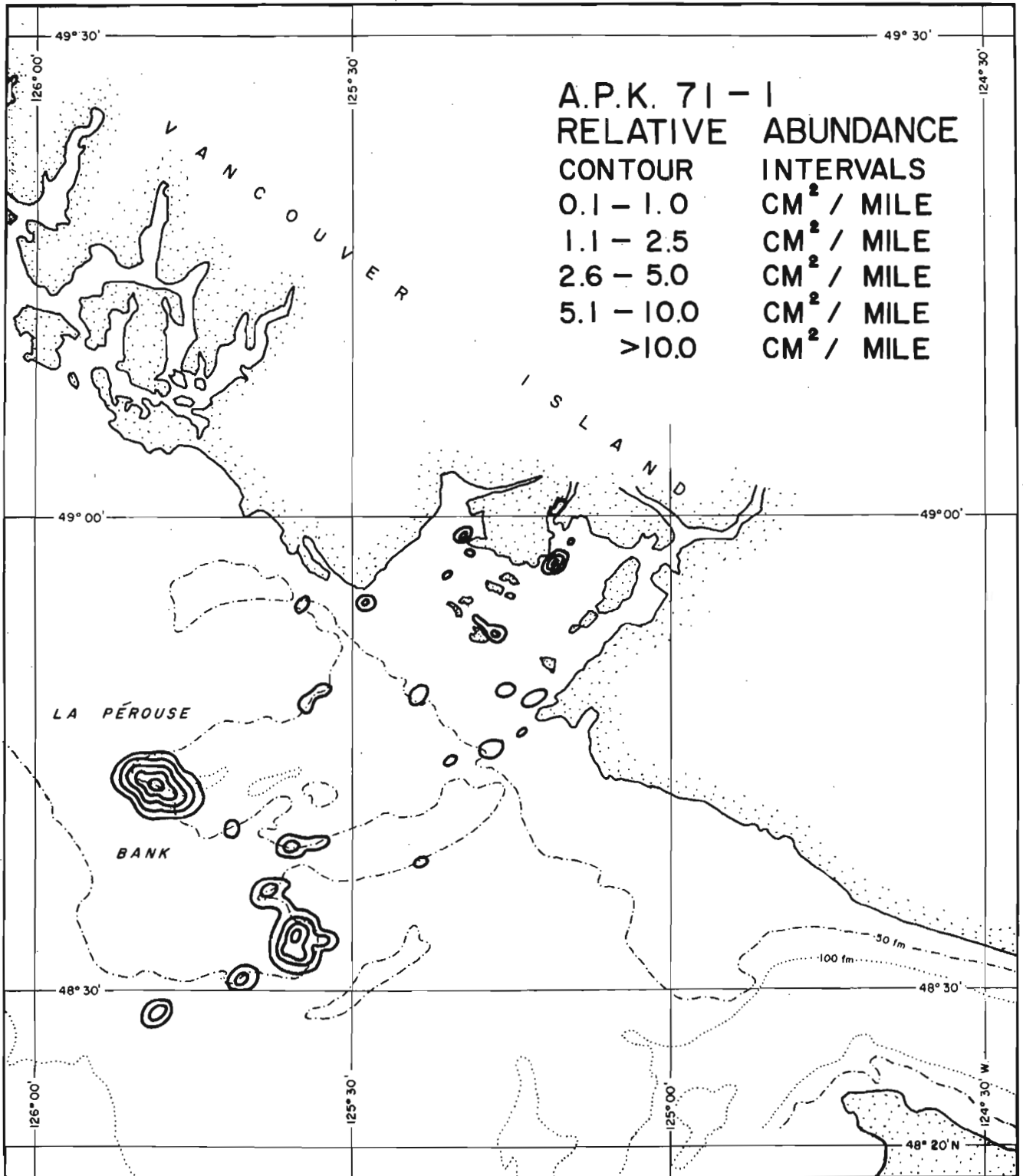


Fig. 6. Herring concentrations on cruise APK 71-1, west coast of Vancouver Island, January 18-February 4, 1971.

