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Inshore-offshore SW Nova Scotia Lobster stock interaction: a hypothesis

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Background

The SW Nova Scotia inshore lobster fishery (Shelburne, Yarmouth and Digby counties) yields about one quarter of the total annual Canadian lobster landings. There are approximately 1500 inshore lobster boats in lobster District 4. Inshore lobster landings in SW Nova Scotia, after lows of around 4 million lb per year from 1933 to 1942, rose sharply and since 1945 have remained high mostly within the range of 7-10 million lb (Fig. 1). This relative stability is in sharp contrast to large fluctuations or declines in lobster landings in some other areas, e.g., Northumberland Strait and S-SE shore of Nova Scotia.

Since 1971 there has been a Canadian offshore lobster fishery in the Browns Bank and NE Georges area that has grown to over a million lb landed per year. This fishery is, at present, limited to eight vessels.

A conflict of interests exists between the inshore and offshore lobster fishermen. Inshore fishermen fear that exploitation of offshore lobsters may reduce inshore landings. Although inshore landings have remained high in SW Nova Scotia overall, there was considerable apprehension when the 1976 landings dropped (mostly due to strong winds during the fall fishing period). More recently, a decline in landings has occurred in nearshore areas between Wedgeport and Clarks Harbour, following a previous drastic decline east of Clarks Harbour.

The present paper is a preliminary summary of several aspects of lobster catches - catch per trap haul, sex ratio, abundance of shorts, abundance of berried lobsters and migration of adults - from the Bay of Fundy around SW Nova Scotia east to Halifax and offshore to Browns and Georges Banks. All available Canadian data on at-sea (total catch) samples from 1942 to 1977 (with some 1978 samples included) have been reviewed. A

hypothesis of interaction between inshore-offshore lobster stocks is proposed.

Results

Data base

Figure 2 shows major landmarks along with fishing grounds and ports near which total-catch samples were obtained.

Table 1 is a compilation of relevant aspects from all Canadian offshore total-catch samples 1971-1977 on a per-trip basis grouped into four areas - Truxton Swell, SW Browns, SE of Browns and NE Georges (including Corsair Canyon). In addition, the table includes two exploratory cruises from Baccaro area and 2 from Lydonia-Welker Canyons, areas that are not now fished by Canadian offshore lobster boats; and two samples on SW Browns Bank with small traps that were designed to retain shorts down to about 30 mm C.L. and exclude lobsters over 90 mm. Except for the last two samples, commercial offshore lobster traps were used, most of which retain lobsters over 65 mm C.L., many retaining lobsters as short as 55-60 mm.

A similar compilation of inshore samples was too extensive (1075 samples) to be presented on a per-trip basis. They are, however, summarized in Table 2 by areas, along with summaries of the offshore samples. The inshore samples were taken with commercial gear used by inshore fishermen. Inshore traps were also used for the German Bank sample. The deep sample from Grand Manan was taken with large oak traps developed specifically for this fishery.

The inshore samples from lobster districts 1 to 4 are grouped by areas from east to west. Lobster Bay is the area from Cape Sable Island (Clarks

Harbour) to the Tusket Islands (Wedgeport-Yarmouth). The Grand Manan shallow samples are from south of Grand Manan (Seal Cove area). The Grand Manan deep samples are from east of Grand Manan (North Head area). The German Bank sample is from an inshore boat with inshore traps fishing there in May.

In Table 2 and further discussion the Grand Manan deep and German Bank samples are grouped with the offshore areas due to similarities in depth of fishing grounds and population structure.

A further summary in Table 2 compares the early inshore samples in 1942-53 (except to 1969 in Port Maitland) with the recent inshore samples 1977-78. Except for Port Maitland, we have from districts 1-4 no total catch data (at-sea samples) from 1954 to 1976. Such sampling has been resumed in 1977.

Catch per trap haul

Of the inshore areas, the Grand Manan shallow and the Yarmouth to Meteghan area have had, and still have, the best catch per unit effort (CPUE) based on number of animals per trap haul. In all 5 inshore areas the CPUE has decreased from the early to the recent samples. In offshore areas recent CPUE in terms of number of animals is higher than inshore, and considerably higher if based on weight, due to the larger offshore animals.

