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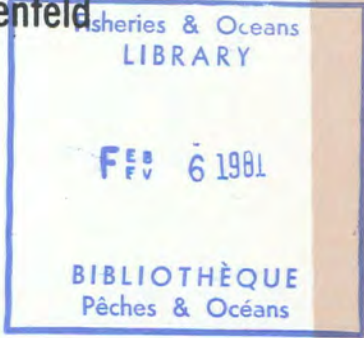


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Exploratory Midwater Fishing for Rockfish Off the West Coast of Vancouver Island January 22-February 1, 1980

J. E. Richards, C. P. Archibald, and L. R. Rosenfeld

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Canadian Data Report of Fisheries
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December 1980

EXPLORATORY MIDWATER FISHING FOR ROCKFISH
OFF THE WEST COAST OF VANCOUVER ISLAND,
JANUARY 22-FEBRUARY 1, 1980

by

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ABSTRACT

Richards, J. E., C. P. Archibald, and L. R. Rosenfeld. 1980. Exploratory midwater fishing for rockfish off the west coast of Vancouver Island, January 22-February 1, 1980. Can. Data Rep. Fish. Aquat. Sci. 226: 47 p.

This report presents data from the exploratory midwater trawling survey for rockfish (Sebastes spp.) conducted off the west coast of Vancouver Island, January 22-February 1, 1980. No large schools of rockfish were found at this time of year, although small, marginally exploitable schools were located, primarily in the area south of Estevan Point. These schools were usually associated with rough bottom and tended to be more diffuse during the day. Rockfish stomach contents were primarily herring, which were widely dispersed throughout the study area; this may have contributed to the dispersed distribution of the rockfish. No juvenile fish were caught in tows made through the plankton layer. Two tows were made in Juan de Fuca Strait to obtain samples of walleye pollock.

Key words: Sebastes flavidus, Sebastes entomelas, midwater, west coast Vancouver Island.

RÉSUMÉ

Richards, J. E., C. P. Archibald, and L. R. Rosenfeld. 1980. Exploratory midwater fishing for rockfish off the west coast of Vancouver Island, January 22-February 1, 1980. Can. Data Rep. Fish. Aquat. Sci. 266: 47 p.

Le présent rapport expose des données tirées de pêches exploratoires de sébastes (Sebastes spp.) au chalut pélagique, pratiquées au large de la côte ouest de l'île Vancouver, entre le 22 janvier et le 1^{er} février 1980. Aucun grand banc de sébastes n'a été observé à ce moment de l'année, bien qu'il y ait certains bancs réduits et marginalement exploitables, principalement dans la région située au sud de la pointe Estevan. Ces bancs se trouvent habituellement dans les régions où le fond est rocailleux et tendent à se disséminer au cours de la journée. Le contenu stomacal des sébastes comportait principalement du hareng, qui est largement abondant dans toute la zone à l'étude; ceci pourrait avoir contribué à la vaste distribution des sébastes. Aucun juvénile n'a été capturé dans les filets traînés dans les couches de plancton. Deux traits de chaluts ont été faits dans le détroit Juan de Fuca pour obtenir des échantillons de morue du Pacifique occidental.

Mots clés: Sebastes flavidus, Sebastes entomelas, pélagique, côte ouest île Vancouver.

INTRODUCTION

In 1975-76 the west coast of Vancouver Island (International Statistical Areas 3C and 3D) was the site of a short-lived but successful foreign rockfish fishery. Polish stern trawlers, using primarily midwater nets, removed 12,873 t and 3,931 t of rockfish in 1975 and 1976, respectively (Table 1). The species composition of the catch in 1975 was reported as Sebastes flavidus and S. entomelas, and in 1976 as S. flavidus, S. entomelas and S. pinniger (Table 1). (See Appendix Table 1 for a list of common and scientific names of fish caught.) The catch per unit effort in 1976 dropped to 39% of the 1975 value.

The domestic fishery in this area, which uses on-bottom gear, never experienced any sustained effects of the Polish fishery. Because of the differences in the type of gear used, it has been suggested that the two fleets may have been exploiting different segments of the rockfish populations in the area.

In January, 1980, the stern trawler M/V CALLISTRATUS was chartered to conduct a survey in Areas 3C and 3D using midwater trawl nets. The purpose of the charter was to explore potential fishing grounds in the area, locate and sample rockfish schools to determine species composition, and obtain length-sex-maturity information and otolith samples from each species. In addition, two hauls were made in the Juan de Fuca Strait to obtain samples of walleye pollock.

METHODS

The study area extended from Amphitrite Point to Cape Cook. Twenty cruise tracks running from the 91 m (50 fm) to the 914 m (500 fm) depth contour were established 5 naut mi apart (Fig. 1). These tracks were then used to systematically search for fish schools by echo sounding. When a school was located an attempt was made to fish it using either an Engel or Diamond IX midwater trawl net. Vessel and net specifications are listed in Appendix Table 2.

Biological samples were obtained from each successful haul. Small catches (<0.5 t) were completely sorted into tubs according to species and weighed on a beam balance. Large catches (>0.5 t) were subsampled in a stratified manner, taking an equal number of tubs from the beginning, middle and end of the catch as it came out of the fish holding bin. The total volume of the catch was estimated by judging what proportion of the fish bin (of known volume) was filled by the catch. This was converted to an estimated weight using the measured weight and volume of the tubbed subsamples. Length, sex and stage of maturity were determined for each rockfish species encountered. Descriptions of rockfish maturity conditions are listed in Table 2. Double otoliths were also collected for use in age determination.

Temperature profiles were obtained using expendable bathythermograph bombs capable of recording to a depth of 823 m (450 fm). This information will be presented in an annual oceanographic report.

Two tows were completed in Juan de Fuca Strait in an effort to obtain samples of walleye pollock for other investigations. Length, sex, and stage of maturity (according to Table 3) were recorded and the left pectoral fin was removed from each pollock sampled for age determination.

RESULTS AND DISCUSSION

DISTRIBUTION AND ABUNDANCE OF ROCKFISH

Echo sounder recordings taken along predetermined survey tracks (Fig. 1) failed to indicate the presence of any large schools of rockfish. The small schools discovered were generally in areas where bottom depth was 146-183 m (80-100 fm). Off-bottom rockfish, as interpreted from sounder recordings, were most abundant in the survey area south of Estevan Point. This area was reported to have been the most productive area during the Polish fishery. The northern region, from Estevan Point to Cape Cook, consisted of a narrow shelf with irregular bottom and a steep continental slope. Small schools of rockfish were detected among the gullies and pinnacles at the edge of the shelf, but the terrain made them inaccessible to midwater gear.

The catches of the 24 tows off the west coast of Vancouver Island (Fig. 2) were poor (Table 4). One exception was tow no. 13 which produced a combined total of 9,850 kg of S. flavidus and S. entomelas. Locating a school of rockfish did not always lead to a successful catch since the off-bottom rockfish encountered in this area displayed a strong net-avoidance reaction. During several hauls the headrope sounder recorded fish diving under the footrope of the net. To compensate for the diving avoidance, it was necessary to tow the net as close to the bottom as possible. On other occasions fish which were monitored passing under the headrope and into the mouth of the net were not retained in the codend. These fish may have escaped through the wing meshes. Details of each tow with respect to time, location, and warp length are included in Appendix Table 3.

After completing the sounder survey track lines, the search pattern was modified by sounding along depth contours ranging from 146-183 m (80-100 fm). This search was concentrated in the area south of Estevan Point. Rockfish schools were often associated with outcroppings of hard bottom, or small gullies found along these contours. A number of tows were made in an attempt to fish these schools, however the irregular seabed topography offered excellent protection from trawl nets. Many of the observed schools were unexploitable, or marginally exploitable with a high risk of net damage.

The time of day appeared to be an important factor affecting the schooling behaviour of the off-bottom rockfish encountered. Because the fish tended to school up at dusk and then disperse at dawn, rockfish schools were most vulnerable to midwater gear at night.