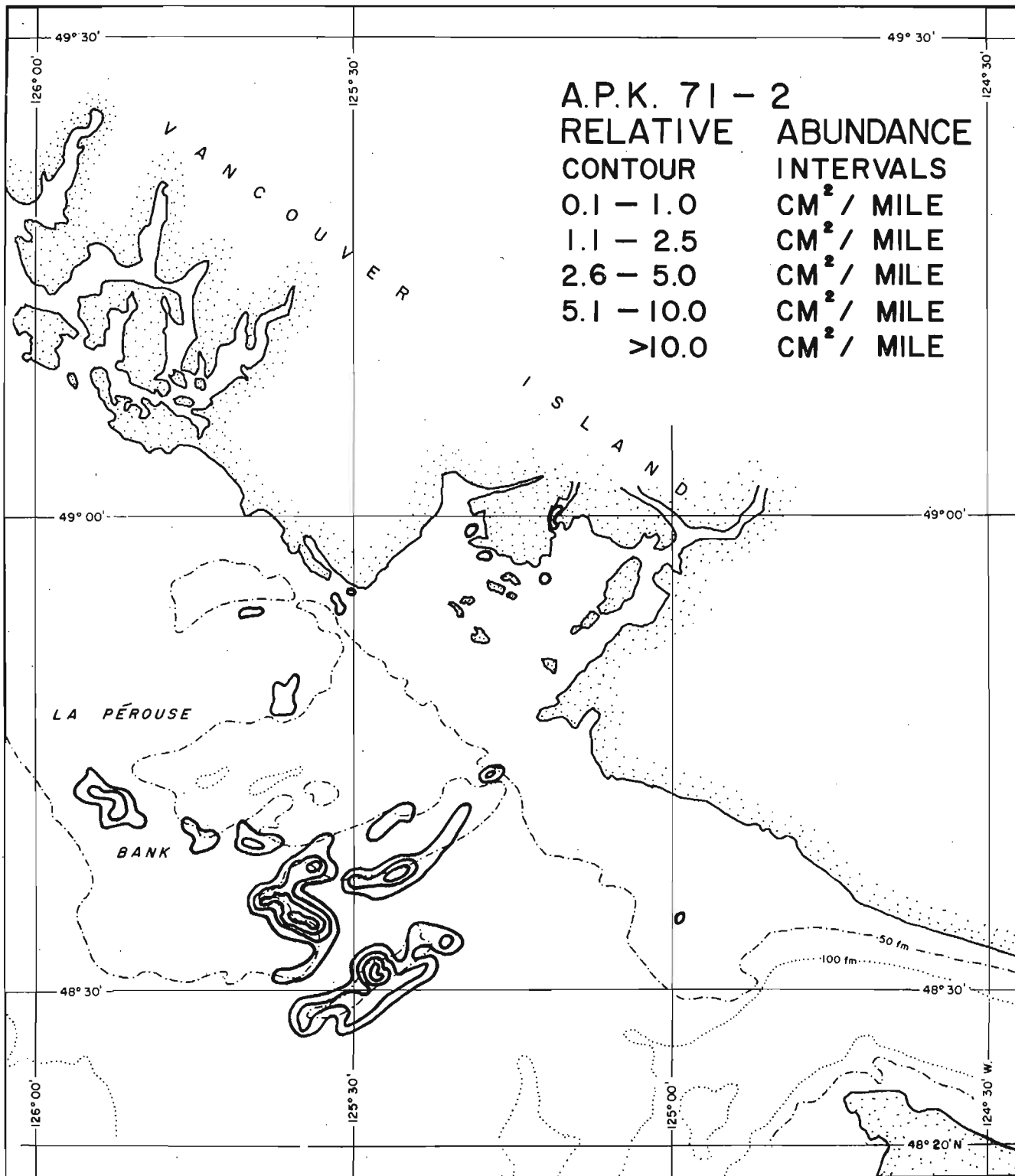


Fig. 7. Herring concentrations on cruise APK 71-2, west coast of Vancouver Island, March 16-April 1, 1971.

Appendix Table 1. Date, time, depth, location and catch in pounds by major species, for each tow made on cruise APK 71-1, west coast of Vancouver Island, January 18-February 4, 1971.

Haul No.	1	2	3	4	5	6
Date	Jan. 19	Jan. 20	Jan. 23	Jan. 23	Jan. 23	Jan. 24
Area <sup>1</sup>	S.J.F.	S.J.F.	B. Sd.	B. Sd.	B. Sd.	S.W.C.
Start (PST) <sup>2</sup>	1527	1122	1121	1344	1518	1355
Duration (min)	39	30	16	13	6	22
Start: N. Lat. °	48	48	48	49	48	48
'	18.0	19.0	58.5	01.0	57.0	41.7
W. Long. °	123	124	125	125	125	125
'	23.3	04.8	20.0	09.5	11.0	47.7
Finish: N. Lat. °	48	48	48	49	48	48
'	18.2	19.5	57.6	01.6	56.8	42.0
W. Long. °	123	124	125	125	125	125
'	20.0	03.2	19.5	09.1	11.4	46.3
Depth (fm) Bottom <sup>3</sup>	62-56	102	22	62-79	50-35	34-50
Target <sup>4</sup>	60	87	17	55	47	20
	63	102	22	62-79	52	39
Bottom at target <sup>5</sup>	63	102	22	62-79	52	39
Net used <sup>6</sup>	434E	434E	434E	434E	434E	434E
<u>Catch</u>						
Herring	14	4	30	1	1	(10000) <sup>8</sup>
Whiting	28	9	-	-	-	-
Hake	-	-	-	10	-	-
Dogfish	8	157	-	-	-	(40)
Salmon	-	Tr <sup>7</sup>	-	-	-	-
Rockfish	1	3	-	Tr <sup>7</sup>	-	-
Eulachon	Tr <sup>7</sup>	15	-	-	-	-
Other	Tr <sup>7</sup>	Tr <sup>7</sup>	-	Tr <sup>7</sup>	Tr <sup>7</sup>	-
Total weight	51	188	30	11	1	(10040) <sup>8</sup>
Remarks <sup>9</sup>						

Appendix Table 1 (cont'd)

Haul No.	7	8	9	10	11	12
Date	Jan. 27	Jan. 27	Jan. 27	Jan. 28	Jan. 28	Jan. 29
Area <sup>1</sup>	S.W.C.	S.W.C.	S.W.C.	S.E.C.	S.E.C.	B. Sd.
Start (PST) <sup>2</sup>	1043	1309	1423	1314	1357	1125
Duration (min)	12	21	9	2	23	3
Start: N. Lat. °	48	48	48	48	48	48
'	43.0	43.0	42.6	35.5	35.7	52.8
W. Long. °	125	125	125	125	125	125
'	49.5	50.5	47.5	40.0	41.0	05.8
Finish: N. Lat. °	48	48	48	48	48	48
'	43.0	43.5	42.6	35.6	37.0	53.1
W. Long. °	125	125	125	125	125	125
'	48.0	49.5	46.4	40.0	36.5	05.5
Depth (fm) Bottom <sup>3</sup>	45-73	41-61	50-50	61-61	34-63	76-76
Target <sup>4</sup>	5	31	27	None	26	66
	66	38	50		34	76
Bottom at target <sup>5</sup>	66	47	50	-	34	76
Net Used <sup>6</sup>	434E	434E	434E	434E	434E	434E
<u>Catch</u>						
Herring	118	101	3606	-	1	6
Whiting	-	-	-	-	-	3
Hake	-	-	-	-	-	3
Dogfish	468	8	-	-	-	-
Salmon	-	-	-	-	-	-
Rockfish	-	-	-	-	-	-
Eulachon	-	-	-	-	-	-
Other	8	-	1	1	1	-
Total weight	594	109	3607	1	2	12
Remarks <sup>9</sup>						

Appendix Table 1 (cont'd)

