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Geographical Size Differences in Canadian Offshore Lobsters

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Abstract

The median sizes of lobsters trapped on Truxton Swell and SW Browns Bank were smaller than those SE of Browns and on Georges Bank. Such differences cannot be attributed to fishing pressure, which has been light on Truxton Swell compared to SE Browns and Georges Bank. It is hypothesized that the offshore lobsters are derived from SW Nova Scotia inshore animals some of which at maturity move offshore. A gradation of sizes from smaller to larger is also noted from the canyons off New York to eastern Georges Bank, suggesting a similar outward movement of lobsters along Georges Bank from west to east.

Résumé

La taille médiane des homards capturés dans le secteur du Truxton Swell ainsi que dans celui du sud-ouest du banc de Brown est inférieure à celle des homards du secteur sud-est du banc de Brown et du banc de Georges. On ne peut attribuer cette différence à un effort de pêche moins intensif dans le secteur de Truxton Swell qu'au sud-est du banc de Brown et sur le banc de Georges. On suppose que les homards de haute mer sont issus des stocks côtiers du sud-ouest de la Nouvelle-Ecosse dont certains individus gagnent le large une fois parvenus à maturité. On observe également une augmentation progressive de taille entre les canyons au large de l'Etat de New York et la partie est du banc de Georges, ce qui laisse entendre une migration similaire des homards de l'ouest vers l'est le long du banc de Georges.

Introduction

The Canadian offshore lobster fishery, beyond a line approximately 50 n. mi. from SW Nova Scotia, started in 1971 and increased to 678 MT in 1976. Since 1976 landings have ranged from 609-684 MT (Table 1) (Stasko and Pye 1980). The most heavily fished areas have been Corsair Canyon, SW Browns and SE Browns. Truxton Swell was first fished in 1974, lightly 1974-75, and intermediately 1976-79. The northeast edge of Georges Bank has never been fished heavily.

In-port sampling for size frequency of landed offshore lobsters was begun in 1976. At-sea sampling of total catch (including discards: sublegal, berried and soft-shelled lobsters) was begun in 1977. Hardly any lobsters under the legal size of 81 mm carapace length (CL) are caught offshore, while shorts (sublegal lobsters) are common on SW Nova Scotia inshore grounds (Stasko 1978).

The present paper utilizes the above sampling data, along with published US data, to compare the size of lobsters from inshore SW Nova Scotia to the edge of the continental shelf SE Browns Bank, and from SW Georges to Corsair Canyon. The median size is used as a quantitative representation of the size distribution of animals in each sample.

Size differences

A comparison of median sizes (both sexes and all years combined 1976-79) for both in-port samples and at-sea samples shows a gradation from small on Truxton Swell to large on eastern Georges Bank (Fig. 1,2). This follows a geographical sequence from NW to SE. Preliminary examination shows no consistent patterns of sex ratios by area and size of animals by season to account for this sequence.

Analysis of variance on median size for each sample (one boat trip to one area) indicates significant differences ($p < .001$) between the four areas. The median size of animals by area, averaged by year with each sample given equal weighting, are shown in Table 2. Median values for Truxton Swell were not significantly different (t-test, $p < .05$) from those in the adjacent SW Browns area, but both were different from SE Browns and Georges Bank. The in-port samples from SE Browns were significantly different from the Georges Bank samples, while the small number of at-sea samples were not. The statistical significance was similar when tested either with annual average median values or with medians of individual samples.

The sequence of increasing sizes beyond the offshore lobster line is a continuation of size increases from SW Nova Scotia inshore grounds (Fig. 3). Port Maitland and Lurcher shoal show typical inshore sizes peaking around the legal size. German Bank shows an intermediate size; this comprises two samples, the shallow one (45-60 m) being similar to that at Lurcher Shoal and the deeper one (130-180 m) having larger animals and lacking shorts. There is a similar size increase from the canyons on southern Georges northeastward to the Corsair Canyon area.