Sex ratio

Inshore the proportion of females is close to 50%, both in the early and recent samples, Offshore the proportion of females appears to be more variable and is slightly higher, averaging 60%.

Abundance of shorts <81 mm C.L.

In inshore areas the proportion of shorts is lowest east of Cape Sable Island, down to 25% in the recent samples. All other inshore areas averaged

45-66% shorts with an apparent slight increase from early to recent samples. By contrast, the proportion of shorts in offshore areas is very low (approximately 1/2000 compared to inshore) except the southern Canyons (Lydonia-Whelker). This market disparity exists despite ability of offshore traps to retain most lobsters over 65 mm C.L., despite use of inshore traps for the German Bank sample, and despite use of special juvenile traps twice on Browns Bank.

The number of shorts per trap haul in inshore areas has decreased from early to recent samples somewhat parallel to the decrease in total catch. In inshore areas, shorts are most plentiful in Grand Manan (shallow) and Yarmouth to Meteghan, least plentiful east of Cape Sable and in Bay of Fundy. In offshore areas, shorts are extremely rare (except in the southern Canyons), the offshore/inshore ratio of number per trap haul being 1/2000 for the early inshore samples and 1/1450 for the recent inshore samples.

Abundance of berried females

Berried females, as percent of all females in a sample, are scarce (less than 1% of females) in all inshore areas, except recent samples east of Cape Sable (6.5%). There appears to be a slight increase in abundance of berried lobsters in the recent inshore samples from Lobster Bay and east of Cape Sable. By contrast, in offshore areas berried females are plentiful; 7-42% of females were berried in recent samples from the six areas. The same pattern is seen in number of berried females per trap haul. The ratio of number per trap haul inshore/offshore is about 1/100 for the early inshore samples and 1/50 for the recent inshore samples.

There appears to be a simple explanation for the scarcity of berried females in inshore areas. In the Fundy-SW Nova Scotia offshore areas most females do not become berried until they reach about 100 mm C.L.

(Templeman 1936, J. Fish. Res. Board Can. 2: 41-48; Templeman 1944, *ibid.*, 8: 421-432; Stasko 1977 and unpublished data, most are fished out before they attain the required size.

Another possible and complementary (not mutually exclusive) explanation is offshore migration of large lobster.

Migration of adults

In the summer of 1975, 4,260 trap-caught lobsters were tagged and released at site of capture, 2,967 of them in inshore areas off SW Nova Scotia and 1,293 on Browns Bank. Between 1975 and fall of 1978 there have been 21 tagged lobsters that crossed between inshore and offshore (includes Truxton Swell and sections of Browns Bank within District 4) areas. Of the 21, 18 moved from inshore to offshore and only 3 from offshore to inshore, a ratio of 6 to 1 in favour of outward movement. The out-moving animals were mostly females (13 F of 18 total) and large animals (average size 101 mm). These are still preliminary results and interpretation requires caution. There were fewer animals tagged offshore thus giving relatively fewer potential shoreward migrants. However, this is counteracted by the greater fishing effort inshore that would take a larger fraction of those having moved shoreward from Browns Bank. Yet another possibility is that the shoreward migrants stop short of the major inshore fishing areas.

Larval recruitment

Stasko's results (unpublished data) indicate that lobster larvae are produced inshore as well as offshore off SW Nova Scotia and that surface currents are such as to carry drifting organisms from the Browns Bank area towards the SW Nova Scotia shore. I assume that lobster larvae offshore do not maintain geographic position against the northward surface currents.

Hypothesis

To recapitulate the relevant facts for SW Nova Scotia:

- berried lobsters are scarce inshore, abundant offshore, a ratio of 1/50 based on numbers per trap haul;
- lobster larvae appear to be produced both inshore and offshore, but currents are such as to carry drifting organisms from Browns Bank towards the SW Nova Scotia shores; the larvae are found mostly near surface;
- short lobsters (sub-legal, less than 81 mm C.L.) are plentiful inshore but are not caught in offshore areas, giving an inshore/offshore ratio (as per Table 2) of 1450/1 based on recent numbers per trap haul;
- there is some dispersal of large animals from inshore to offshore areas.