Haul No.	13	14	15	16	17	18
Date	Jan. 29	Jan. 29	Jan. 30	Jan. 31	Jan. 31	Feb. 1
Area <sup>1</sup>	B. Sd.	B. Sd.	B. Sd.	S.E.C.	S.E.C.	S.E.C.
Start (PST) <sup>2</sup>	1514	1600	0745	1318	1522	1123
Duration (min)	16	17	20	8	19	17
Start: N. Lat. °	48	48	48	48	48	48
'	53.4	53.0	51.6	34.3	33.4	34.2
W. Long. °	125	125	125	125	125	125
'	04.7	05.5	08.0	36.4	35.0	36.0
Finish: N. Lat. °	48	48	48	48	48	48
'	52.7	53.3	52.4	34.7	33.6	32.7
W. Long. °	125	125	125	125	125	125
'	05.7	04.8	06.5	35.5	36.0	36.6
Depth (fm) Bottom <sup>3</sup>	81-77	79-80	71-66	55-66	44-44	38-43
Target <sup>4</sup>	71	66	60	None	34	25
	81-77	79-80	70		44	42
Bottom at target <sup>5</sup>	81-77	79-80	71-66	-	44	42
Net used <sup>6</sup>	434E	434E	434E	434E	434E	434E
<u>Catch</u>						
Herring	Tr <sup>7</sup>	Tr <sup>7</sup>	Tr <sup>7</sup>	-	1530	(13056) <sup>8</sup>
Whiting	5	5	22	-	-	-
Hake	-	6	240	-	-	-
Dogfish	-	-	74	-	-	(64) <sup>8</sup>
Salmon	-	-	-	-	7	-
Rockfish	-	2	30	-	-	-
Eulachon	-	-	-	-	-	-
Other	-	Tr <sup>7</sup>	2	-	7	4
Total weight	5	13	368	-	1544	13124
Remarks <sup>9</sup>						

Appendix Table 1 (cont'd)

Haul No.	19	20	21	22	23
Date	Feb. 2	Feb. 2	Feb. 2	Feb. 2	Feb. 2
Area <sup>1</sup>	B. Sd.	B. Sd.	B. Sd.	B. Sd.	B. Sd.
Start (PST) <sup>2</sup>	1013	1128	1325	1452	1550
Duration (min)	2	13	21	8	11
Start: N. Lat. °	48	48	48	48	48
'	58.5	58.2	57.0	53.2	53.2
W. Long. °	125	125	125	125	125
'	20.0	20.0	10.8	18.1	18.1
Finish: N. Lat. °	48	48	48	48	48
'	58.7	59.0	56.0	52.6	53.5
W. Long. °	125	125	125	125	125
'	19.0	19.0	11.9	16.6	19.5
Depth (fm) Bottom <sup>3</sup>	13-13	22-22	55-55	34-34	26-17
Target <sup>4</sup>	10	16	44	18	18
	13	22	49	37	20
Bottom at target <sup>5</sup>	13	22	52	37	20
Net used <sup>6</sup>	434E	434E	434E	434E	434E
<u>Catch</u>					
Herring	20	1734	2	-	18
Whiting	3604	-	10	-	-
Hake	-	-	-	-	-
Dogfish	-	-	8	-	-
Salmon	-	-	1	-	4
Rockfish	-	-	-	-	-
Eulachon	-	-	-	-	-
Other	39	-	8	-	14
Total weight	3663	1734	29	-	36
Remarks <sup>9</sup>					

Footnotes to Appendix Table 1

- <sup>1</sup>Area: S.J.F. = Strait of Juan de Fuca  
B. Sd. = Barkley Sound  
S.W.C. = South West Corner of La Pérouse Bank  
S.E.C. = South East Corner of La Pérouse Bank
- <sup>2</sup>Start: (PST) = Pacific Standard Time  
(PDT) = Pacific Daylight Time
- <sup>3</sup>Depth: (fm) = Depth in fathoms at beginning and end of haul
- <sup>4</sup>Target: Upper figure is the water depth to the top of school.  
Lower figure is the water depth to the bottom of school in fathoms.
- <sup>5</sup>Bottom at target: Is the actual depth of bottom where target was located in fathoms.
- <sup>6</sup>Net used: 434E = 434 meshes of 16" mesh around the mouth of net
- <sup>7</sup>Tr: Trace of fish (less than 1 pound)
- <sup>8</sup>Weights in parentheses are estimated. (Catch was too large to weigh in its entirety.)
- <sup>9</sup>Remarks

- Haul APK 71-1-1: Light scattered target layer on bottom.  
1 lb S. flavidus. Others: 28 lb whiting, trace Myctophid and pink shrimp. Headrope floats installed in a polypropylene net bag.
- 2: Scattered single fish targets from about 87 fms to the bottom. Others: 9 lb whiting, trace Myctophid, pink shrimp, turbot, anchovy, fanged viperfish, chinook salmon. Rockfish: 3 lb S. flavidus.
- 3: Tow made at Lyall Point.
- 4: Gear was short cabled; bottom variable peaks. Layer of fish on bottom. Net festooned with euphausiids. Others: trace anchovy. Rockfish: trace juvenile S. proriger.
- 5: Missed target with gear; tide put net to one side of school. Others: trace juvenile squid, sandlance.

Footnotes to Appendix Table 1 (cont'd)

- 6: Schools on edge of bank on bottom. Heavy seas and high winds making it necessary to release fish from net and estimate catch weight.
- 7: Large school on edge of bank. Gear off to one side of ship during tow. Other: 8 lb squid.
- 8: Gear off to one side of ship during tow.
- 9: Loran Channel 2H5 not operating during tow. Other: 1 lb blackcod.
- 10: Lost power on ship's main engines; gear dropped to bottom and tow aborted. Other: 1 lb squid.
- 11: Gear towed over edge of bank but missed fish. Other: 1 lb squid.
- 12: Transducer cable broke during tow. Layer of single-fish echoes 60 fm to bottom.
- 13: Net not working properly during tow. Net-sounder giving poor echogram. Herring, 6 juveniles less than 120 mm.
- 14: Net-sounder giving too many echoes. Target single-fish echoes 66 fm to bottom. Rockfish: S. paucispinis. Other: trace lamprey.
- 15: Herring, trace of juveniles less than 120 mm. Rockfish: 20 lb S. paucispinis, 10 lb S. flavidus. Others: trace lamprey, pink shrimp, 2 lb squid.
- 16: Gear acting very erratic, groundline jumping. Ship's main engines stopped when started to haul gear. Gear ripped along headrope. Water tow.
- 17: Net towed to one side of ship. Others: 7 lb blackcod, 7 lb chinook.
- 18: One complete school caught. Unable to weigh entire catch due to high winds and heavy seas. Catch weight estimated. Other: 4 lb blackcod.
- 19: Gear tangled and net went to bottom. Gear towed blind for 2 minutes. Generator quit during tow resulting in no Simrad sounder. Others: 16 lb starry flounder, 3 lb blackcod, trace lingcod, lemon sole, trace shiner seaperch.