Fishing pressure is heavy and is believed to account for the scarcity of large lobsters both on inshore SW Nova Scotia grounds (Stasko and Campbell 1980) and in the canyons on SW Georges Bank (Skud and Perkins 1969). However, small lobsters (e.g. less than the 81-mm CL legal size) are abundant on inshore SW Nova Scotia grounds as well as in the SW Georges Canyons, but are almost totally absent in trap catches from Truxton Swell to eastern Georges Bank (Fig. 2,3 and Tables 3,4). Similar scarcity of shorts was recently noted in trawl catches on Browns Bank, July-October 1980, where out of 132 lobsters caught none were less than 81 mm CL, and only 4 were less than 100 mm (D. Pezzack, personal communication).

Hypothesis

The size differences between the several offshore areas cannot be ascribed to fishing pressure. If fishing pressure was such as to affect the size distribution, then one would expect to have the largest median size in the Truxton Swell area where the fishing pressure has been least and started only in 1974 (Table 1). Yet in the Truxton Swell area the median size is small compared to SE Browns and Georges Bank (Table 2) where the fishery has been substantial since 1972.

Other explanations to account for the size differences could be differences in growth rates, differences in natural mortality, regional differences in catchability, substrate types, sampling anomalies or patterns of movements. Since fishing for lobsters in the several offshore areas takes place at similar depths (mostly 160-220 m, occasionally to 350 m, seasonally shallower in summer and deeper in winter), there is no a priori reason to assume differences in growth and natural mortality. Catchability and substrate type are interrelated but are unlikely causes for size differences since trawling and trapping both show similar trends. Besides, the geographical areas under question are large and each offers a variety of substrates. Anomalies in sampling, due to unequal number of samples from each season, are unlikely explanations since preliminary examination of data show no consistent regional patterns in sex ratio and seasonal patterns in size of animals.

Lobster movements appear to be a likely explanation. This is an extension of the hypothesis (Stasko 1978) that offshore lobster stocks in the Browns Bank area are derived from SW Nova Scotia inshore lobsters. According to this hypothesis some proportion of the inshore lobsters, when they reach maturity, travel offshore where they produce larvae that drift inshore and supplement inshore larval production. The hypothesis is based on the observations that berried lobsters are scarce inshore (due to heavy fishing pressure) and abundant offshore, while sublegal (less than 81 mm CL) lobsters are abundant inshore and almost completely absent in trap catches (Stasko 1978) and trawl catches (D. Pezzack, personal communication) offshore.

The extension of the Stasko (1978) hypothesis is that dispersing lobsters from inshore SW Nova Scotia reach Truxton Swell and SW Browns sooner (i.e. at a smaller size) than SE Browns and Georges Bank. This time difference allows for additional growth of lobsters arriving at SE Browns. For SE Browns, compared to Truxton Swell and SW Browns, such a time difference might be either due to a slower rate of progress if travelling along a reasonably direct route, or due to a route that takes at least some of the animals across Truxton Swell and SW Browns en route to SE Browns.

Results of lobster tagging in July-August 1975 off SW Nova Scotia south and east of Seal Island (distant inshore grounds) and on top of Browns Bank (shallowest part) show that some lobsters move considerable distances (Stasko, unpublished). Of 4,260 tagged lobsters released (2,967 distant inshore and 1,293 on Browns Bank), 400 (9.4%) have been recovered as of January 31, 1980, 363 with known location of recapture. Of the 363 animals, 44 (12 %) moved 50 n. mi. or more; 83 (23%) moved 30 n. mi. or more. From these summer releases, 25 animals moved between inshore and offshore grounds, 22 of them moving outward. Within the offshore area there was movement both to west and to southeast of the release site on top of Browns. Only 6 animals (1.7%) moved across the Fundian Channel (deep water between Browns Bank and Georges Bank to the south) to Georges Bank, 2 of these all the way from the Seal Island area off SW Nova Scotia.

In the 1968-71 US tagging of offshore lobsters (Uzmann et al. 1977), 855 animals (of a total of 7,326) were tagged on eastern Georges Bank north and east of 41°12' lat. 66°52' long. Of the 855 released, 100 (12%) were recovered; all were recovered south of the Fundian Channel. None reached the Canadian inshore lobster grounds. The Canadian offshore lobster fishery did not start until 1971-72.