Several tows were made through plankton layers in search of juvenile fish, however none were caught.

DISTRIBUTION AND ABUNDANCE OF HERRING

Numerous schools of Pacific herring were observed in the area between Nootka Sound and Esperanza Inlet. Tows 4, 5, and 6 were made to confirm identification. The latter tow netted approximately 10 t of herring during a 5-min sweep into a large school. Although the size of this aggregation of fish was not completely determined, the point at which it was encountered was 1 naut mi wide. From this axis it extended north for 6 naut mi maintaining a thickness of about 37 m (20 fm). Herring were present in 14 of the 24 tows (Table 4), comprising between 1-100% of the total catch. The widespread distribution of herring may explain the relatively dispersed rockfish distribution. Stomachs of the rockfish sampled contained primarily herring.

BIOLOGICAL SAMPLING

The biological data collected during this cruise are summarized in Table 5. In addition to sampling 734 S. flavidus from the west coast of Vancouver Island, 200 S. flavidus were sampled from Juan de Fuca Strait. This information may allow a comparison of regional variability in certain population parameters. Length/sex frequency information from S. flavidus collected on the west coast of Vancouver Island and in Juan de Fuca Strait are summarized in Tables 6 and 7 respectively. Similar information pertaining to S. entomelas and S. proriger is presented in Table 8. A more detailed breakdown can be found in Appendix Tables 4-7.

Maturity stages for all rockfish sampled during this cruise are summarized in Table 9. All but a few of the S. flavidus males examined from both the west coast of Vancouver Island and Juan de Fuca Strait (100% and 92% respectively) were in a resting stage (8A). Regional differences in maturities of S. flavidus females were apparent: on the west coast 37% of the females were in a fertilized state (stage 4), compared to only 6% for females from Juan de Fuca Strait. Conversely, 62% of the Juan de Fuca Strait females were in a resting condition (stage 7) compared to only 16% for west coast Vancouver Island females. These differences may be partly influenced by the presence of smaller fish in the Juan de Fuca sample as well as unequal sample sizes.

Length/sex frequencies and stage of maturity for 300 walleye pollock collected from Juan de Fuca Strait are included in Tables 10 and

11. A more detailed length-frequency-maturity breakdown can be found in Appendix Table 8.

Incidental catches of chinook salmon were examined for tags (none found) and released if there was a possible chance of survival. The remainder were sampled for length and sex (Table 12).

SUMMARY AND CONCLUSIONS

1. Midwater trawling for rockfish in the study area off the west coast of Vancouver Island was unsuccessful.

2. No large schools of rockfish were found at this time of the year.

3. Small, marginally exploitable schools were located in the area south of Estevan Point.

4. Rockfish schools were usually associated with rough bottom which provided protection from trawl gear.

5. Rockfish tended to school at night and disperse during the day.

6. Primary component of S. flavidus stomach contents was herring which were widely distributed throughout the study area. This may have contributed to the dispersed distribution pattern of the rockfish.

7. No juvenile fish were caught in tows made through plankton layers.

ACKNOWLEDGMENTS

The authors would like to thank the Officers and crew of the M/V CALLISTRATUS for their assistance during the cruise. We would especially like to acknowledge the efforts and expertise of Captain Tom Foote and First Officer Dave Lorrett. Scientific staff were employed by the Province of British Columbia.

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Table 1. Summary of the species composition of rockfish catches during the 1975-76 Polish fishery in Areas 3C and 3D on the west coast of Vancouver Island. Approximate effort and catch per unit effort (CPUE) data are also presented.

Species	1975		1976	
	Weight (t)	%	Weight (t)	%
<u>Sebastes flavidus</u>	6,700	52	2,339	59
<u>S. entomelas</u>	6,125	48	1,364	35
<u>S. pinniger</u>	-	-	211	5
other rockfish	48	<1	17	<1
Total catch (t)	12,873		3,931	
Approx. total nominal effort (h)	6265		4950	
CPUE (t/h)	2.05		0.79	

Table 2. Description of rockfish maturity stages¹ (Westrheim 1975).

Maturity code	Gonad condition
1	IMMATURE (translucent; males, stringlike; females small)
FEMALES: 2	MATURING (small, yellow eggs; translucent or opaque)
3	MATURE (large, yellow eggs; opaque)
4	FERTILIZED (large, orange-yellow eggs; translucent)
5	EMBRYOS or LARVAE (includes eyed eggs)
6	SPENT (large, flaccid, red ovaries. A few larvae may be present)
7	RESTING (moderate size, firm, red-grey ovaries)
MALES: 8A	RESTING (ribbon-like; small, brown)
8B	DEVELOPING (swelling; brown-white)
8C	DEVELOPED (large, white; easily broken)
8D	RUNNING (running sperm)
8E	SPENT (flaccid, red)
9	MATURING (stringlike, translucent, white)

¹In Sebastes flavidus an intermediate stage, characterized by small white testes, exists between the resting (8A) and the developing (8B) stages. Some color variations also occur in the female maturing stage (2). S. reedi ovaries exhibit small orange eggs while S. aleutianus and S. brevispinis small eggs are pinkish in color.

Table 3. Criteria used to describe maturity stages for walleye pollock. (Adapted from hake maturity stages, Weir et al. 1978.)

	Female	Male
Immature 1 I-1	Virgin, ovary small, light pink and semi-transparent, no ova	Virgin, testes small, no convolutions.
Immature 2 I-2	Virgin, ovary still small, light pink and semi-transparent, some ova but without yolk.	Virgin, testes small and pink but convoluted.
Ripening-1 R-1	Ovary small but starting to enlarge, fills about 1/4 body cavity, light yellow ova with yolk and opaque, blood vessels on ovary pronounced.	Testes about 1/4 body cavity and convoluted, contains small amount of milt, convolutions firm and pink.
Ripening-2 R-2	Ovary larger, filling more than 1/3 the body cavity, yellow. Ova with yolk and opaque, blood vessels on ovary pronounced.	Testes about 1/2 body cavity convoluted, loose and about 2/3 full of milt, edge of convolutions pink and firm.
Ripe R.	Ovary translucent yellow - 1/2-2/3 the body cavity, yellow ova opaque or translucent.	Testes large, convoluted and full of milt, fills about 2/3 of body cavity, some milt may flow from vent with pressure.
1 Ripe 1R	Ovary large, fills 1/2-2/3 the body cavity, less than 1/2 the ova are translucent.	No stage in males.
2 Ripe 2R	Ovary large, fills 2/3 the body cavity, more than 1/2 the ova are translucent.	No stage in males.
Running ripe R.R.	Translucent ova flow from vent with <u>slight</u> pressure, ovaries almost fill body cavity, ova opaque or translucent, ova loose in ovary. Ovary translucent.	Testes large, milt flows from vent with <u>slight</u> pressure, edge of testes may be bloodshot in fresh specimens.
Spent S.	Ovary bloodshot, purple in color, some ova may remain translucent. Ovary flaccid about 1/3 body cavity.	Testes bloodshot and flaccid may contain some milt, now reduced to less than 1/2 body cavity.

Table 3 (cont'd)

	Female	Male
Resorbing Resb.	Fish has not spawned, ovaries large, about 1/2 body cavity and is soft and flaccid, ova are large and watery.	No stage in males.
Recovering Rec.	Ovaries returning to pre-ripening size, less than 1/2 body cavity, not flaccid, moderately firm. Ova small, no bloodshot appearance.	Testes moderately firm, little milt and loose convolutions.
Resting Rest.	Ovaries small less than 1/4 body cavity, moderately firm, bloodshot appearance gone, white sheen to external ovary surface.	Testes small, firm and pink, may be some milt, with convolutions, less than 1/4 body cavity.

Table 4. Species composition of M/V CALLISTRATUS trawl catches, January 22-February 1, 1980. Values expressed in kg. Tr indicates trace of fish (<0.5 kg).

