INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Restricted

Serial No. 2694
(B.g.7)

ICNAF Res.Doc. 72/11
(also ICNAF SAC No. 72/10)

ANNUAL MEETING - JUNE 1972

Catch and effort data for the southwest Nova Scotia (4X) purse seine fishery, 1966-1971

by

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The purse seine fishery off the S.W. Nova Scotia coast is a relatively new fishery, beginning in the early 1960's, expanding markedly through the mid 1960's and reaching its highest catch levels in 1968, since when catches have declined. It exploits largely pre-spawning and spawning concentrations and covers an area which is indicated in Fig. 1a.

Two groups of boats are active in the fishery. One group originates from the islands of Grand Manan and Campobello on the western side of the Bay of Fundy, the other is based on the Nova Scotia ports of Yarmouth and Pubnico. The "Campobello" fleet begins its operation in late spring in the northern part of the fishing area (A in Fig. 1a), moving south to the spawning area (B) during the spawning season. The "Yarmouth" fleet fishes the southern part of the fishing area (C) and tends to move north to the spawning area as spawning begins.

Log book coverage of fishing operations began in the season of 1966 and has continued and expanded since. Coverage in the early years was poor but by 1970 about 40% of the boats taking part sent in log records, not all, however, with complete information. Even so, sufficient data are available so as to determine the seasonal and area distribution of effort and of catch in the fishery and to provide information on changes in crude catch per effort over the period 1966 to 1971 inclusive.

The fishery is an "overnight" fishery. Boats leave for the grounds in the afternoon from ports on the Nova Scotia coast, fish during the night, and return the next morning. The most convenient effort measure is therefore catch per boat night. More than one set is usually made, the average number being about two per night but detailed information of catches for individual sets (as distinct for catches per night's fishing) is available for only a small proportion of log records.

Some log books give location of catch in terms of distance and bearing from known reference points; most show a general position indicating that they are in the vicinity of a particular reference point. Estimates of the weight of catch are given to a high degree of precision and are probably correct within the metric ton.

Information on weather conditions, gear dimensions, estimates of abundance of schools and of the size of herring making up the catch, records of herring in "spawning" condition, etc. are also included on many log book returns but not in a standard form.

Methods

Each boat was treated separately for each night's operation, the boat, date, number of sets (when known), and catch location being entered on IBM computer cards. The fishing area was divided into statistical squares of 5' latitude by 5' longitude. These are shown in Fig. 1b with the numerical code used in their identification. Where only a general reference for the catch location was given, consecutive entries with the same general reference were allocated in sequence amongst those squares in the vicinity of the general reference. For such reference areas near or adjacent to the coast, allocation was to two squares on a N-S axis; for offshore areas allocation was to the four squares surrounding the reference. The number of sets per night's operation was available for about a third of the entries; an average was computed for the whole season and the whole fishing area for these and this average was applied to the remainder.

Because the two fleets in the fishery (and particularly in the early and late part of the season) tend to be segregated along the north-south axis, and because the movement of the herring schools is also along this general direction, the whole area was sub-divided into those sections labelled A, B and C in Figs. 1a and 1b. Section A which includes St. Mary's Bay and the Digby Neck-Long Island section of the entrance to the Bay of Fundy represents the base for the "Campobello" fleet. Section B includes the main spawning area (the Trinity-Lurcher area) in which both fleets are active, particularly during the spawning period. Section C, to the south, is the area where the "Yarmouth" fleet begins operations in late spring.

For each statistical square and for each fishing season the number of boat nights, number of sets and catch was totalled for half-monthly periods during the season, and for the whole season. Total boat nights, total sets, and total catch were obtained for each E-W line of squares and for each of the sections A, B and C, again for each half-monthly period and for the whole season.

Results

Tables 1 to 6 list the yearly totals of catch (in metric tons), number of boat nights, and catch per boat night for each location square for the period 1966 to 1971. The number of sets and catch per set will not be used in this analysis. The format is as follows:

116	- Square Number (Fig. 1b)
1205	- Total Catch (Metric Tons)
18	- Number of Boat Nights
66.9	- Catch per Boat Night (Metric Tons)

Table 7 gives the total catch, number of boat nights and catch per night for each section and for the whole area for each year 1966-1971 inclusive.