Footnotes to Appendix Table 1 (cont'd)

- 20: Gear towed in Maine Bay, Barkley Sound.
- 21: Small scattered schools. Others: 8 lb Pacific cod,  
3 lb chinook salmon.
- 22: Bottom variable peaks. Gear missed target. Water tow.
- 23: Gear towed blind; net-sounder not working. Others:  
14 lb shiner seaperch, 4 lb chinook salmon, trace squid.

Appendix Table 2. Date, time, depth, location and catch in pounds by major species, for each tow made on cruise APK 71-2, west coast of Vancouver Island, March 16-April 1, 1971.

Haul No.	1	2	3	4	5	6
Date	March 17	March 17	March 17	March 18	March 18	March 19
Area <sup>1</sup>	S.J.F.	S.J.F.	S.J.F.	C.B.S.	G.S.	B.N.
Start (PST) <sup>2</sup>	0820	0913	1215	0842	1209	1030
Duration (min)	5	32	30	18	28	60
Start: N. Lat. °	48	48	48	48	48	48
'	17.8	19.5	29.2	36.7	39.5	39.5
W. Long. °	123	123	124	125	125	125
'	44.2	50.4	28.0	28.5	38.7	44.2
Finish: N. Lat. °	48	48	48	48	48	48
'	18.0	20.5	29.3	37.3	38.5	39.5
W. Long. °	123	123	124	125	125	125
'	44.8	52.5	30.2	27.5	38.0	39.7
Depth (fm) Bottom <sup>3</sup>	93-92	83-71	108-111	50-47	35-34	35-32
Target <sup>4</sup>	67	67	85	35	27	26
	92	83-71	108-111	47	34	33
Bottom at target <sup>5</sup>	92	83-71	108-111	47	34	33
Net used <sup>6</sup>	434E	434E	434E	434E	434E	434E
<u>Catch</u>						
Herring	2	5	3	281	305	265
Whiting	Tr <sup>7</sup>	3	74	-	-	-
Hake	-	-	828	-	-	-
Dogfish	-	-	-	-	-	-
Salmon	-	-	-	4	4	8
Rockfish	-	7	16	-	1	-
Eulachon	2	30	80	-	-	-
Other	2	10	29	-	-	-
Total weight	6	55	1030	285	310	273
Remarks <sup>8</sup>						

Appendix Table 2 (cont'd)

Haul No.	7	8	9	10	11	12
Date	March 19	March 19	March 21	March 21	March 21	March 21
Area <sup>1</sup>	S.E.C.	S.E.C.	S.W.C.	S.W.C.	S.W.C.	S.W.C.
Start (PST) <sup>2</sup>	1340	1525	0927	1009	1127	1437
Duration (Min)	10	11	7	29	5	20
Start: N. Lat. °	48	48	48	48	48	48
'	36.7	35.6	43.0	42.5	40.7	42.0
W. Long. °	125	125	125	125	125	125
'	37.2	38.7	55.0	55.4	53.0	53.8
Finish: N. Lat. °	48	48	48	48	48	48
'	37.2	36.0	42.5	41.2	40.2	44.0
W. Long. °	125	125	125	125	125	125
'	37.5	39.4	54.6	53.8	52.0	54.0
Depth (fm) Bottom <sup>3</sup>	33-32	35-37	40-40	39-40	38-37	39-40
Target <sup>4</sup>	None	33 55	32 40	38 40	None	None
Bottom at target <sup>5</sup>	33-32	55	40	40	38-37	39-40
Net used <sup>6</sup>	434E	434E	434E	434E	434E	434E
<u>Catch</u>						
Herring	-	-	15	6	-	Tr <sup>7</sup>
Whiting	-	-	-	-	-	-
Hake	-	-	-	-	-	-
Dogfish	-	(100,000) <sup>8</sup>	-	-	-	-
Salmon	-	-	-	-	-	5
Rockfish	-	-	-	-	-	-
Eulachon	-	-	-	-	-	-
Other	-	-	-	Tr <sup>7</sup>	-	-
Total weight	-	(100,000) <sup>8</sup>	15	6	-	5
Remarks <sup>9</sup>						

Appendix Table 2 (cont'd)

Haul No.	13	14	15	16	17	18
Date	March 23	March 23	March 23	March 25	March 25	March 26
Area <sup>1</sup>	B. Sd.	B. Sd.	E.I.	S.E.C.	S.E.C.	F.B.
Start (PST) <sup>2</sup>	0711	0753	1239	1536	1712	1028
Duration (min)	7	30	15	50	27	26
Start: N. Lat. °	48	48	49	48	48	48
'	51.8	52.4	00.3	35.6	35.7	34.0
W. Long. °	125	125	125	125	125	125
'	07.5	05.0	10.6	38.2	36.0	25.5
Finish: N. Lat. °	48	48	49	48	48	48
'	53.2	53.3	00.8	34.3	34.2	33.3
W. Long. °	125	125	125	125	125	125
'	05.0	04.7	09.7	35.7	35.7	23.8
Depth (fm) Bottom <sup>3</sup>	79-79	74-83	47-71	36-41	37-36	54-55
Target <sup>4</sup>	72	72	42-66	50	29	40
	74-79	74-83	47-71	55	36	47
Bottom at target <sup>5</sup>	74-79	74-83	47-71	58	37	52
Net used <sup>6</sup>	434E	434E	434E	434E	434E	434E
<u>Catch</u>						
Herring	-	-	75	15	33	16
Whiting	-	10	44	-	-	-
Hake	-	165	252	-	-	-
Dogfish	-	52	-	-	-	-
Salmon	-	-	-	-	-	4
Rockfish	-	-	-	-	-	-
Eulachon	-	-	-	-	-	-
Other	-	2	Tr <sup>7</sup>	-	-	-
Total weight	-	229	371	15	33	20
Remarks <sup>8</sup>						