Thus, results of the tagging studies <u>are consistent with but do not prove</u> the hypothesis that size-frequency differences in the offshore areas north of the Fundian Channel are due to sequential arrival of emigrating inshore lobsters.

The same tagging results show very little exchange across the Fundian Channel to Georges Bank. However, absence of sublegal lobsters from trap catches in the Corsair area and their abundance on southern Georges and west suggests the possibility of an emigration from southern Georges to eastern Georges Bank. The tag return data of Uzmann et al. (1977) could be re-analyzed for east-west direction of movement predominance for large lobsters, e.g. over 100 mm CL.

Acknowledgments

The size frequencies for Canadian lobster areas are from data files at the Biological Station, St. Andrews, New Brunswick. The manuscript was reviewed by D. Pezzack and Alan Campbell. Figures were drawn by P. W. G. McMullon and F. B. Cunningham.

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Table 1. Canadian offshore lobster landings in metric tons by area fished. Landings are based on logbooks, fisheries officers' reports and sales slips. Where logbook records were not available, locations are estimated on the basis of previous and subsequent locations fished by each boat.

	Browns Bank area (4X)			Georges Bank (5Ze)		Combined areas - MT (%)				
Year	Truxton Swell	SW Browns	SE Browns	NE Georges	Corsair area	4X	5Ze	Total	% landings reported in logs	No. of boats
1971	-	-	8	92*	-	8 (8)	92 (92)	100	22.4	5
1972	-	22	158	-	154	180 (54)	154 (46)	334	26.5	6
1973	-	136	181	9	167	317 (64)	176 (36)	493	41.4	7
1974	10	122	149	-	135	281 (68)	135 (32)	416	68.6	6
1975	18	117	247	-	163	382 (70)	163 (30)	545	83.0	8
1976	71	307	118	14	168	496 (73)	182 (27)	678	92.8	7
1977	70	220	68	48	229	358 (56)	277 (44)	635	98.4	8
1978	53	240	81	33	277	374 (55)	310 (45)	684	100.0	8
1979	36	240	105	2	226	381 (63)	228 (37)	609	100.0	8
'71-79	258	1404	1115	198	1519	2777 (62)	1717 (38)	4494		

*These 1971 landings are from the Welker to Lydonia Canyon area on SE Geroges Bank.

Table 2. Averages of median carapace length (mm) for in-port and at-sea samples 1976-79 by area by year. In deriving the average median values the median size for each trip is weighted equally. Comparison of median sizes between fishing areas (t-test) gives probability values as shown beneath the totals. Probability values were similar when tested with medians of individual trips.

Year	Truxton Swell			SW Browns			SE Browns			**Georges		
	Avg. med.	No. of trips	No. of anim.	Avg. med.	No. of trips	No. of anim.	Avg. med.	No. of trips	No. of anim.	Avg. med.	No. of trips	No. of anim.
IN-PORT SAMPLING												
1976	112	5	769	113	10	1,413	122	6	838	126	6	1,058
77	107	1	263	110	3	512	122	2	187	127	6	917
78	118	1	152	116	4	731	120	1	310	126	8	1,935
79	113	3	366	116	10	1,576	124	14	2,079	129	19	2,145
'76-79	112	10	1,550	114	27	4,232	123	23	3,414	127	39	6,055
	p > .05						*p < .01					
			*p < .001									
AT-SEA SAMPLING												
1977	108	2	2,805	112	4	5,264	132	1	14	129	3	1,204
78	110	3	948	115	2	2,226	120	1	567	127	3	1,474
79	113	2	409	115	4	1,746	127	1	662	130	2	1,916
'77-79	109	7	4,162	113	10	9,236	124	3	1,243	129	8	4,594
	p > .05						p > .05					
			*p < .001									
PORT AND SEA COMBINED	p > .05						*p < .05					
			*p < .001									

*Differences in average median values are statistically significant at the 5% level.
**All but 2 of the Georges Bank samples are from the Corsair Canyon area.

