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Observations on the cod fishery in the Gulf of St. Lawrence during the spring of 1958.

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At the 7th Annual Meeting of ICNAF, Canada and the United States were invited by the French delegation to send biologists to observe fishing operations of trawlers in the 1958 spring fishing season, and to sample their catches. Arrangements were subsequently made through the Federation des Syndicats d'Armateurs a la Grande Peche for the writers to go aboard the trawlers "Clairvoyant" and "Zelande".

The trawler "Zelande" picked us up at Sydney on March 15 and proceeded to Subdivision 4R where fishing commenced on March 16. McCracken transferred to the "Clairvoyant" on March 17th and remained there until March 25. Clark remained aboard the "Zelande" until March 21, went aboard the "Santo Andre" for five days and returned to the "Zelande" from March 26 to March 30.

Acknowledgements

We particularly wish to thank M. Dezeustre of Pecheries Bordeaux and M. Girard of Les Chalutiers Malouins, Saint Malo, for their arrangements. We also wish to thank Captain LeCoeur of the trawler "Clairvoyant" and Captain Thomas of the trawler "Zelande" for their cooperation and assistance. Mr. Clark is also very grateful to Captain Sao Marcos at whose invitation he spent a number of days aboard the Portuguese trawler "Santo Andre". We appreciate the cooperation of the Canadian Department of Fisheries and the services of their M.V. "Cygnus" and "Eastern Explorer" in returning us from sea to Canadian ports.

Areas fished

The trawlers fished off the west coast of Newfoundland (4R), in the central Gulf of St. Lawrence, off the northeastern part of Cape Breton Island (4T) and southeast of St. Paul Island (4V) (Figure 1). Fishing was carried out in depths from 45-165 fathoms (80-300 metres) but mainly in about 110 fathoms (200 metres). Localities where catches were sampled are shown in Figure 1.

No sea ice was seen in the Gulf of St. Lawrence and surface temperatures ranged from 1.0°C to -1.0°C. in the St. George Bay area (4R) and -1.0°C. in the Bird Rock area.

Fishing Gear

The size of gear used by all three trawlers is essentially the same. Specific details of the gear used are given in Table 1. The trawls used, with headrope about 80 feet and footrope about 110 feet, have about the same mouth opening as those used by Canadian and United States large otter trawlers. Ground cables were about 180 feet in length between the otter door and the Danlens. Bridles between the Danlens and upper wing end were about 30 feet. Body of the trawl in all cases was of manila. French vessels were making extensive use of nylon in the codend and lengthening piece. The nets had much longer lengthening pieces and codends than North American trawlers.

^ Bassens, Bordeaux,

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Table 1. Details of otter trawls used by vessels for which catches were taken.

	<u>Zelande</u>	<u>Clairvoyant</u>	<u>Santa Andre</u>
Headrope	80 feet	80 feet	80 feet
Footrope	116 "	110 "	110 "
Body of net:			
Twine	Manila (single)	Manila (single)	Manila (single)
Mesh size	ca. 6" new, knot centres	ca. 6" new, knot centres	ca. 6" new, knot centres
After Belly:			
Twine	Nylon, single	Manila)	Manila, single
Length	60 meshes ?	30 meshes) ?	40 meshes
Mesh size	5½" new, knot centres	5½" mesh)	5½" new, knot centres
Lengthening Piece:			
Twine	Nylon, double	Nylon, double	Manila, double
Length	70 meshes	ca. 100 meshes	ca. 70 meshes
Mesh size	ca. 4½" inside) knot, wet, used) ?	ca. 4"-4½" knot centre, new	ca. 5½" knot centre, new
Codend:	Single-layer	Double-layers	Double-layer
Twine	Nylon, double twine	Nylon and manila double twine	Manila, double twine
Length	45 meshes	ca. 50 meshes	ca. 35 meshes
Mesh size	ca. 4½" inside knot, used, wet	4-4½" nylon 5½" mesh manila	knot, used, wet
Splitting Strap Attachment	17 meshes ahead of codline mesh	About 24 meshes ahead of codline	24 meshes ahead of codline mesh
Protective Material Topside:	Chafing gear- single nylon (old after belly) attached loosely over last 12 meshes of codend - open aft about 18" of slotted cowskin under split- ting strap.	Layer of double manila netting covers bag, open aft. About 2½ feet slotted under splitting strap.	Slotted cowskin covering bag - attached forward and lateral edges, open aft.
Underside	Cowhides under codend - netting under splitting strap.	Layer of double manila netting full length of lengthening piece and codend - extra layer under splitting strap along with cowskin - cowhides covering bottom of codend.	Cowskin under codend.