Appendix Table 2 (cont'd)

Haul No.	19	20	21	22	23	24
Date	March 26	March 30	March 30	March 30	March 30	March 31
Area <sup>1</sup>	F.B.	S.E.C.	S.E.C.	S.E.C.	F.B.	S.J.F.
Start (PST) <sup>2</sup>	1252	0907	1023	1307	1525	0633
Duration (min)	15	10	40	33	9	45
Start: N. Lat. °	48	48	48	48	48	48
'	31.1	36.2	35.7	33.3	31.2	26.5
W. Long. °	125	125	125	125	125	124
'	28.2	39.0	40.0	35.2	26.2	24.0
Finish: N. Lat. °	48	48	48	48	48	48
'	31.2	35.6	36.0	33.0	30.6	26.0
W. Long. °	125	125	125	125	125	124
'	26.0	38.1	37.5	33.0	27.2	21.8
Depth (fm) Bottom <sup>3</sup>	53-53	34-35	33-37	49-69	50-51	109-109
Target <sup>4</sup>	38	27	25	25	35	70
	53	35	35	45	51	109
Bottom at target <sup>5</sup>	53	35	35	45	51	109
Net used <sup>6</sup>	434E	434E	434E	434E	434E	434E
<u>Catch</u>						
Herring	1739	657	1216	1647	3423	3
Whiting	-	-	-	-	-	41
Hake	-	-	-	-	-	-
Dogfish	-	-	-	-	-	724
Salmon	-	4	-	7	-	5
Rockfish	-	-	-	-	-	3
Eulachon	-	-	-	-	-	16
Other	2	-	1	-	-	3
Total weight	1741	661	1217	1654	3423	793
Remarks <sup>9</sup>						

Appendix Table 2 (cont'd)

Haul No.	25	26
Date	March 31	March 31
Area <sup>1</sup>	S.J.F.	S.J.F.
Start (PST) <sup>2</sup>	0935	1209
Duration (min)	33	30
Start: N. Lat. °	48	48
'	21.6	19.0
W. Long. °	124	123
'	05.0	47.0
Finish: N. Lat. °	48	48
'	20.8	18.3
W. Long. °	124	123
'	02.2	45.5
Depth (fm) Bottom <sup>3</sup>	85-91	91-94
Target <sup>4</sup>	70	70
	85-91	91-94
Bottom at target <sup>5</sup>	85-91	91-94
Net used <sup>6</sup>	434E	434E
<u>Catch</u>		
Herring	8	5
Whiting	40	1
Hake	-	-
Dogfish	455	15
Salmon	-	-
Rockfish	12	3
Eulachon	48	1
Other	232	-
Total weight	795	25
Remarks <sup>9</sup>		

Footnotes to Appendix Table 2

- <sup>1</sup>Area: S.J.F. = Strait of Juan de Fuca  
C.B.S. = Cape Beale Spit  
G.S. = Gunsight  
S.E.C. = South East Corner of La Pérouse Bank  
S.W.C. = South West Corner of La Pérouse Bank  
B. Sd. = Barkley Sound  
E.I. = Effingham Inlet  
F.B. = Finger Bank  
B.N. = Bottleneck
- <sup>2</sup>Start: (PST) = Pacific Standard Time  
(PDT) = Pacific Daylight Time
- <sup>3</sup>Depth: (fm) = Depth in fathoms at beginning and end of haul
- <sup>4</sup>Target: Upper figure is the water depth to the top of school; lower figure is the water depth to the bottom of school in fathoms.
- <sup>5</sup>Bottom at target: Is the actual depth of bottom where target was located.
- <sup>6</sup>Net used: 434E = 434 meshes of 16" mesh around the mouth of the net.
- <sup>7</sup>Tr: Trace of fish (less than 1 pound)
- <sup>8</sup>Weights in parentheses are estimated. (Catch was too large to weigh in its entirety.)
- <sup>9</sup>Remarks:
- Haul APK 71-2-1: Short tow as net-sounder not working. Gear festooned with juvenile eulachons and euphausiids. Other: 2 lb euphausiid.
- 2: Target was a layer of single-fish echoes from 67 fm to the bottom. Gear was towed with footrope 6-10 fm off bottom; with an 8 fm opening. Others: 10 lb euphausiids, trace squid.
- 3: Layer of fish from 85 fm to bottom. Net-sounder not working properly during tow. Others: 22 lb ratfish, 1 lb turbot, 1 lb rex sole, 16 lb S. flavidus, 5 lb glass shrimp, trace pink and sidestripe shrimp, trace fanged viperfish.
- 4: Scattered herring schools.

Footnotes to Appendix Table 2 (cont'd)

- 5: Small schools on bottom and just off the bottom. School of fish caught in net when raising gear to haul. Others: S. entomelas, salmon, 4 lb chinook.
- 6: School showed on net-sounder but not on Simrad sounder. Fish "seen" escaping from net when started to haul gear. Other: 8 lb chinook.
- 7: Gear towed blind as net-sounder not working.
- 8: Net had to be cut from end to end to get rid of dogfish.
- 9: Small scattered herring schools.
- 10: 2-fm layer of fish tight to bottom with scatterings of fish 4 fm off bottom. Others: trace Pacific sandlance, trace juvenile squid.
- 11: Crossed doors.
- 12: Exploratory tow without any actual target. Trace of herring about 180 mm immature fish, 4 lb chinook, 8 oz chum salmon.
- 13: Gear did not work properly; chain over wing tip.
- 14: Other: 2 lb ratfish.
- 15: Variable bottom; 5-fm layer of fish along bottom. Others: trace anchovy, trace squid.
- 16: Strong tide in area; drifted off target area. Ship's main engines stalled when started to haul net and gear went to bottom.
- 17: Towed to the south.
- 18: 4 lb 4 oz chinook salmon.
- 19: Fish "seen" trying to escape when towing gear. Others: 2 lb sablefish, trace squid.
- 20: School showed on net-sounder only. 3 lb 8 oz of chinook salmon.
- 21: Other: 1 lb sablefish.
- 22: Lot of herring in area. 7 lb chinook salmon.
- 23: On herring schools.