Species	Haul no.									
	1	2	3	4	5	6	7	8	9	10
<u>Sebastes babcocki</u>										
<u>S. entomelas</u>										
<u>S. flavidus</u>			3					3	7	
<u>S. paucispinis</u>										
<u>S. pinniger</u>										
<u>S. proriger</u>										
English sole										
Rex sole										
Turbot										
Hake										
Lingcod		2								
Pacific cod										
Pollock										
Herring		1		1100	200	10000		50	150	
Shad										
Chinook salmon	10	12	7	7	5				15	
Smelt	1									
Soupfin shark	12									
Dogfish				2						
Ratfish										
Longnose skate										
Shrimp										
Squid	5	2								
Total	28	17	10	1109	205	10000	0	53	172	0

Table 4 (cont'd)

Species	Haul no.									
	11	12	13	14	15	16	17	18	19	20
<u>Sebastes babcocki</u>								Tr		
<u>S. entomelas</u>			5250						13	
<u>S. flavidus</u>		268	4600					2460	130	
<u>S. paucispinis</u>			Tr					Tr		
<u>S. pinniger</u>										
<u>S. proriger</u>		69	Tr					Tr		
English sole										
Rex sole										
Turbot										
Hake										
Lingcod	5							Tr		
Pacific cod		8								
Pollock										
Herring	75	30	Tr	15	200			410	Tr	
Shad										
Chinook salmon	3	Tr	Tr					Tr		
Smelt										
Soupfin shark	20									
Dogfish	5	Tr	Tr							
Ratfish										
Longnose skate					15					
Shrimp		Tr						Tr		
Squid		Tr								
Total	108	375	9850	15	215	0	0	2870	143	0

Table 4 (cont'd)

	Haul no.						Total				
							24 tows W. coast Van. Is.		2 tows Juan de Fuca		
	21	22	23	24	25	26	wt.	%	wt.	%	
<u>Sebastes babcocki</u>							Tr				
<u>S. entomelas</u>							5263	20			
<u>S. flavidus</u>		6	370	103	124	1677	7950	31	1801	54	
<u>S. paucispinis</u>						Tr	Tr		Tr		
<u>S. pinniger</u>				Tr	Tr		Tr		Tr		
<u>S. proriger</u>							69	<1			
English sole					8	18			26	<1	
Rex sole						18			18	<1	
Turbot					Tr	Tr			Tr		
Hake					Tr				Tr		
Lingcod							7	<1			
Pacific cod				55	36	248	63	<1	284	8.5	
Pollock					75	1000			1075	32	
Herring						Tr	12231	48	Tr		
Shad						Tr			Tr		
Chinook salmon				3	10	10	62	<1	20	<1	
Smelt						Tr	1	<1	Tr		
Soupfin shark							32	<1			
Dogfish			4		90	Tr	11	<1	90	2.7	
Ratfish						39			39	1.2	
Longnose skate							15	<1			
Shrimp						Tr	Tr		Tr		
Squid							7	<1			
Total	0	6	374	161	343	3010	25711	100	3353	100	

Table 5. Summary of the biological data collected during the M/V CALLISTRATUS cruise January 22-February 1, 1980.

Species	Length/sex/age/maturity			Length/sex/maturity		
	Area 1	Area 2	Total	Area 1	Area 2	Total
<u>Sebastes flavidus</u>	474	200	674	260	-	260
<u>S. entomelas</u>	200	-	200	100	-	100
<u>S. proriger</u>	100	-	100	-	-	-
Walleye pollock	-	300	300	-	-	-
Chinook salmon	-	-	-	28	5	33

Note: Area 1 = west coast Vancouver Island.
Area 2 = Juan de Fuca Strait.

Table 6. Length/sex frequencies of Sebastes flavidus collected from the west coast of Vancouver Island during the M/V CALLISTRATUS cruise, January 22-February 1, 1980.

Length (cm)	Haul 12			Haul 13			Haul 18		
	M	F	T	M	F	T	M	F	T
30									
1									
2									
3									
4									
35									
6									
7	1		1					1	1
8							1		1
9	2		2	1	1	2	4		4
40	2	2	4				3	1	4
1	5		5	3		3	9	3	12
2	15	1	16	2		2	3	1	4
3	16	5	21	1		1	7	2	9
4	15	1	16	1	1	2	7	5	12
45	21	3	24	6	1	7	9	3	12
6	37	7	44	6	9	15	7	2	9
7	13	2	15	12	7	19	3	4	7
8	21	1	22	7	12	19	3	4	7
9	3	3	6	1	22	23	1	8	9
50	5	2	7		26	26		5	5
1	1	1	2		39	39		1	1
2	1		1		18	18		2	2
3		1	1		15	15		1	1
4					3	3			
55					6	6			
6		1	1						
Total	158	30	188	40	160	200	57	43	100

Table 6 (cont'd)

Length (cm)	Haul 19			Haul 23			Haul 24			Total		Grand total
	M	F	T	M	F	T	M	F	T	M	F	
30												
1												
2												
3												
4												
5												
6												
7										1	1	2
8				1		1	1		1	3	0	3
9				3		3				10	1	11
40	3	1	4	4		4	2		2	14	4	18
1	1	1	2	4	1	5				22	5	27
2	3		3	7	3	10	5		5	35	5	40
3	4	9	13	5	2	7	1		1	34	18	52
4	8	5	13	12	2	14	2		2	45	14	59
45	6	2	8	10	3	13	10	1	11	62	13	75
6	7	4	11	4	3	7	4		4	65	25	90
7	6	3	9	8	4	12	6	3	9	48	23	71
8	8	6	14	7	2	9	7	1	8	53	26	79
9	2	2	4	6	3	9	5	2	7	18	40	58
50		1	1		2	2	2	3	5	7	39	46
1							2	2	4	3	43	46
2		3	3		1	1				1	24	25
3		1	1		2	2					20	20
4											3	3
55								1	1		7	7
6					1	1					2	2
Total	48	38	86	71	29	100	47	13	60	421	313	734

Table 7. Length/sex frequencies of Sebastes flavidus collected from Juan de Fuca Strait during M/V CALLISTRATUS cruise, January 22-February 1, 1980.

Length (cm)	Haul 25			Haul 26			Total		Grand total
	M	F	T	M	F	T	M	F	
30				1		1	1		1
1				1		1	1		1
2				3	1	4	3	1	4
3				1		1	1		1
4				1	1	2	1	1	2
5	2	1	3	11	9	20	13	10	23
6	1		1	5	2	7	6	2	8
7	3	2	5	6	2	8	9	4	13
8	3	3	6	3	8	11	6	11	17
9	6	10	16	3	5	8	9	15	24
40	9	5	14	1	7	8	10	12	22
1	1	6	7	1	3	4	2	9	11
2	3	3	6	1		1	4	3	7
3	3	5	8	2	1	3	5	6	11
4	3	3	6	1	1	2	4	4	8
45	4		4	2		2	6		6
6	5	3	8	1		1	6	3	9
7	2	1	3	1		1	3	1	4
8	5	3	8	6	3	9	11	6	17
9	2		2	2		2	4		4
50		1	1	2	1	3	2	2	4
1		1	1	1		1	1	1	2
2		1	1					1	1
3									
Total	52	48	100	56	44	100	108	92	200

Table 8. Length/sex frequencies of Sebastes proriger and Sebastes entomelas collected from the west coast of Vancouver Island during M/V CALLISTRATUS cruise, January 22-February 1, 1980.

Length (cm)	<u>Sebastes proriger</u>			<u>Sebastes entomelas</u>		
	Haul no. 12			Haul no. 13		
	M	F	T	M	F	T
30	3		3			
1						
2		1	1			
3		2	2			
4		13	13	2		2
35		24	24			
6		17	17			
7		12	12	2	2	4
8		12	12		1	1
9		5	5	5	3	8
40		6	6	14	4	18
1		5	5	16	9	25
2				10	19	29
3				12	13	25
4				16	11	27
45				9	14	23
6				4	5	9
7				7	9	16
8				7	7	14
9				6	2	8
50				3	11	14
1				1	10	11
2					20	20
3					20	20
4					14	14
55					8	8
6					4	4
Total	3	97	100	114	186	300

Table 9. Summary of rockfish maturity assessments from samples obtained during the M/V CALLISTRATUS cruise, January 22-February 1, 1980.