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Catches

The catches of the three otter trawlers consisted mainly of cod. In Subdivision 4R catches were usually 70-80 thousand pounds per day. Catches from the relatively small amount of fishing in Subdivisions 4T and 4V were much smaller. Catch per tow (2 hours) varied from a low of 1,000 pounds taken 50 miles east of Gaspe Peninsula to a high of 70,000 pounds taken off Cape St. George. Hauls up to 25,000 pounds were taken west of St. George Bay and off Cape Anguille. Catches off the Bird Rocks did not exceed 10,000 pounds.

Some redfish were taken in most hauls. A few catches of up to 5,000 pounds per tow were seen, off Cape St. George, Cape Anguille and Cape Ray at depths of 80 fathoms and over. In one tow 40 small redfish (7 to 8 cm. long) were noted. Some haddock were taken in most tows in Subdivision 4R. Only occasionally were they taken in quantity, particularly off Cape Anguille and Cape Ray. Pollock were taken occasionally. Other species noted were American plaice, wolffish, hake, skates, lumpfish, grenadiers. A few shrimp and an occasional silver hake were noted in the catch. One or two halibut were taken in most tows.

Food of Cod

Examinations of cod stomachs were made in two locations. These may be summarized as follows:

<u>Sample No.</u>	<u>Date</u>	<u>Position</u>	<u>Depth in fathoms</u>	<u>Total Examined</u>	<u>No. with Food</u>
1	3/17	48°28' x 59°45' W. of Cape St. George	90-154	75	7
2	3/22	48°59' x 59°30' N. of Cape St. George	110-130	80	31

The stomachs of the seven cod in sample No. 1 which had been feeding contained:

- 4 - unidentified fish of 8-22 cm. length (capelin?)
- 1 - redfish, 18 cm. - possibly eaten in net as muscle convulsions were noticed (2 hours following hauling)
- 1 each - spider crab, annelid, shrimp, brittle star

The empty stomachs of "non-feeding" cod frequently contained very small fragments of brittle stars or shrimp.

A summary of the stomach contents of the 31 cod in sample No.2 which had been feeding is given in Table 2. Fish is shown to be the most important source of food for the cod, capelin being the predominant species. Euphasids and shrimp are also relatively important items. No difference between the sexes in stomach contents is discernible.

Cod taken north of Cape Anguille (48°05' x 59°47') in 200-250 meters were observed to be feeding most heavily on redfish.

Maturity and reproductive cycle

Gross examination of the gonads of cod was carried out for samples from Subdivisions 4R, 4T and 4V. Sampling locations are listed in Table 3, which shows that most fish examined were taken from depths greater than 100 fathoms and most of the samples came from Subdivision 4R. Both male and female mature and immature cod were taken in the catch at all sampling localities (Table 4). In Subdivision 4R the proportion of males in the catch appears to be slightly higher than females.

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Table 2. Stomach contents of cod sample No. 2.

Variety of food items	Total Number of Items	As Primary Food			As Secondary Food		
		Number of:			Number of:		
		Males	Females	Both Sexes	Males	Females	Both Sexes
Amphipod	1	-	1	1	-	-	-
Capelin	37	3	3	6	1	-	1
Cod	1	1	-	1	-	-	-
Cod viscera	7	1	1	2	-	-	-
Crab (spider)	2	-	-	-	1	-	1
Euphasid	12	4	4	8	1	-	1
Plaice	2	1	1	2	-	-	-
Redfish	2	-	1	1	1	-	1
Shrimp	5	1	1	2	1	-	1
Unident. fish and frags.	?	5	3	8	-	1	1

Table 3. Cod samples examined for maturity and stages of reproductive cycle.

Sample No.	Date	Subdivision	Region	Position		Depth Fathoms
				N. Lat.	W. Long.	
1	17/3/58	4R	W. Cape St. George	48°28'	x 59°41'	90-154
2	22/3/58	4R	N. Cape St. George	48°59'	x 59°30'	110-130
3	19/3/58	4R	W. Cape St. George	48°30'	x 59°40'	115-120
4	21/3/58	4R	N. Cape Anguille	48°05'	x 59°37'	120-140
5	23/3/58	4R	Cape Ray	47°41'	x 59°30'	115-130
6	18/3/58	4T	Bird Rocks	48°20'	x 62°00'	133-160
7	25/3/58	4V	St. Paul Is.	47°00'	x 60°00'	115-130

Table 4. Numbers of male and female immature and mature cod, and percentages of males in samples (1).