Although the larval drift and migration of adults are still poorly documented, the abundance of berried lobsters offshore and abundance of shorts inshore seems to be clear from the data presented.

The tentative conclusion is that at least some lobsters over 81 mm C.L. disperse from inshore grounds to the offshore areas (Browns Bank area, NE Georges, German Bank, deep water east of Grand Manan), where they produce larvae which supplement inshore larval production and the resulting inshore production of shorts (less than 81 mm C.L.). The near total absence of shorts in Canadian offshore lobster areas suggests that the offshore lobster stocks are dependent on outward dispersal of legal size lobsters.

Acknowledgments

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Table 1. Abundance of short and berried lobsters from all offshore lobster trips, 1971-77. Females "F" include berried females. The two SW Browns trips marked with an asterisk (*) represent catches in special small traps designed to retain shorts down to about 30 mm CL and to exclude lobsters over 90 mm.

Location	Date	No. of traps hauled	Lobster catch				Shorts			Berried		
			M	F	(% T)	Total	No./t.h.	No. (% T)	No./t.h.	No. (% F)	No./t.h.	
Truxton Swell	July 11-15/77	487	549	780	(58.7)	1329	2.73	0	0	0	74 (9.5)	0.15
Truxton Swell	July 25-28/77	406	542	932	(63.2)	1474	3.63	0	0	0	41 (4.4)	0.10
S.W. Browns	June 7-16/77	871	542	794	(59.4)	1336	1.53	0	0	0	68 (8.6)	0.08
S.W. Browns	June 20-24/77	367	224	269	(54.6)	493	1.34	0	0	0	26 (9.7)	0.07
S.W. Browns	Aug. 2-27/77	524	655	937	(58.9)	1592	3.04	0	0	0	165 (17.6)	0.29
S.W. Browns	Aug. 31-Sept. 5/77	603	719	1118	(60.9)	1837	3.05	0	0	0	246 (22.0)	0.37
S.E. Browns	July 10-23/72	400	56	70	(55.6)	126	0.32	0	0	0	15 (21.4)	0.38
S.E. Browns	June 30-July 4/73	960	769	800	(50.9)	1569	1.63	1	(0.06)	0.001	161 (20.2)	0.17
S.E. Browns	July 13-15/76	635	484	1093	(69.3)	1577	2.48	2	(0.13)	0.003	362 (33.1)	0.57
S.E. Browns	Aug. 3-5/76	956	536	1265	(70.2)	1801	1.88	1	(0.06)	0.001	348 (27.5)	0.36
S.E. Browns	July 4-9/77	413	108	264	(71.0)	372	0.90	0	0	0	54 (20.5)	0.13
Corsair Canyon	April 18-27/72	1125	716	527	(42.4)	1243	1.10	0	0	0	71 (13.5)	0.06
N.E. Georges	July 10-23/72	650	89	104	(53.9)	193	0.30	0	0	0	26 (25.0)	0.04
Corsair Canyon	July 20-22/77	195	49	179	(78.5)	228	1.17	0	0	0	0	0
Corsair Canyon	Dec. 12-18/77	265	323	295	(47.7)	618	2.33	0	0	0	83 (28.1)	0.31

Baccaro Bk.	July 10-23/72	1380	73	101	(58.0)	174	0.13	0	0	0	36 (35.6)	0.03
Baccaro & Browns	June 28-July 2/72	711	440	727	(62.3)	1167	1.64	0	0	0	314 (43.2)	0.44
Lydonia Canyon	Sept. 17-29/71	593	781	371	(32.2)	1152	1.94	51	(4.43)	0.086	130 (35.0)	0.219
Whelker Canyon	Jan. 10-18/72	566	591	246	(29.4)	837	1.48	216	(25.8)	0.38	29 (11.1)	0.05
*S.W. Browns	Aug. 22-27/77	50	1	1	(50.0)	2	0.04	0	0	0	0	0
*S.W. Browns	Aug. 31-Sept. 5/77	70	1	3	(75.0)	4	0.06	0	0	0	0	0