Haul no.	Species	Maturity stage*												Sex ratio M:F
		Male				Female								
		1	8A	8B	Total	1	2	3	4	5	6	7	Total	
Area 1														
12	<u>Sebastes proriger</u>		3	-	3	1	97	70	82	30	-	2	97	1:32.3
	%		100	-		<1	100	38	44	16	1			
13	<u>S. entomelas</u>		113	1	114	1	1	70	82	30	-	2	186	1:1.6
	%		99	1		<1	<1	38	44	16	-	1		
12	<u>S. flavidus</u>		158	-	158		8	6	-	1	-	15	30	1:0.2
13			40	-	40		8	13	81	55	1	2	160	1:4.0
18			57	-	57		11	3	14	3	-	12	43	1:0.7
19			48	-	48		15	4	7	3	-	9	38	1:0.8
23			71	-	71		3	5	8	1	-	12	29	1:0.4
24			47	-	47		-	3	6	3	1	-	13	1:0.3
Total			421		421		45	34	116	66	2	50	313	1:1.3
%			100				14	11	37	21	1	16		
Area 2														
25	<u>S. flavidus</u>		48	4	52		5	3	4	-	-	36	48	1:0.9
26		3	99	6	108		31	5	5	-	-	51	92	1:0.8
Total		3	147	10	160		36	8	9	-	-	87	140	1:0.9
%		2	92	6			26	6	6	-	-	62		

*Maturity stages explained in Table 2.
 Area 1 = west coast Vancouver Island.
 Area 2 = Juan de Fuca Strait.

Table 10. Length/sex frequencies of walleye pollock (Theragra chalcogramma) collected from Juan de Fuca Strait during M/V CALLISTRATUS cruise, January 22-February 1, 1980.

Length (cm)	Haul 25			Haul 26			Grand total
	M	F	T	M	F	T	
15					1	1	1
~							
26				1	1	2	2
27		1	1	2	3	5	6
28	2	2	4	6	7	13	17
29	2	1	3	10	6	16	19
30	2	6	8	11	14	25	33
1	3	4	7	8	6	14	21
2	4	6	10	6	6	12	22
3		2	2	3	4	7	9
4	1	2	3	1	1	2	5
35	2	3	5	5	4	9	14
6	2	2	4	1	3	4	8
7		7	7	4	4	8	15
8	2	5	7	7	8	15	22
9	3	6	9	2	8	10	19
40	1	4	5	2	5	7	12
1		6	6	2	6	8	14
2	2	4	6		3	3	9
3	3	2	5	1	4	5	10
4	3	3	6	2		2	8
45	3	2	5	1		1	6
6	1	2	3				3
7	2		2		1	1	3
8	1	2	3	1	1	2	5
9		3	3		1	1	4
50	1	1	2		1	1	3
1	1	1	2				2
2	1	1	2				2
3		2	2				2
4		1	1		1	1	2
55		1	1		1	1	2
Total	42	82	124	76	100	176	300

Table 11. Maturity stages of walleye pollock (Theragra chalcogramma) collected from Juan de Fuca Strait during M/V CALLISTRATUS cruise, January 22-February 1, 1980.

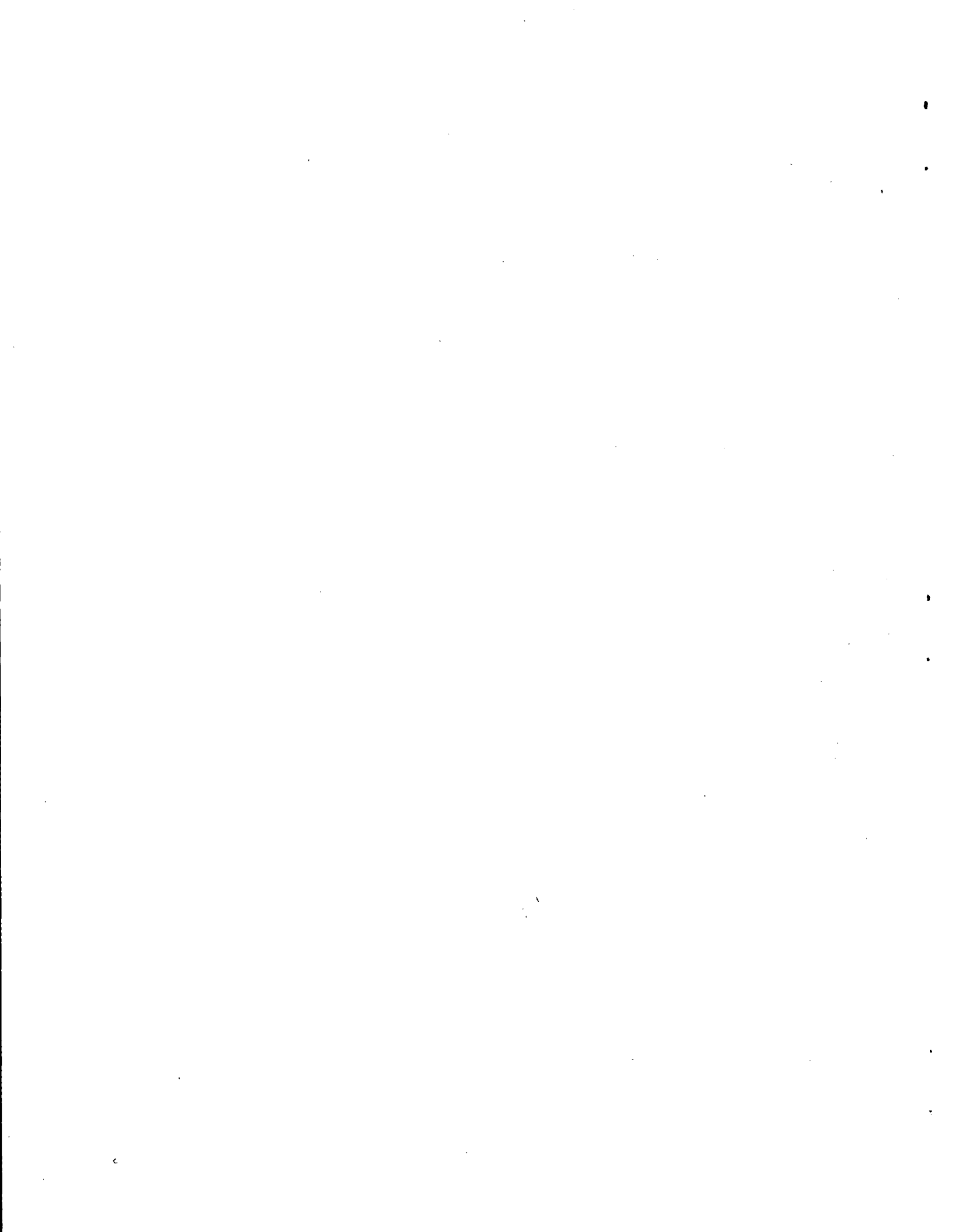
Haul no.		Stage of maturity*											Sex ratio M:F	
		Male					Female							
		I1	I2	R1	R2	R	Total	I1	I2	R1	R2	R		Total
25	No. fish		15	3	24		42	46		5	31		82	1:1.9
	%		36	7	57		100	56		6	38		100	
26	No. fish	2	43	3	28		76	74	1	5	20		100	1:2.3
	%	3	56	4	37		100	74	1	5	20		100	
Combined	no. fish	2	58	6	52		118	120	1	10	51		182	
	%	2	49	5	44		100	66	0.5	5.5	28		100	

*See Table 3 for description of maturity stages.