Footnotes to Appendix Table 2 (cont'd)

- 24: Single-fish layer from 70 fm to the bottom.  
Gear towed with footrope 10 fm off bottom.  
0647 hr. 45 fm warp added for total of 300 fm  
3 lb S. flavidus, 5 lb chinook salmon.  
Others: 2 lb ratfish, trace slender barracudina.
  
- 25: Single-fish layer from about 70 fm to the bottom.  
12 lb S. flavidus. Others: 205 lb ratfish,  
7 lb Pacific cod, 18 lb turbot, 1 lb sidestripe  
shrimp, trace squid, trace fanged viperfish,  
1 lb rex sole.
  
- 26: Single-fish echoes from 70 fm to the bottom.  
Gear towed with footrope 4 fm off bottom.  
3 lb S. flavidus. Others: trace slender barracudina,  
trace euphausiids, trace squid, trace pink shrimp,  
trace myctophid, trace Liparid.

Appendix Table 3. Length frequency distribution of herring in 5 mm-length groups for juvenile herring 75-122 mm and 3 mm-length groups for adult herring by area of concentration and haul on cruise APK 71-1 to the west coast, Vancouver Island, January 18 to February 4, 1971.

Length Group	Trial I.	S.J.F.	S.W. Corner			Total	S.E. Corner			Barkley Sound					Total	Grand Total				
	Haul	Haul	6	7	9		11	17	18	3	4	5	12	19			20	21	23	
75- 80	2	1	-	-	-	-	-	-	-	-	-	7	-	-	8	2	17	20		
81- 86	11	5	-	-	-	-	-	-	-	-	6	3	91	-	-	44	15	159	175	
87- 92	49	14	-	-	-	-	-	-	-	-	14	9	147	-	-	30	21	221	284	
93- 98	79	21	-	-	-	-	-	-	-	-	10	-	52	-	-	27	19	108	208	
99-104	69	18	-	-	-	-	-	-	-	-	3	2	13	-	-	10	28	56	143	
105-110	32	13	-	-	-	-	-	-	-	-	-	1	5	-	-	5	41	52	97	
111-116	17	3	-	-	-	-	-	-	-	-	2	-	1	-	-	2	27	32	52	
117-122	3	1	-	1	-	1	-	-	-	-	-	2	-	-	-	1	16	19	24	
3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	
6- 8	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
9-131	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
132- 4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	3	
5- 7	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	5	
8-140	5	1	-	-	-	-	-	2	-	2	2	-	-	-	-	1	-	3	11	
141- 3	1	2	-	3	-	3	-	-	-	-	2	-	-	-	-	1	2	5	11	
4- 6	6	2	-	1	-	1	-	-	-	-	-	-	-	-	-	-	4	4	13	
7- 9	3	2	-	2	-	2	-	-	-	-	-	-	-	-	-	1	2	3	10	
150- 2	5	4	-	5	-	5	-	2	-	2	1	-	-	-	-	-	5	6	22	
3- 5	4	1	-	6	2	8	-	2	-	2	2	-	-	-	-	-	5	7	22	
6- 8	-	2	-	5	-	5	1	-	-	1	5	-	-	-	1	-	1	7	15	
9-161	2	2	-	4	2	6	-	2	-	2	3	1	-	-	-	-	3	7	19	
162- 4	-	-	-	12	1	13	-	4	-	4	1	-	-	-	1	-	11	13	30	
5- 7	1	-	-	15	-	15	-	-	-	-	3	-	-	-	2	-	10	15	31	
8-170	-	1	-	10	1	11	-	3	1	4	3	-	-	-	4	-	8	15	31	
171- 3	2	-	1	10	-	11	-	2	-	2	2	-	1	-	-	-	5	8	23	
4- 6	-	-	-	9	2	11	-	9	3	12	2	-	-	-	4	3	10	19	42	
7- 9	-	1	1	12	2	15	-	8	6	14	1	-	-	-	3	2	6	12	42	
180- 2	-	-	1	15	5	21	-	7	3	10	1	-	-	-	4	2	1	8	39	
3- 5	1	-	-	20	4	24	-	18	12	30	5	-	-	-	4	-	3	12	67	
6- 8	-	-	3	12	2	17	-	22	13	35	7	-	-	-	3	2	1	13	65	
9-191	-	-	6	24	10	40	-	23	30	53	4	-	-	-	7	7	1	19	112	
192- 4	-	2	5	18	7	30	-	25	24	49	7	-	1	-	3	3	1	15	96	
5- 7	-	-	9	19	8	36	1	31	25	57	7	-	-	-	5	5	-	17	110	
8-200	-	-	17	20	12	49	2	39	39	80	8	-	-	-	7	13	-	32	161	
201- 3	-	-	16	22	12	50	2	11	23	36	8	-	-	-	4	8	-	20	106	
4- 6	1	-	25	13	11	49	-	23	15	38	8	-	-	-	6	4	-	18	106	
7- 9	-	-	22	7	9	38	-	14	18	32	11	-	-	-	4	8	1	24	94	
210- 2	-	-	22	5	8	35	-	8	9	17	6	-	-	-	2	9	1	18	70	
3- 5	-	-	16	1	5	22	-	9	10	19	2	-	-	-	7	11	-	20	61	
6- 8	-	-	18	3	8	29	-	1	2	3	3	-	-	-	3	9	-	15	47	
9-221	-	-	14	3	7	24	-	3	2	5	4	-	-	-	2	1	-	7	36	
222- 4	-	-	5	-	1	6	-	1	1	2	1	-	-	-	1	4	-	6	14	
5- 7	-	-	10	-	3	13	-	2	2	4	1	-	-	-	2	3	-	6	23	
8-230	-	-	3	-	-	3	-	-	-	-	-	-	-	-	1	1	-	2	5	
231- 3	-	-	1	-	-	1	-	-	-	-	2	-	-	-	-	1	-	3	4	
4- 6	-	-	3	-	-	3	-	2	-	2	-	-	-	-	-	1	-	1	6	
7- 9	-	-	1	-	-	1	-	-	-	-	1	-	-	-	1	-	-	2	3	
240- 2	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	
3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	
246	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	
259	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	
Total fish	298	96	200	277	122	599	6	273	238	517	114	36	19	316	79	100	132	261	1057	2567