Table 3. Size frequencies of Canadian trap-caught offshore lobsters 1976-79.

Size mm	In-port samples 1976-79 Truxton Swell	S.W. Browns	S.E. Browns	Eastern Georges	At-sea samples 1977-79 Truxton Swell	S.W. Browns	S.E. Browns	Eastern Georges
65-69	-	-	-	-	-	-	-	0.02
70-74	-	-	-	0.02	0.1	-	-	0.1
75-79	0.1	0.02	-	-	0.1	0.8	-	0.1
80-84	0.9	0.3	0.1	0.3	0.5	0.4	-	0.1
85-89	2.1	1.0	0.2	0.3	2.8	1.2	0.4	0.3
90-94	4.8	2.7	0.8	0.5	6.9	3.4	0.5	0.4
95-99	8.0	6.2	1.5	1.3	9.5	5.4	2.0	0.5
100-104	13.2	10.9	3.9	2.7	14.6	11.0	4.3	1.9
105-109	14.8	14.4	7.5	5.0	16.6	16.0	7.1	4.1
110-114	13.7	15.9	10.8	7.6	13.4	16.0	11.3	7.1
115-119	10.1	13.8	13.8	12.5	10.6	14.7	14.0	11.1
120-124	10.0	11.3	15.7	12.9	8.2	11.9	12.6	12.7
125-129	7.2	8.5	11.9	12.1	5.5	7.3	14.2	11.7
130-134	5.1	5.4	9.3	11.1	3.8	4.7	10.1	11.5
135-139	2.8	2.8	7.3	8.2	2.1	3.2	6.8	7.9
140-144	2.5	2.4	5.4	6.4	1.8	2.0	4.9	7.9
145-149	1.7	1.8	3.5	5.3	1.5	1.0	4.5	5.3
150-154	1.4	1.2	2.8	4.2	0.9	0.8	2.8	4.5
155-159	0.7	0.8	1.7	2.6	0.5	0.5	1.7	3.9
160-164	0.3	0.4	1.0	2.1	0.5	0.2	0.6	2.7
165-169	0.5	0.2	1.3	2.2	0.1	0.2	1.1	2.1
170-174	0.3	0.1	0.8	1.4	0.1	0.04	0.6	1.6
175-179	-	0.1	0.3	0.6	0.1	0.02	0.2	1.0
180-184	-	0.02	0.2	0.4	0.02	0.01	0.1	0.7
185-189	-	-	0.1	0.2	-	0.01	0.1	0.4
190-194	-	-	0.1	0.2	-	0.01	-	0.2
195-199	-	-	0.03	0.1	-	0.02	-	0.1
200-204	-	-	-	0.03	-	-	-	0.02
205-209	-	-	-	0.03	-	-	-	0.02
210-214	-	-	-	-	-	-	-	-
215-219	-	-	-	-	-	-	-	-
220-224	-	-	0.03	-	-	-	-	-
225-229	-	-	-	-	-	-	-	-
230-234	-	-	-	-	-	-	-	-
235-239	-	-	-	-	-	0.01	-	-
No. of lobsters	1,550	4,232	3,414	6,055	4,162	9,236	1,243	4,594

Table 4. Size frequencies of Canadian trap-caught lobsters in sequence from inshore SW Nova Scotia to Truxton Swell, and US trawl-caught offshore lobsters from off New York to eastern Georges Bank. Of the 2 German Bank samples, one was in 1980.