Table 2. Summary of catches from at-sea trips (total catch samples) from Grand Manan, Bay of Fundy, SW Nova Scotia, Nova Scotia south shore, and offshore lobster grounds. The data represent all such records available in St. Andrews for the period 1942-1977. The sequence top to bottom is from east to west then offshore. The three counts of males marked with a + indicate that in some samples males and females were not recorded separately, but total count includes them, as does no./th. The one berried count 3+24 indicates that 3 of them were in the samples where males and females were not recorded separately. The 120 trap hauls with special juvenile traps and the Baccaro and Lydonia-Whelker samples are not included in this table. The early inshore combined data represent samples to 1953 in Grand Manan, to 1969 in Port Maitland, and only to 1950 at all other inshore locations. Except for Port Maitland to 1969 we have from districts 1-4 no data on total catches (at-sea samples) from 1954 to 1976.

Location	Date	No. of traps hauled	Lobster catch				Shorts		Berried		No. of trips		
			M	F (% T)	T	No./th.	No. (% T)	No./t.h.	No. (% F)	No./t.h.			
Inshore	E. of Cape Sable	1943-49	7988	5520+	5479 (47)	11784	1.48	4719 (40)	0.59	33 (0.45)	0.004	91	
		1977	274	104	123 (54)	227	0.83	56 (25)	0.20	8 (6.50)	0.029	3	
	Lobster Bay	1942-49	36406	21897+	21559 (50)	49953	1.37	24688 (49)	0.68	3+24 (0.11)	0.001	196	
		1977-78	1270	780	706 (48)	1486	1.17	827 (56)	0.65	6 (0.85)	0.005	5	
	Yarmouth to Meteghan	1942-69	47285	57788+	66812 (54)	127208	2.69	65187 (51)	1.38	54 (0.08)	0.001	431	
		1977-78	2078	1692	1739 (51)	3431	1.65	2273 (66)	1.09	1 (0.06)	0.001	14	
	Bay of Fundy	Mar. '47	5375	2663	2960 (53)	5623	1.05	2507 (45)	0.47	17 (0.57)	0.003	80	
		June '77	204	64	61 (49)	125	0.61	57 (46)	0.28	0 (0)	0	3	
	Grand Manan (shallow)	1945-53	24038	37981	39815 (51)	77796	3.24	47773 (61)	1.99	70 (0.18)	0.033	251	
		May '78	145	137	213 (61)	350	2.41	228 (65)	1.57	0 (0)	0	1	
	Offshore	Grand Manan (deep)	1977	75	33	45 (58)	78	1.04	0 (0)	0	12 (27)	0.160	2
		German Bank	May '77	149	87	65 (43)	152	1.02	1 (0.66)	0.006	27 (42)	0.181	1
Truxton Swell		1977	893	1091	1712 (61)	2803	3.14	0 (0)	0	115 (7)	0.486	2	
SW Browns		1977	2365	2140	3118 (59)	5258	2.22	0 (0)	0	505 (16)	0.214	4	
SE Browns		1972-77	3364	1953	3492 (64)	5445	1.62	4(0.07)	0.001	940 (27)	0.279	5	
NE Georges		1972-77	2235	1177	1105 (48)	2282	1.02	0 (0)	0	180 (16)	0.081	4	
Early inshore	1942-69	121092	125849+	136625 (52)	272364	2.25	144874 (53)	1.20	3+198 (0.14)	0.002	1049		
Recent inshore	1977-78	3971	2777	2840 (51)	5619	1.42	3441 (61)	0.87	15 (0.53)	0.004	26		
Recent offshore	1972-77	9081	6481	9537 (60)	16018	1.76	5 (0.03)	0.0006	1179 (19)	0.196	18		