Sample No.	Subdivision	Imm. ♂	Mat. ♂	Imm. ♀	Mat. ♀	% Males
1	4R	13	45	13	24	61
2	4R	14	23	15	26	49
3	4R	6	49	14	20	56
4	4R	12	35	17	23	54
5	4R	12	28	12	21	54
6	4T	16	12	10	12	56
7	4V	9	28	28	21	42

(1) Since most samples were from cod retained, the proportion of immatures is lower than in the actual catch.

Size at maturity

Division of cod into immature and mature categories in March, by gross inspection, for the area of sampling is quite easy, since mature cod are in an advanced stage of the reproductive cycle. The percentage of mature male and female cod in relation to length, for Subdivisions 4R, and 4T - 4V are shown in Table 5.

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In both areas male cod begin maturing at a smaller size (43-46 cm.) than females (46-49 cm.). In the sample from Subdivision 4R it is quite apparent that 100% maturity is reached at a smaller size for males (61 cm.) than for females (67 cm.).

Although maturity samples for Subdivisions 4T and 4V are small, they indicate that cod begin to mature at about the same size in these Subdivisions as in 4R. However, onset of maturity appears to be less sharply defined in relation to size for Subdivisions 4T and 4V, with immature fish occurring at larger size than in 4R.

Table 5. Percentage of mature male and female cod by length in Subdivisions 4R and 4V-4T

Length Group cm.	4R		4V-4T			
	Male No.	Female No.	Male No.	Female No.	Male %	Female %
31	1	0				
34	-	-				
37	5	0	2	0		
40	6	0	5	0		
43	3	0	6	0		
46	12	17	12	0	3	33
49	15	27	11	18	1	0
52	20	45	24	21	10	20
55	25	68	18	45	8	50
58	30	93	12	75	6	67
61	28	100	16	87	5	60
64	28	100	27	93	6	83
67	24	100	19	100	2	50
70	16	100	14	100	8	50
73+	23	100	34	100	15	100
	179		200		64	
						71

Steps of Reproductive Cycle

Gonads of mature cod examined were classified into one of the following four stages: I - Ripening, II - Ripe, III - Spawning, IV - Spent-Recovering. Results of these examinations are presented in Table 6. Most of the mature cod were in the pre-spawning stage of their reproductive cycle. Cod from Subdivision 4R appeared to be further advanced in the reproductive cycle than those of 4T, and especially 4V. It also appeared that cod were further advanced toward spawning in the area north of Cape George than in any other area, since stage III males and females were only seen in any appreciable number there.

The advanced stage of gonad development in Subdivision 4R suggests earlier spawning for stock of cod sampled there than for those sampled in 4T and 4V. Stages of cod gonad development seen in this latter subdivision are in agreement with results of spring and summer sampling in 4T. These have shown that cod spawning occurs in 4T from late May to September, but with peak spawning in late June.

Lengths of Cod

Cod measurements were taken in all the major fishing areas of the trawlers visited (Appendix Table I). Most of the sampling was of that portion of the catch which was retained for salting. In three instances these samples were supplemented by measurements of the discarded portion of the same catch. Two samples were obtained of the unsorted catch and included some discardable sizes. The discard was

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so light, usually, that lengths of fish in the sorted (culled) and unsorted catches differed little.

The individual samples are listed in Table II of the Appendix. The samples were placed into groups representing six fishing areas and plotted in Fig. 2 as percentage length distributions. From comparison of the distributions it may be seen that the smallest cod were in the Bird Rock area (4T), where most were smaller than 53 cm. In the St. Paul Island area (4V), to the south, the fish were considerably larger, the majority being rather uniformly distributed over the 48-71 cm. range. The cod of Subdivision 4R were characterized by modes between 60 and 65 cm. and 48 and 53 cm. The Cape Ray and Cape Anguille fish were similar in length. Somewhat more smaller fish were taken west of Cape George and more larger fish north of Cape George.