	Cndn. at-sea trap sampling 1977-79				U.S. trawl surveys 1965-67				
Size mm	Port Maitland	Lurcher Shoal	German Bank	Truxton Swell	Hudson Canyon	Veatch Canyon	Oceanogr. Canyon	Lydonia Canyon	South of Corsair
40-49	-	-	-	-	0.2	0.3	-	-	-
50-54	0.1	-	-	-	3.6	5.1	0.6	0.2	-
55-59	0.9	-	-	-	-	-	-	-	-
60-64	4.3	-	0.8	-	12.7	14.1	2.1	0.8	-
65-69	10.3	3.7	1.7	-	-	-	-	-	-
70-74	19.5	14.3	5.8	0.1	26.7	24.3	4.3	2.2	-
75-79	24.5	20.5	8.7	0.1	-	-	-	-	-
80-84	15.5	9.8	7.4	0.5	25.4	22.6	5.0	3.6	-
85-89	12.4	14.8	9.3	2.8	-	-	-	-	-
90-94	6.8	16.4	7.9	6.9	16.5	16.0	6.6	6.0	1.1
95-99	2.6	7.8	7.0	9.5	-	-	-	-	-
100-104	1.9	6.6	6.4	14.6	9.4	7.5	9.9	8.2	1.1
105-109	0.6	3.7	8.3	16.6	-	-	-	-	-
110-114	0.3	0.8	5.6	13.4	2.5	4.2	8.8	9.9	3.7
115-119	-	0.8	7.4	10.6	-	-	-	-	-
120-124	0.3	0.8	6.8	8.2	1.1	2.1	12.2	13.1	11.9
125-129	0.1	-	5.0	5.5	-	-	-	-	-
130-134	-	-	3.1	3.8	0.8	1.4	13.9	15.3	12.2
135-139	-	-	3.3	2.1	-	-	-	-	-
140-144	-	-	1.5	1.8	0.2	0.5	10.9	12.5	15.2
145-149	-	-	1.9	1.5	-	-	-	-	-
150-154	-	-	1.5	0.9	0.3	0.7	6.6	8.0	14.1
155-159	-	-	-	0.5	-	-	-	-	-
160-164	-	-	0.6	0.5	0.2	0.3	6.7	3.7	17.0
165-169	-	-	-	0.1	-	-	-	-	-
170-174	-	-	-	0.1	0.1	0.3	4.3	6.4	8.5
175-179	-	-	-	0.1	-	-	-	-	-
180-184	-	-	-	0.02	0.1	0.2	3.4	3.4	10.4
185-189	-	-	-	-	-	-	-	-	-
190-194	-	-	-	-	-	0.2	2.6	3.4	2.6
195-199	-	-	-	-	-	-	-	-	-
200-204	-	-	-	-	0.1	-	0.9	1.7	1.1
205-209	-	-	-	-	-	-	-	-	-
210-214	-	-	-	-	-	0.1	0.9	0.9	1.1
215-219	-	-	-	-	-	-	-	-	-
220-224	-	-	-	-	-	-	0.2	0.6	-
225-229	-	-	-	-	-	-	-	-	-
230-234	-	-	-	-	-	-	0.2	0.2	-
No. of lobsters	1,673	244	517	4,162	907	2,618	534	535	270