Appendix Table 4. Length frequency distribution of herring in 5 mm-length groups for juvenile herring, 75-122 mm and 3 mm-length groups for adult herring by area of concentration and haul on cruise APK 71-2 to west coast Vancouver Island, March 16 to April 1, 1971.

Length Group	Strait of Juan de Fuca Hauls						Barkley Sound Haul	Southeast Corner Hauls											Southwest Corner Hauls	Cape Beale Spit Haul	Grand Total					
	1	2	3	24	25	26	Total	15	5	6	16	17	18	19	20	21	22	23	Total	9		10	Total	4		
75- 80	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
81- 86	4	2	3	-	-	-	9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
87- 92	15	9	2	1	4	3	34	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37
93- 98	13	8	10	9	13	7	60	9	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	71
99-104	2	5	4	8	8	7	34	6	-	-	-	1	1	-	-	-	1	-	3	6	-	6	-	-	2	51
105-110	1	8	5	6	11	8	39	1	-	1	8	2	8	4	-	1	3	-	27	1	2	3	-	-	2	72
111-116	-	-	1	4	4	-	9	2	-	-	10	2	9	7	-	-	2	-	30	3	1	4	-	-	2	47
117-122	-	-	4	2	2	-	8	2	-	-	8	1	9	1	-	1	1	-	21	3	5	8	-	-	2	41
3- 5	-	2	-	-	1	-	3	1	-	-	1	1	2	1	-	-	-	1	6	-	-	-	-	-	3	13
6- 8	-	-	-	-	-	-	-	-	-	-	3	-	2	1	-	1	-	-	7	-	-	-	-	-	-	7
9-131	-	-	-	-	2	-	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-	5
132- 4	-	-	2	-	-	-	2	-	-	-	-	1	-	-	-	-	-	1	1	-	1	-	-	-	-	4
5- 7	-	2	2	-	-	-	4	3	-	-	1	-	2	-	-	-	-	3	1	-	1	-	-	-	2	13
8-140	-	1	-	-	1	1	3	3	-	-	-	1	3	-	-	-	2	-	5	-	1	1	-	-	1	13
141- 3	-	2	-	1	8	1	12	7	2	-	-	-	3	-	-	-	-	5	-	-	-	-	-	-	6	30
4- 6	-	2	2	1	5	-	10	11	1	-	5	-	6	3	-	-	-	1	16	2	-	2	-	-	4	43
7- 9	-	3	2	2	12	1	20	17	1	-	6	-	8	4	-	2	4	1	26	6	2	8	-	-	8	79
150- 2	-	2	3	-	2	2	9	17	2	-	9	-	3	4	-	3	4	-	25	8	3	11	-	-	15	77
3- 5	2	-	1	2	4	-	9	8	7	1	11	-	9	1	-	5	3	-	37	8	2	10	-	-	18	82
6- 8	-	1	2	2	2	-	7	14	6	2	6	4	11	10	1	3	3	-	46	12	1	13	-	-	17	97
9-161	-	1	2	1	4	-	8	11	15	3	10	3	10	10	-	6	19	-	76	7	2	9	-	-	22	126
162- 4	-	-	-	-	-	1	1	17	19	3	7	2	7	9	2	7	14	-	70	7	5	12	-	-	18	118
5- 7	-	-	-	-	-	-	-	12	13	10	3	2	7	10	2	-	13	3	63	7	3	10	-	-	13	98
8-170	-	1	-	-	1	-	2	13	17	12	3	6	4	8	4	4	9	1	68	1	4	5	-	-	18	106
171- 3	-	1	-	-	-	2	3	11	19	7	5	5	3	8	4	3	12	2	68	1	6	7	-	-	13	102
4- 6	-	-	-	-	1	3	4	10	9	13	5	5	3	7	6	5	13	3	69	4	2	6	-	-	19	108
7- 9	-	-	-	-	2	-	2	4	4	12	5	8	3	5	3	7	14	3	64	3	1	4	-	-	26	100
180- 2	-	-	1	-	2	1	4	1	11	7	4	2	5	8	4	11	13	5	70	3	1	4	-	-	15	94
3- 5	1	-	-	-	-	1	2	3	5	19	3	3	4	11	10	7	8	4	74	2	1	3	-	-	12	94
6- 8	-	-	1	-	-	1	2	2	5	17	1	4	-	11	4	11	11	10	74	4	-	4	-	-	8	90
9-191	-	-	-	-	1	2	3	-	5	10	2	12	4	9	6	6	8	8	70	-	-	-	-	-	3	76
192- 4	1	-	-	1	3	2	7	4	9	12	2	10	3	7	17	6	9	15	88	1	3	4	-	-	3	106
5- 7	-	-	1	2	1	1	5	3	6	10	4	12	4	14	8	2	14	19	93	4	-	4	-	-	5	110
8-200	-	-	-	3	2	-	5	-	9	1	1	9	1	11	9	6	3	12	62	2	-	2	-	-	4	73
201- 3	-	-	1	-	1	1	3	-	5	6	2	11	1	11	3	1	4	9	53	-	-	-	-	-	3	59
4- 6	-	-	-	-	1	-	1	-	3	4	1	7	-	6	6	2	5	17	51	-	-	-	-	-	1	53
7- 9	-	-	-	-	-	-	-	1	1	2	3	13	1	7	4	-	1	7	39	-	-	-	-	-	1	41
210- 2	-	-	-	-	-	3	3	-	1	2	-	7	1	5	5	2	2	5	30	1	-	1	-	-	-	34
3- 5	-	-	-	2	-	-	2	-	2	-	1	5	-	2	-	-	1	11	22	-	-	-	-	-	1	25
6- 8	-	-	1	-	-	-	1	-	-	-	-	1	-	-	1	2	-	1	5	-	-	-	-	-	-	6
9-221	-	-	-	1	-	1	2	-	-	-	-	2	-	2	-	-	1	4	9	-	-	-	-	-	-	11
222- 4	-	-	-	-	1	-	1	-	-	-	-	2	-	1	1	-	-	2	6	-	-	-	-	-	-	7
5- 7	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	2
8-230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	3
231- 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	4	-	-	-	-	-	-	4
4- 6	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	1
7- 9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
240- 2	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
249-251	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1
Total fish	40	50	50	48	99	50	337	200	177	154	131	144	139	200	100	100	200	350	1495	100	45	145	267			2444