Table 12. Length and sex of chinook salmon (Oncorhynchus tshawytscha) caught during M/V CALLISTRATUS cruise, January 22-February 1, 1980.

Haul no.	Length (cm)	Sex
1	28	M
	28	F
	69	F
	76	F
2	27	M
	30	M
	30	M
	33	M
	34	M
	51	M
	22	F
	28	F
	28	F
	29	F
32	F	
3	35	M
	37	M
	65	-
4	37	M
	61	M
	43	F
5	33	M
	32	F
	33	F
	55	-
11	30	F
	28	-
	28	-
26*	46	M
	54	M
	55	M
	43	F
	66	F

*Tow 26 was made in Juan de Fuca Strait; all others were off the west coast of Vancouver Island.



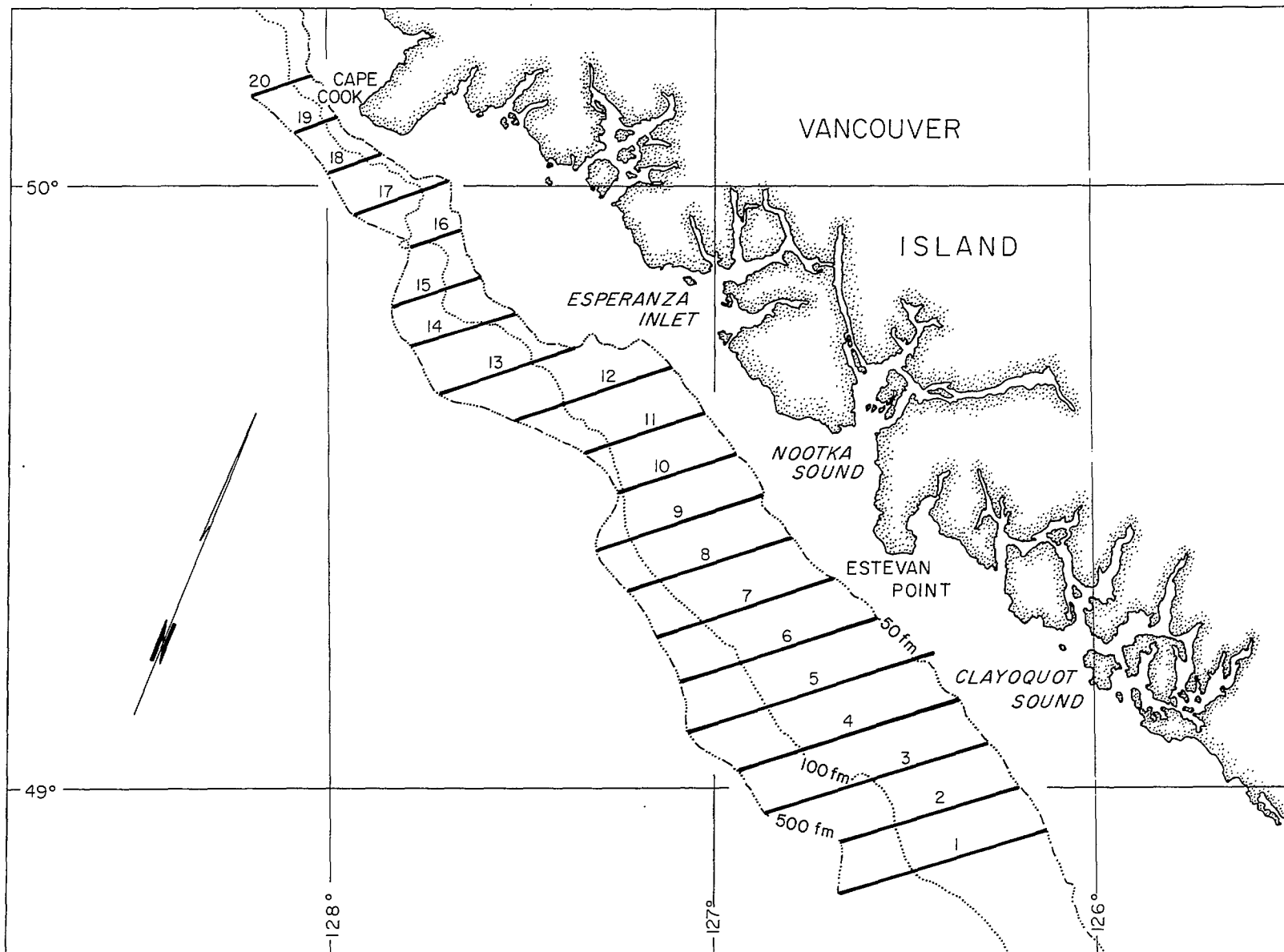
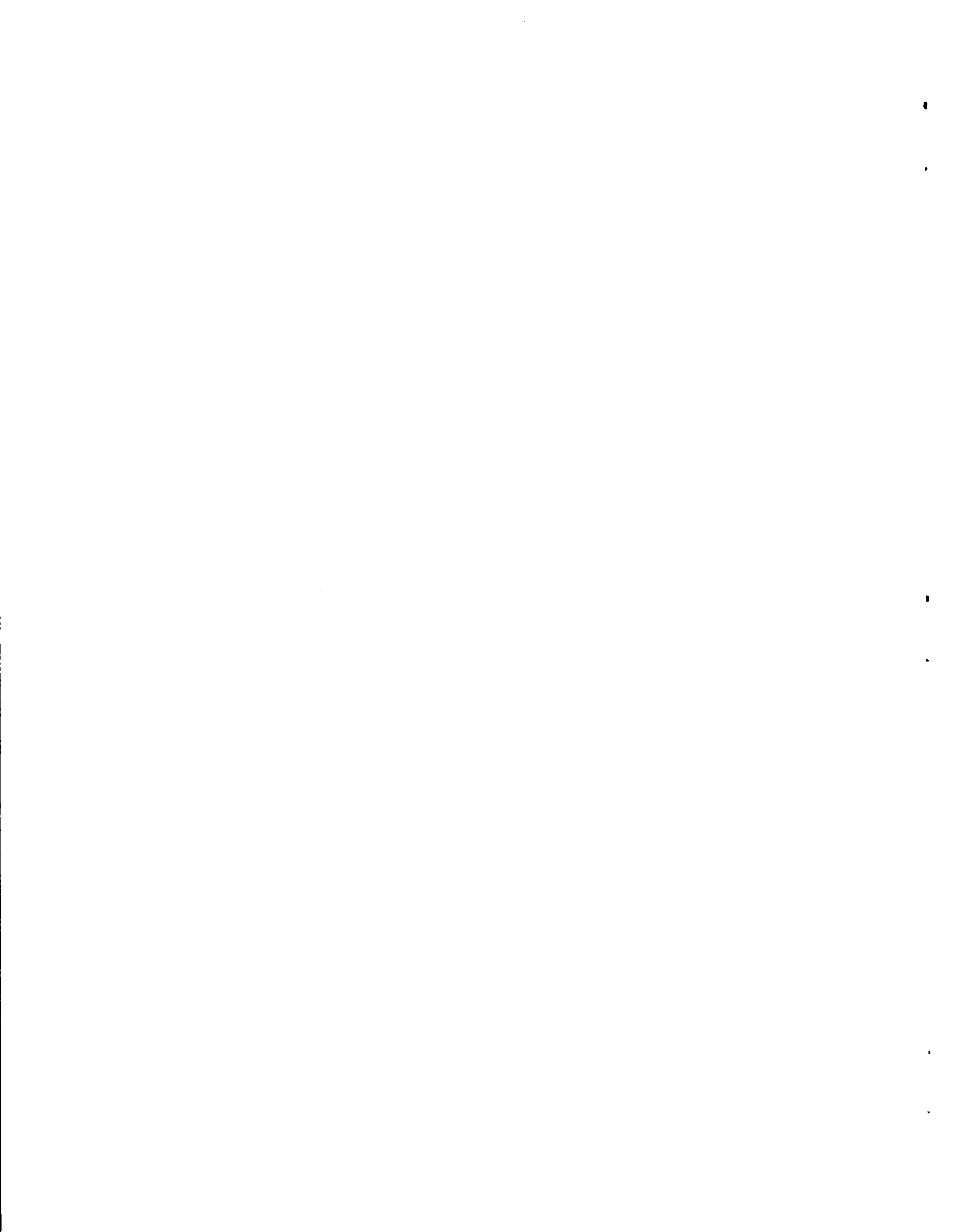


Figure 1. Track lines for sounder survey off west coast of Vancouver Island, M/V CALLISTRATUS cruise, January 22-February 1, 1980.