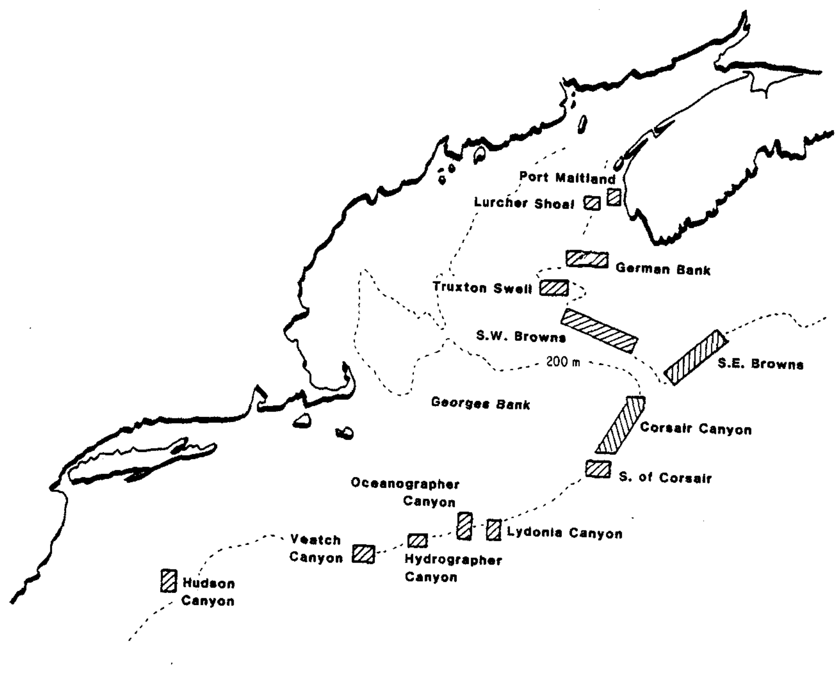

Fig. 1. Location of size-frequency samples shown in Fig. 2 and 3.

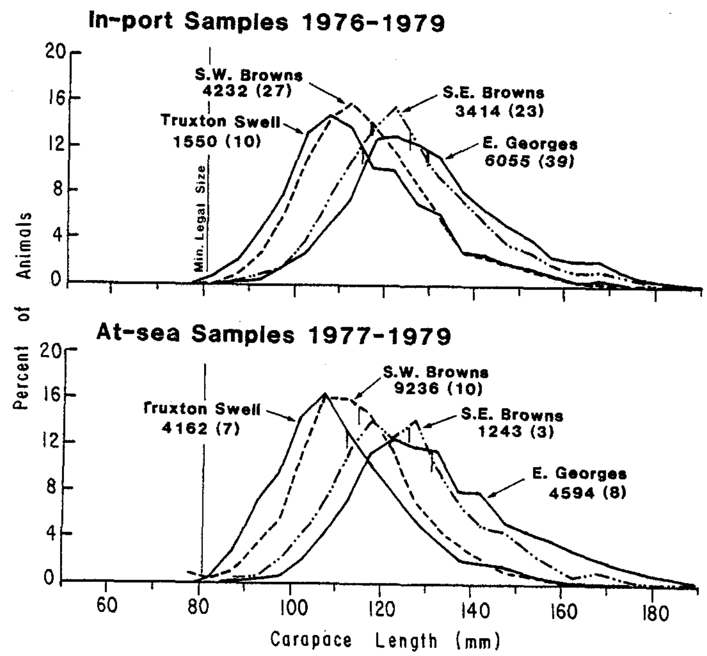

Fig. 2. Size frequencies (Table 3) for Canadian offshore lobster areas showing number of animals, number of sampling trips (in brackets) and median size (short vertical line underneath curves) for each area.

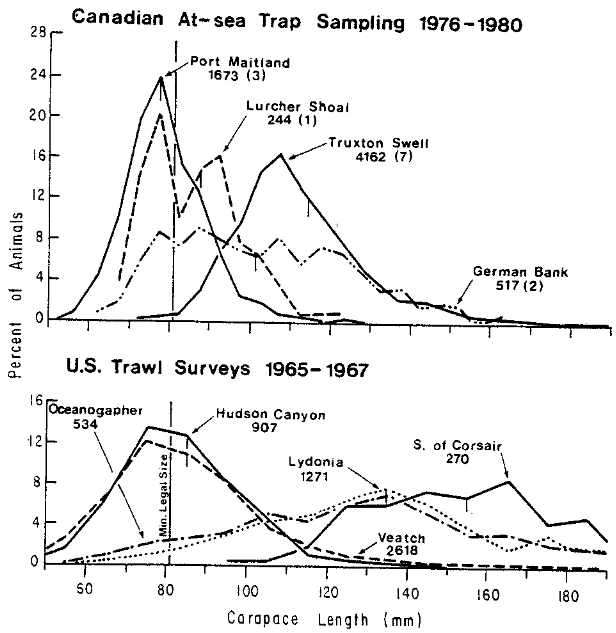

Fig. 3. Size frequencies (Table 4) for sequence of areas from inshore and intermediate areas to distant offshore, showing number of animals, number of sampling trips, (in brackets) and median size (short vertical line) for each area. The US data are from Skud and Perkins (1969).