Table 6. Reproductive stages of mature cod, during late March in Subdivisions 4R, 4T and 4V

Subdivision and Location	Males Stages					Females Stages				
	No.	I %	II %	III %	IV %	No.	I %	II %	III %	IV %
4R										
Off Cape Ray	28	57	43	-	-	21	85	10	-	5
W. Cape Anguille	35	69	28	-	3	23	70	30	-	-
W. Cape St. George	94	29	67	2	2	54	86	10	-	4
N. Cape St. George	25	-	60	36	4	26	58	8	20	14
4T										
N.W. Bird Rocks	12	-	67	8	25	12	50	-	-	50
4V										
St. Paul Island	28	79	-	-	21	21	85	10	-	5

Lengths of Haddock

Only one small sample of haddock lengths was obtained. While a few haddock were caught in most hauls in 4R, only occasionally were they an important part of the haul. The sample listed below shows the large size of haddock which were encountered in the 4R area:

Length	37	40	43	46	49	52	55	58	61	64	67	70
Numbers	2	7	6	9	1	7	1	11	6	3	2	2

Discarded Fish

Only small amounts of cod were discarded in the areas fished, the greatest amount in any of the areas visited making up about 10 per cent of the weight of the total catch.

All redfish taken were discarded but catches did not exceed 5,000 pounds per tow in any area. Only negligible quantities of the smaller sizes of other food fishes were discarded.

Discard samples of cod were obtained aboard each of the trawlers. The length composition of the discards is shown in Fig. 3. The following "culling" percentages were calculated from the samples after adjustment to equal proportion to the whole catch.

Conclusions can be drawn from this limited sampling only with caution. We can probably conclude with safety only that cod of less

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than 36 cm. are not usually retained.

<u>Size in cm.</u>	<u>Percentage Discarded</u>		
	<u>Santo Andre</u>	<u>Zelande</u>	<u>Clairvoyant</u>
<35	100	100	100
36-38	93	31	100
39-41	66	19	100
42-44	59	0	92
45-47	33	0	54
48-50	11	0	16
51-53	0	0	3
>54	0	0	0

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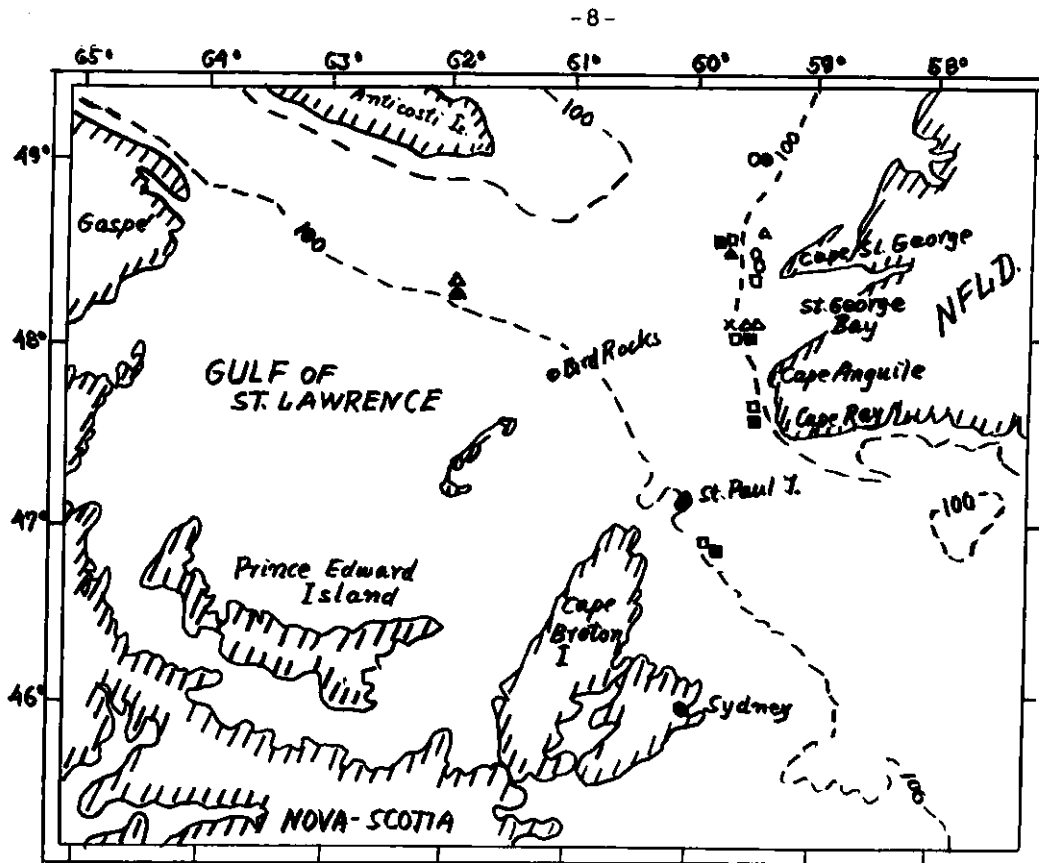


Figure 1. Gulf of St. Lawrence showing sampling locations. Triangles for Zelanda, circles for Santo Andre; open for length samples, solid for food and maturity samples.