Appendix Table 5. Occurrence of food items in the stomachs of dogfish (Squalus acanthias) by 5-cm length group, on cruise APK 71-1.

Length interval (cm)	Number of stomachs containing:												
	Stomachs examined	Euphausiid	Herring	Eulachon	Sandlance	Anchovy	Lanternfish	Other fish	Ctenophore	Other	Total food occurrences	Empty	Stomachs with food
65.0-69.0													
70.0-74.0													
75.0-79.0													
80.0-84.0													
85.0-89.0	1											1	
90.0-94.0	5		3							1	4	1	4
95.0-99.0	15		6					1		3	10	5	10
100.0-104.0	10		4					1		2	7	3	7
105.0-109.0	10		4		1						5	5	5
110.0-114.0	3		2							1	3		3
Totals	44		19		1			2		7	29	15	29
*Percent	100		65.5		3.5			6.9		24.1	65.9	34	66

\*The percentage each food item formed of the number of stomachs containing food.

Appendix Table 6. Occurrence of food items in the stomachs of dogfish (Squalus acanthias) by 5-cm length group, on cruise APK 71-2.

Length interval (cm)	Number of stomachs containing:												
	Stomachs examined	Euphausiid	Herring	Eulachon	Sandlance	Anchovy	Lanternfish	Other fish	Ctenophore	Other	Total food occurrences	Empty	Stomachs with food
20.0-24.0	2									1	1	1	1
25.0-29.0	27			1					2	10	13	14	13
30.0-34.0	10							1			1	9	1
35.0-39.0	2											2	
40.0-44.0	2			1							1	1	1
45.0-49.0	5			1							1	4	1
50.0-54.0	23	1		3							4	19	4
55.0-59.0	13		1	1							2	11	2
60.0-64.0	14	1		2						1	4	11	3
65.0-69.0	16			3						1	4	12	4
70.0-74.0	10			3							3	7	3
75.0-79.0	5											5	
80.0-84.0	2											2	
85.0-89.0	1											1	
90.0-94.0													
95.0-99.0													
Totals	132	2	1	15					3	13	34	99	33
*Percent	100	5.9	2.9	44.1					9.1	38.2	25.8	75	25

\*The percentage each food item formed of the number of stomachs containing food.

Appendix Table 7. Length in millimeters, weight in grams, sex and age by species of all salmon taken in cruise APK 71-1 to the west coast, Vancouver Island, January 18 to February 4, 1971.

Haul number	Time	Date	Chinook salmon <i>Oncorhynchus tshawytscha</i>			
			Length	Weight	Sex	Age
2	1122	January 20	220	124	♂	0-0
2	1122	January 20	167	59	♀	0-0
17	1522	January 31	620	3175	♂	-
21	1325	February 2	287	334	♂	0-0
21	1325	February 2	279	361	♂	0-0
21	1325	February 2	265	301	♂	0-0
23	1550	February 2	520	1814	♀	-

Note: Age of salmon given in two units -- the first indicates the number of freshwater annuli present, and the second, the number of saltwater annuli present. For example, a 1-3 fish would have gone to sea after one year in fresh water (having one freshwater annulus), and would have spent three years in salt water, (having three saltwater annulus), it would therefore have been in its fifth year of life.

Appendix Table 8. Length in millimeters, weight in grams, sex and age by species of all salmon taken in cruise APK 71-2 to the west coast, Vancouver Island, March 16 to April 1, 1971.

Haul number	Time	Date	Chinook salmon <i>Oncorhynchus tshawytscha</i>				Chum salmon <i>Oncorhynchus keta</i>			
			Length	Weight	Sex	Age	Length	Weight	Sex	Age
4	0842	March 18	365	907	♀	0-1				
4	0842	March 18	350	907	♂	-				
5	1209	March 18	540	1928	♂	0-2				
6	1030	March 19	225	227	♀	-				
6	1030	March 19	290	340	♀	0-1				
6	1030	March 19	340	454	♀	0-1				
6	1030	March 19	435	1134	♀	-				
6	1030	March 19	485	1928	♀	-				
12	1437	March 21	510	1814	♂	-				
12	1437	March 21					260	227	♂	0-0
18	1028	March 26	505	1701	♀	-				
18	1028	March 26	345	340	♂	0-1				
20	0907	March 30	455	1361	♀	0-2				
20	0907	March 30	230	227	♂	-				
22	1307	March 30	600	3175	♂	0-3				
24	0633	March 31	395	907	♀	0-1				
24	0633	March 31	470	1361	♂	0-1				

Note: Age of salmon given in two units -- the first indicates the number of freshwater annuli present, and the second, the number of saltwater annuli present. For example, a 1-3 fish would have gone to sea after one year in fresh water (having one freshwater annulus), and would have spent three years in salt water (having three saltwater annulus), it would therefore have been in its fifth year of life.