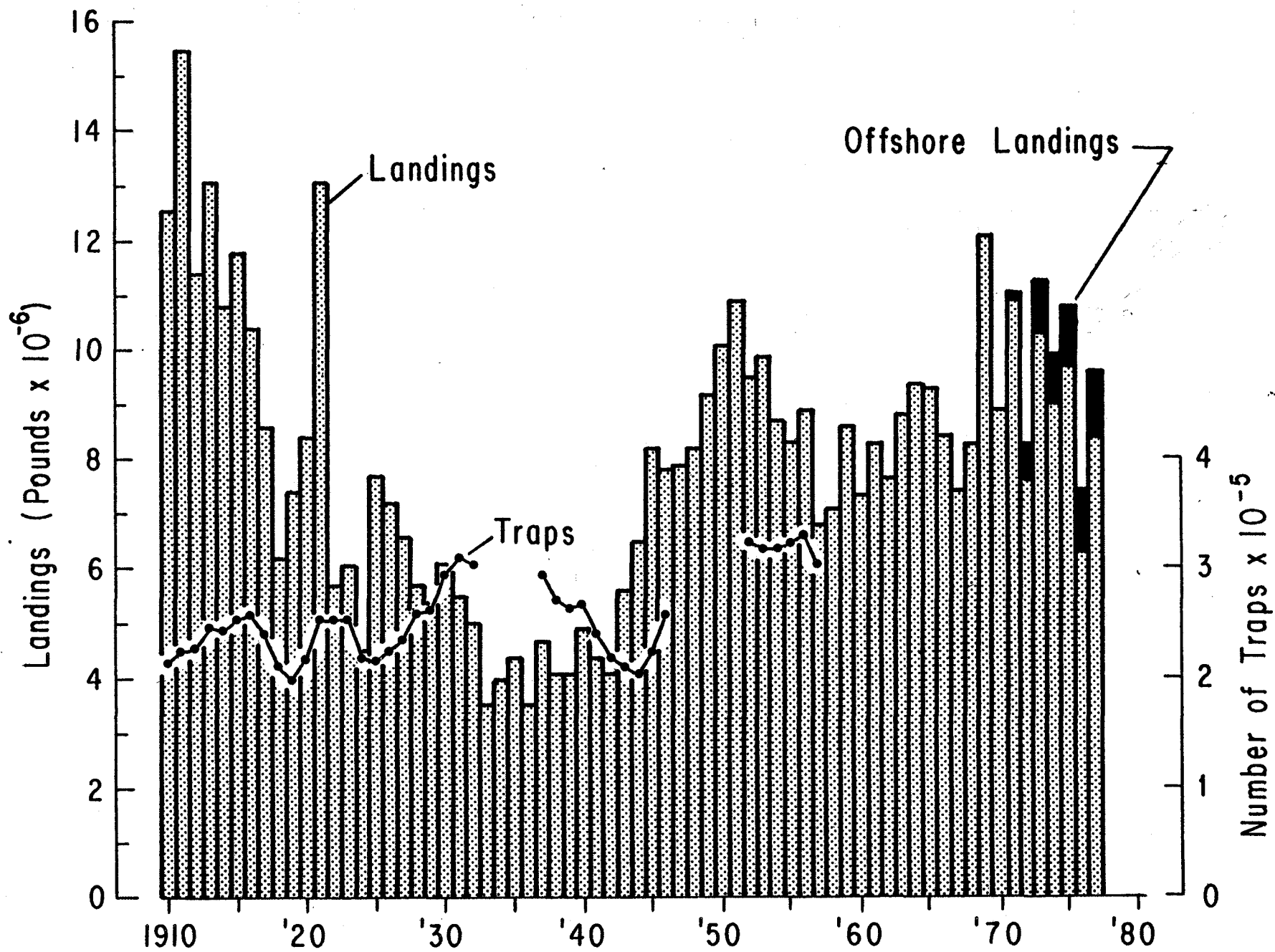


Fig. 1. Lobster landings in Shelburne, Yarmouth and Digby Counties, N.S.