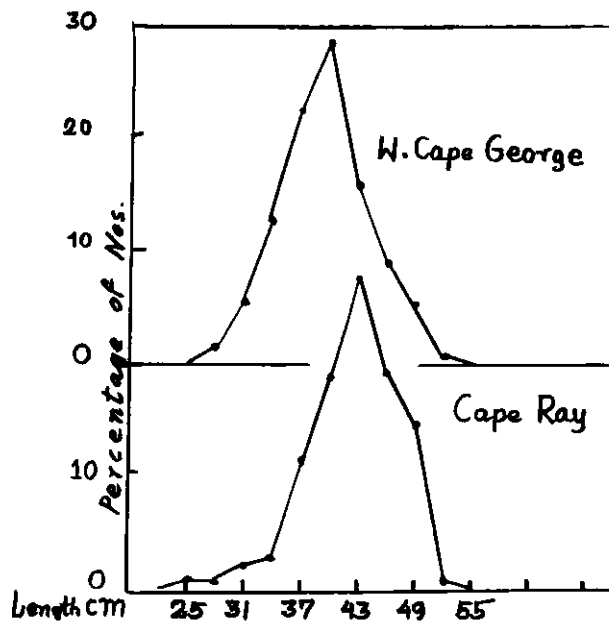


Figure 3. Samples of discards.