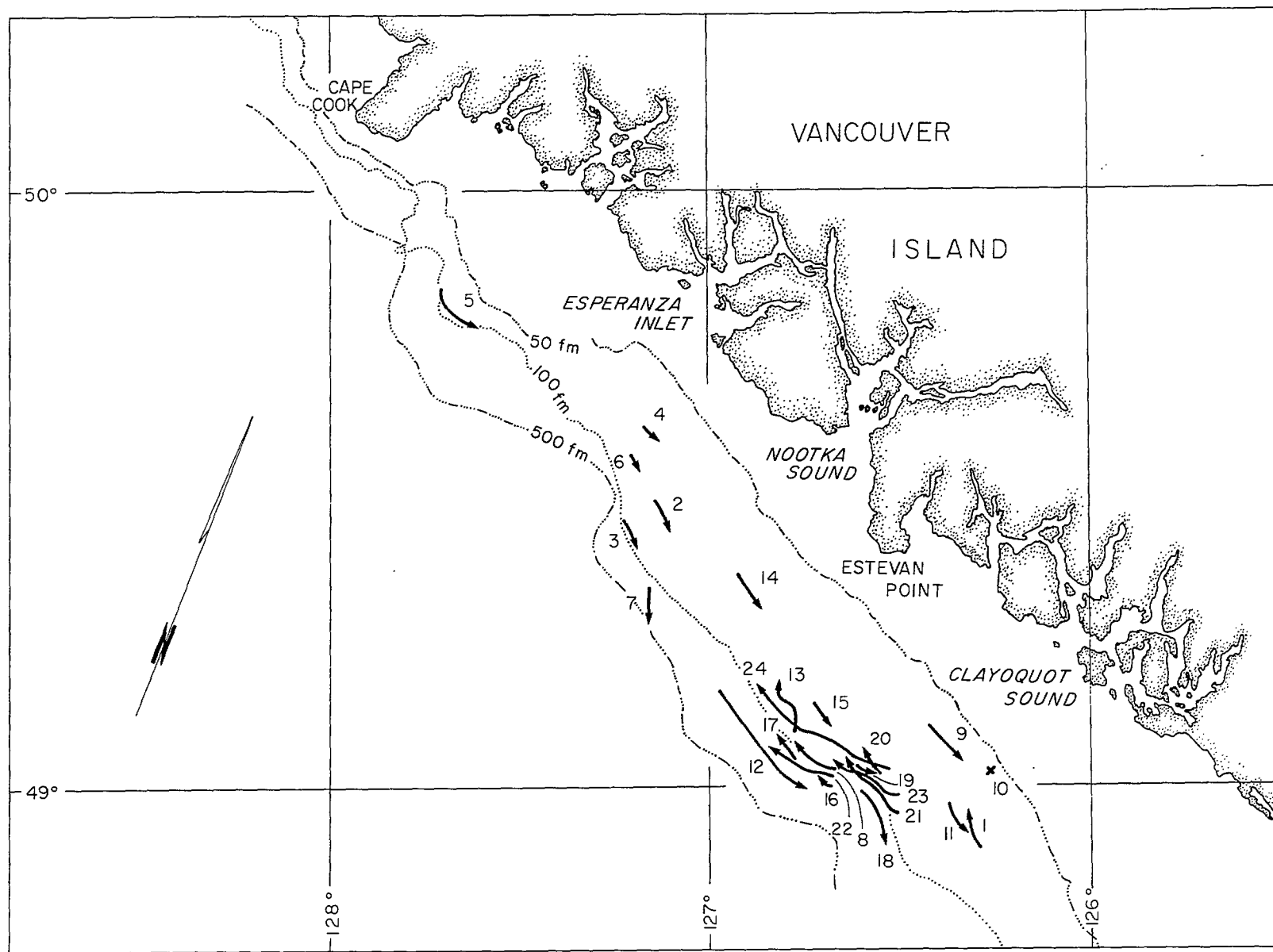
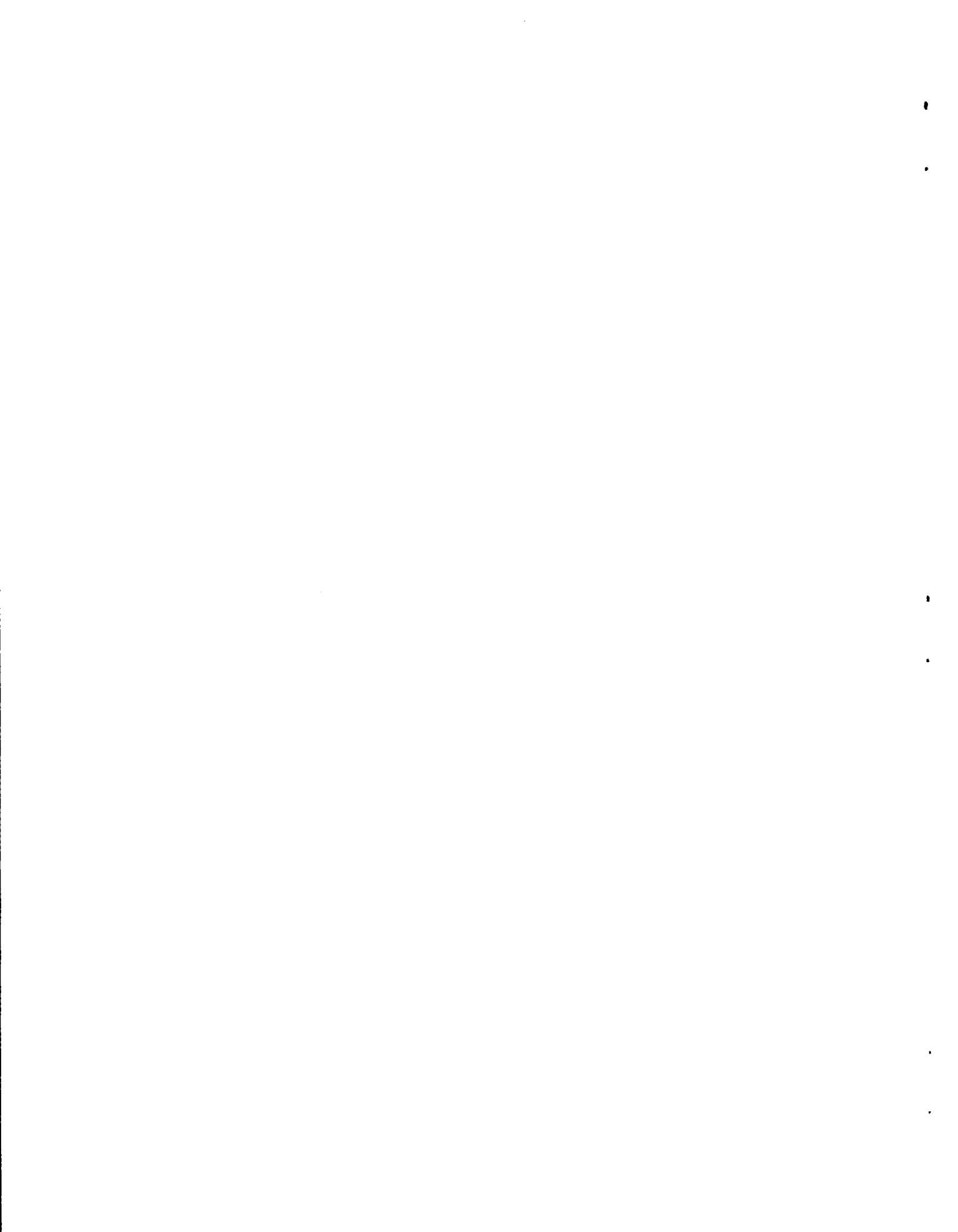


Figure 2. Haul locations for M/V GALLISTRATUS cruise, January 22-February 1, 1980 off west coast Vancouver Island.