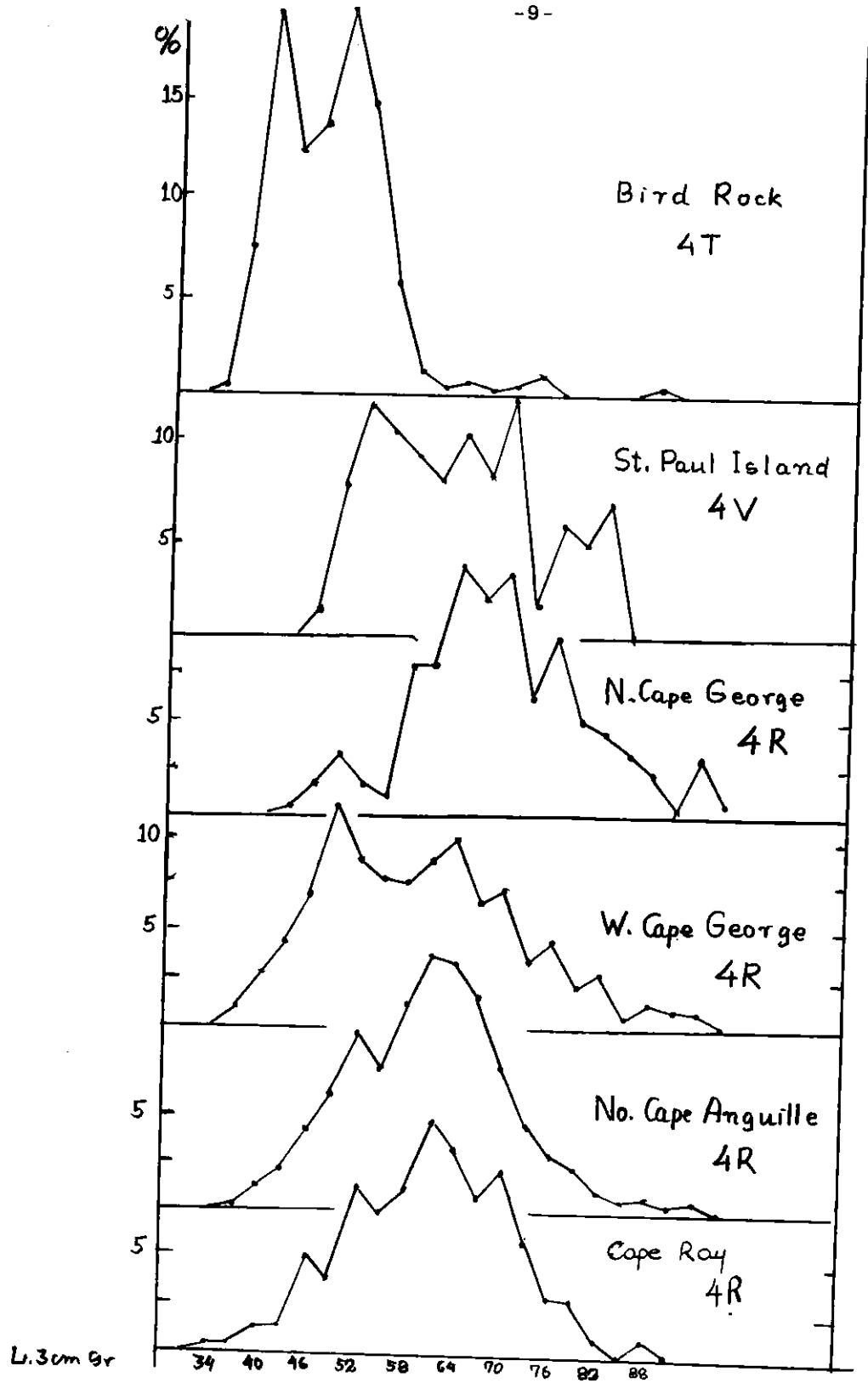


Figure 2. Comparative length distributions of catches ("unsorted" and "retained" samples).

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Table I. Locations of length samples

No.	Sample Type	Vessel	Date	Location	Depth
a	Ret.	Zel.	3/19	Bird Hook - 48° 20' x 62° 00'	135-160 fm.
b	"	Clair.	"	St. Pauls Is. - 47° 00' x 60° 00'	110-120 fm.
c	Disc.	"	3/23	Cape Bay - 47° 41' x 59° 28-30'	115-125 fm.
d	Unsort.	"	"	"	"
e	Ret.	"	"	"	"
f	Unsort.	"	3/21	N. Cape Anguille - 48° 05' x 59° 47'	135 fm.
g	Ret.	"	3/22	" " - 48° 05' x 59° 35'	120 fm.
h	"	Zel.	3/16	" " - 48° 08' x 59° 30'	85 fm.
i	"	Clair.	3/19	W. Cape George - 48° 30' x 59° 40'	115-120 fm.
j (r)	"	"	3/19	" " - 48° 20' x 59° 30'	75 fm.
k (d)	Disc.	"	3/19	" " "	"
l (r)	Ret.	St. And.	3/26	" " - 48° 27' x 59° 30'	70 fm.
m (d)	Disc.	"	"	" " "	"
n (g)	Ret.	Zel.	3/27	" " - 48° 29' x 59° 28'	75 fm.
o (d)	Disc.	"	"	" " "	"
p	Ret.	St. And.	3/22	N. Cape George - 48° 59' x 59° 30'	125 fm.

Table II. Length Samples (Details given in Table I)

	a	b	c	d	e	f	g	h	i	j(r)	k(d)	l(r)	m(d)	n(g)	o	
25				1												
28				1												
31				3												
34	1			4	1											
37	22		15	1		1			2							
40	56		24	4		3	1	3	1							
43	36		36	4		6	1	4	1	1						
46	41	1	25	8	6	7	4	12	2	6						
49	58	7	19	5	5	9	2	22	4	18	16	8	1	44		
52	44	10	1	14	9	15	11	23	5	21	2	3		27	3	
55	17	9		14	5	22	5	12	8	16		8		18	2	
58	3	8		13	9	17	9	31	13	16		7		12	14	
61	1	7		23	9	13	7	51	15	20		3		16	14	
64	2	9		28	14	13	11	45	15	32		3		14	23	
67	1	7		14	7	12	7	40	11	15		3		12	20	
70	2	11		17	8	7	3	29	9	16		8		13	23	
73	3	1		14	2	7	3	14	3	7		9		4	11	
76		5		8		5		11	4	7		12+		6	17	
79		4		8		2	8	9	2	3		8			9	
82		6		3		1	1	4				12		7	8	
85				1				3		2		2			6	
88	1			3		2		2	1	1		7			4	
91				1				2	2	1		3			1	
94								3	1			3		1	6	
97+	1							3				11		1	8	
TOTAL	289	85	129	184	74	142	67	323	99	182	121	138	115	232	92	177