Appendix Table 1. Scientific and common names of fish species captured.

Common name	Scientific name
ROCKFISH	
Redbanded rockfish	<u>Sebastes babcocki</u>
Widow rockfish	<u>Sebastes entomelas</u>
Yellowtail rockfish or greenies	<u>Sebastes flavidus</u>
Bocaccio	<u>Sebastes paucispinis</u>
Canary rockfish	<u>Sebastes pinniger</u>
Redstripe rockfish	<u>Sebastes proriger</u>
FLATFISH	
English sole or lemon sole	<u>Parophrys vetulus</u>
Rex sole	<u>Glyptocephalus zachirus</u>
Turbot	<u>Atheresthes stomias</u>
ROUNDFISH	
Hake	<u>Merluccius productus</u>
Lingcod	<u>Ophiodon elongatus</u>
Pacific cod	<u>Gadus macrocephalus</u>
Walleye pollock	<u>Theragra chalcogramma</u>
Pacific herring	<u>Clupea harengus pallasii</u>
American shad	<u>Alosa sapidissima</u>
Chinook salmon	<u>Oncorhynchus tshawytscha</u>
Smelt	family Osmeridae
SELACHII	
Soupfin shark	<u>Galeorhinus zyopterus</u>
Spiny dogfish	<u>Squalus acanthias</u>
Ratfish	<u>Hydrolagus colliei</u>
Longnose skate	<u>Raja rhina</u>

Appendix Table 2. Vessel and net specifications for M/V CALLISTRATUS cruise, January 22-February 1, 1980.

Vessel: M/V CALLISTRATUS

Skipper: Tom Foote

Port: Vancouver

Gross tons: 1,040

HP: 2500

Overall length: 192 ft (58.5 m)

Type: Stern trawler

Electronic Aids

Sounder: Atlas 600S, Furuno Grand Ace

Radio: 2 VHF-(2)SSB

Radar: 2 Furuno

Autopilot: Gylot

Loran: Raynav 6000 with Epsco plotter

Net sounder: Atlas 600S

Net Dimensions

	Engel	Diamond IX
Head rope	106.8 m	100 m
Foot rope	106.8 m	100 m
Horizontal opening	53 m	-
Vertical opening	33 m	24 m
Bridle length	100 m	100m (+2.5 m on bottom)
Trawl doors type	Süberkrüb	Polyvalent
:size	4 m x 2 m	1.3 m x 3 m
:shape	dished	oval
:weight	1000 kg	1250 kg
Clump weights	1000 kg ea	500 kg ea

Appendix Table 3 (cont'd)

Haul: 9 Date: January 27, 1980 Direction (T): 118° Speed (kts): 4.3

Duration: 1.25 h Start: Time: 0535 Stop: Time: 0650
Latitude: 49°5' Latitude: 49°2'
Longitude: 126°25' Longitude: 126°20'
Loran C: 14511.1 Loran C: 14534.5
29315.2 29285.2

Depth (m): Net: 120 Bottom: 144 Warp length: 274 m

Haul: 10 Date: January 27, 1980 Direction (T): 330° Speed (kts): -

Duration: - Start: Time: 0750 Stop: Time: -
Latitude: 49°1' Latitude: -
Longitude: 126°15' Longitude: -
Loran C: 14555.0 Loran C: -
29273.0

Depth (m): Net: 113 Bottom: 154 Warp length: 365 m

Haul aborted - doors failed to set.

Haul: 11 Date: January 27, 1980 Direction (T): 157° Speed (kts): 3.3

Duration: 1.0 h Start: Time: 0420 Stop: Time: 0520
Latitude: 48°57' Latitude: 48°19'
Longitude: 126°21' Longitude: 126°19'
Loran C: 14532.0 Loran C: 14546.0
29257.0 29236.0

Depth (m): Net: 91 Bottom: 143 Warp length: 274 m

Haul: 12 Date: January 27, 1980 Direction (T): 300° Speed (kts): 3.7

Duration: 3.5 h Start: Time: 1945 Stop: Time: 2330
Latitude: ≈49°8' Latitude: 49°9'
Longitude: ≈126°58' Longitude: 126°55'
Loran C: -* Loran C: 14375.0
-* 29374.0

Depth (m): Net: 128 Bottom: 201 Warp length: 411 m

*Loran signal interference caused by snow storm.

Appendix Table 3 (cont'd)

Haul: 17	Date: January 29, 1980	Direction (T): -	Speed (kts): -
<u>Duration:</u> 0.4 h	<u>Start:</u> Time: 1755	<u>Stop:</u> Time: 1820	
	Latitude: 49°02'	Latitude: 49°04'	
	Longitude: 126°46'	Longitude: 126°49'	
	Loran C: 14424.0	Loran C: 14409.0	
	29315.0	29333.0	
<u>Depth (m):</u>	Net: 91	Bottom: 175	Warp length: 320 m
Tow aborted - loss of net sounder signal.			

Haul: 18	Date: January 29, 1980	Direction (T): 120°	Speed (kts): 3.6
<u>Duration:</u> 2.1 h	<u>Start:</u> Time: 1955	<u>Stop:</u> Time: 2200	
	Latitude: 48°58'	Latitude: 48°54'	
	Longitude: 126°36'	Longitude: 126°32'	
	Loran C: 14470.0	Loran C: 14493.0	
	29281.0	29242.0	
<u>Depth (m):</u>	Net: 128	Bottom: 292	Warp length: 365 m

Haul: 19	Date: January 30, 1980	Direction (T): 138°	Speed (kts): 4.4
<u>Duration:</u> 0.5 h	<u>Start:</u> Time: 0340	<u>Stop:</u> Time: 0405	
	Latitude: 49°01'	Latitude: 48°60'	
	Longitude: 126°37'	Longitude: 126°36'	
	Loran C: 14463.9	Loran C: 14470.0	
	29299.2	29305.0	
<u>Depth (m):</u>	Net: 146	Bottom: 175	Warp length: 365 m

Haul: 20	Date: January 30, 1980	Direction (T): 350°	Speed (kts): 4.0
<u>Duration:</u> 1.0 h	<u>Start:</u> Time: 0750	<u>Stop:</u> Time: 0850	
	Latitude: 49°01'	Latitude: 49°03'	
	Longitude: 126°33'	Longitude: 126°35'	
	Loran C: 14481.4	Loran C: 14447.0	
	29290.8	29305.0	
<u>Depth (m):</u>	Net: 146	Bottom: 175	Warp length: 365 m

Appendix Table 4. Size composition, sex ratio and maturity stages for Sebastes flavidus caught off the west coast of Vancouver Island, January 22-February 1, 1980. See Table 2 for explanation of maturity codes.

Haul 12		MALE							FEMALE							
CONDITION		1	9	8	8A	8B	8C	8D	8E	1	2	3	4	5	6	7
LENGTH (cm)																
35																
6																
7					1											
8																
9					2											
40					2						1					1
1					5											
2					16											1
3					16						1					4
4					15											1
45					21											3
6					37						3	1				3
7					13											2
8					21							1				
9					3						2			1		
50					5							2				
1					1							1				
2					1											
3												1				
4																
55																
6											1					
7																
8																
9																
60																
SUB TOTAL					158						8	6		1		15
% MATURITY					100						27	20		3		50
TOTAL					158									30		
SEX RATIO					0.84									0.16		

Appendix Table 4 (cont'd)

Haul 13		MALE							FEMALE						
CONDITION	1	9	8	8A	8B	8C	8D	8E	1	2	3	4	5	6	7
LENGTH (cm)															
35															
6															
7															
8															
9				1										1	
40															
1				3											
2				1											
4				1					1						
45				6								1			
6				6					3		3	2			1
7				12						2	5				
8				7					2	2	3	5			
9				1					1	3	14	4			
50									1	2	13	9			1
1											4	22	13		
2												7	11		
3												7	8		
4												2	1		
55												4	2		
SUB TOTAL				40						8	13	81	55	1	2
% MATURITY				100						5	8	51	34	0.7	1.3
TOTAL				40								160			
SEX RATIO				0.20								0.80			

Appendix Table 4 (cont'd)

Haul 18		MALE							FEMALE							
CONDITION		1	9	8	8A	8B	8C	8D	8E	1	2	3	4	5	6	7
LENGTH (cm)																
35																
6																
7																1
8					1											
9					4											
40					3						1					
1					9											3
2					3						1					
3					7											2
4					7						2					3
45					9						2					1
6					7								1	1		
7					3						3		1			
8					3								3			1
9					1						2	1	3	1		
50												1	3	1		
1													1			
2												1	1			
3													1			
4																
55																
SUB TOTAL					57						11	3	14	3		12
% MATURITY					100						26	7	32	7		28
TOTAL					57						43					
SEX RATIO					0.57						0.43					

Appendix Table 4 (cont'd)

Haul 19		MALE							FEMALE						
CONDITION	1	9	8	8A	8B	8C	8D	8E	1	2	3	4	5	6	7
LENGTH (cm)															
40				3											1
1				1						1					
2				3											
3				4						5					4
4				8						5					
45				6						1					1
6				7						2					2
7				6							1	1			1
8				8						1	1	3	1		
9				2							1		1		
50											1				
1															
2												3			
3													1		
4															
55															
SUB TOTAL				48						15	4	7	3		9
% MATURITY				100						40	10	18	8		24
TOTAL				48						38					
SEX RATIO				0.56						0.44					

Appendix Table 4 (cont'd)

Haul 23		MALE							FEMALE						
CONDITION	1	9	8	8A	8B	8C	8D	8E	1	2	3	4	5	6	7
LENGTH (cm)															
35															
6															
7															
8				1											
9				3											
40				4											
1				4											1
2				7						1					2
3				5											2
4				12							1				1
45				10							1				2
6				4						1	1				1
7				8							1	3			
8				7						1					1
9				6							1	1			1
50												2			
1															
2												1			
3														1	1
4															
55															
6												1			
SUB TOTAL				71						3	5	8	1		12
% MATURITY				100						10	17	28	3		42
TOTAL				71									29		
SEX RATIO				0.71									0.29		

Appendix Table 4 (cont'd)

Haul 24															
MALE									FEMALE						
CONDITION	1	9	8	8A	8B	8C	8D	8E	1	2	3	4	5	6	7
LENGTH (cm)															
35															
6															
7															
8				1											
9															
40				2											
1															
2				5											
3				1											
4				2											
45				10							1				
6				4											
7				6							1	2			
8				7								1			
9				5								1	1		
50				2								1	2		
1				2							1	1			
2															
3															
4															
55														1	
SUB TOTAL				47							3	6	3	1	
% MATURITY				100							23	46	23	8	
TOTAL				47							13				
SEX RATIO				0.78							0.22				

Appendix Table 5. Size composition sex ratio and maturity stages for Sebastes entomelas caught off the west coast of Vancouver Island, January 22-February 1, 1980. See Table 2 for explanation of maturity codes.

Haul 13		MALE							FEMALE						
CONDITION	1	9	8	8A	8B	8C	8D	8E	1	2	3	4	5	6	7
LENGTH (cm)															
34				2											
35															
6															
7				2					1						1
8												1			
9				5								3			
40				14								4			
1				16							1	3	4		1
2				10							1	12	6		
3				12								5	8		
				16								8	3		
45				9							2	8	4		
6				4								5			
7				7								7	2		
8				7						1	3	3			
9				6							1		1		
50				2	1						6	5			
1				1							4	5	1		
2											13	7			
3											14	5	1		
4											13	1			
55											8				
6											4				
7															
8															
9															
60															
SUB TOTAL				113	1				1	1	70	82	30		2
% MATURITY				99	1				0.5	0.5	38	44	16		1
TOTAL	114							186							
SEX RATIO	0.38							0.62							

Appendix Table 6. Size composition, sex ratio and maturity stages for Sebastes proriger caught off the west coast of Vancouver Island, January 22-February 1, 1980. See Table 2 for explanation of maturity codes.

Haul 12	MALE								FEMALE						
CONDITION	1	9	8	8A	8B	8C	8D	8E	1	2	3	4	5	6	7
LENGTH (cm)															
30				3											
1															
2										1					
3										2					
4										13					
35										24					
6										17					
7										12					
8										12					
9										5					
40										6					
1										5					
2															
3															
4															
45															
SUB TOTAL				3						97					
% MATURITY				100						100					
TOTAL				3						97					
SEX RATIO				0.03						0.97					

Appendix Table 7 (cont'd)

Haul 26		MALE							FEMALE						
CONDITION	1	9	8	8A	8B	8C	8D	8E	1	2	3	4	5	6	7
LENGTH (cm)															
30	1														
1				1											
2	1			2											1
3					1										
4				1						1					
35	1			10						5					4
6				5						1					1
7				6						1					1
8				3						7					1
9				2	1					3					2
40				1						3	1				3
1				1						2					1
2				1											
3				2						1					
4				1						1					
45				2											
6				1											
7				1											
8				6						1		1			1
9				2											
50				2							1				
1				1											
2															
3															
4															
55															
SUB TOTAL	3			51	2					26	2	1			15
% MATURITY	5			91	4					59	4.5	2.5			34
TOTAL	56							44							
SEX RATIO	0.56							0.44							

Appendix Table 8. Size composition, sex ratio and maturity stages for walleye pollock (*Theragra chalcogramma*) caught in Juan de Fuca Strait, January 22-February 1, 1980. See Table 3 for explanation of maturity codes.

Haul 25	Male					Female				
	I1	I2	R1	R2	R	I1	I2	R1	R2	R
27						1				
28		1	1			2				
29		2				1				
30		2				5		1		
1		2	1			4				
2		4				6				
3						2				
4		1				1		1		
35		1		1		3				
6		1		1		1			1	
7						7				
8				2		5				
9		1		2		4			2	
40				1		2			2	
1						1			5	
2				2		1			3	
3			1	2				1	1	
4				3					3	
45				3					2	
6				1					2	
7				2						
8				1					2	
9									3	
50				1				1		
1				1					1	
2				1					1	
3									2	
4								1		
55									1	
Sub total		15	3	24		46		5	31	
% maturity		36	7	57		56		6	38	
Total			42					82		
Sex ratio			0.34					0.66		

Appendix Table 8 (cont'd)

Haul 26	Male					Female				
	I1	I2	R1	R2	R	I1	I2	R1	R2	R
15						1				
~										
26	1					1				
7	1		1			3				
8		5		1		7				
9		6	1	3		6				
30		10		1		13		1		
1		7	1			6				
2		6				4	1		1	
3		1		2		4				
4		1				1				
35		4		1		4				
6				1		3				
7		2		2		4				
8		1		6		8				
9				2		6		2		
40				2		2		1	2	
1				2		1			5	
2								1	2	
3				1					4	
4				2						
45				1						
6										
7									1	
8				1					1	
9									1	
50									1	
1										
2										
3										
4									1	
55									1	
Sub total	2	43	3	28		74	1	5	20	
% maturity	3	56	4	37		74	1	5	20	
Total			76					100		
Sex ratio			0.43					0.57		