The annual catch per unit effort data are plotted in Fig. 2 to show the decline in catch per unit effort over the six year period and indicates rather less than a 50% decline since 1966. The information on which Fig. 2 is based is from all log records over the period 1966-1971.

Over the six year period there have been many changes in the composition of the purse-seine fleet. Table 8 gives the catch per boat night (metric tons) for those vessels which have returned log books reasonably consistantly for at least four of the six years. The percentage decline in catch per unit effort between a period of years with the highest and lowest catch per night is also listed again showing about a 50% decline.

Figure 3 shows the seasonal distribution of catch which indicates an increase in section B in late August which coincides with the height of the spawning period (Iles, this meeting).

Discussion

No correction factors have been applied to these crude indices of abundance represented by the catch per boat-night. Some of the factors that might have been operating are as follows:

1. Increased efficiency in operation of gear and vessel.
2. Increased knowledge of movements and behaviour of herring schools in the area
3. Less efficient vessels withdrawing from the fleet.

4. Addition to the fleet of large new vessels with higher fishing power.
5. Increase in effective size of gear used.
6. Diversion of effort by the more mobile component of the fleet to other areas when catch per boat is low (this is particularly true of 1971).
7. Increased searching activity as school abundance declines.

All of these factors would tend to increase the effective effort applied in the fishery and bias the catch per boat upwards as a measure of relative abundance.

It is not possible to quantity the effect of these factors at the present time, either individually or in combination. The best minimum estimates of their effect is a factor of two over the six year period indicating a 75% decline in stock abundance.

Table 1. Distribution of Catch and Effort - Nova Scotia Fishery - 1966. Catches in Metric Tons.

2	3	4	5	6	7	8	9	10
12	13	14	15	16	17	18 49 1 49.0	19	20
22	23	24	25	26	27	28	29	30
32	33	34	35 244 5 46.8	36	37 5 1 5.0	38	39	40
42	43	44 38 2 19.0	45 101 3 33.6	46 74 3 24.6	47	48	49	50
52	53	54	55 25 1 25.0	56	57	58	59	60
62	63 130 2 65.0	64 487 7 69.5	65 792 12 66.0	66 318 4 79.5	67	68	69	70
72	73 25 1 25.0	74 1429 24 59.5	75 773 20 38.6	76 48 2 24.0	77	78	79	80
82	83	84 1436 22 65.2	85 1046 16 65.3	86 139 2 69.5	87	88	89	90
92 607 7 86.7	93 543 6 90.5	94 226 3 75.3	95 343 4 85.7	96 179 3 59.6	97	98	99	100
102 325 4 81.2	103 625 8 78.1	104 109 1 109.0	105	106	107	108	109	110
112	113	114 68 2 34.0	115 121 4 30.2	116	117	118	119	120
122	123	124	125	126	127 125 3 41.6	128	129	130
132	133	134	135 63 1 63.0	136	137	138	139	140
142	143	144	145 79 1 79.0	146 82 1 82.0	147	148 45 1 45.0	149	150
152	153	154	155	156	157	158	159	160
162	163	164	165	166	167	168	169	170

A

B

C

G 4

Table 2. Distribution of Catch and Effort - Nova Scotia Fishery - 1967. Catches in Metric Tons.

2	3	4	5	6	7	8	9	10
12	13	14	15	16	17	18	19	20
22	23	24	25	26	27 16 1 16.0	28	29	30
32	33	34	35 14 0 14.0	36	37	38	39	40
42	43	44	45	46 30 0 30.0	47	48	49	50
52	53	54	55 74 1 74.0	56	57	58	59	60
62	63 89 1 89.0	64 188 2 94.0	65 545 9 60.5	66 16 1 16.0	67	68	69	70
72	73 14 1 14.0	74 494 9 54.8	75 651 19 34.2	76 32 1 32.0	77	78	79	80
82	83 51 1 51.0	84 755 9 83.8	85 270 6 45.0	86	87	88	89	90
92 16 1 16.0	93 815 12 67.9	94 134 2 67.9	95 262 4 65.5	96 174 1 174.0	97	98	99	100
102 28 1 28.0	103 295 4 73.7	104	105 209 3 69.6	106 34 2 17.0	107	108	109	110
112	113	114 89 2 44.5	115 1565 26 60.1	116 37 1 37.0	117	118	119	120
122	123	124 129 3 43.0	125 1249 17 73.4	126 8 1 8.0	127	128	129	130
132	133	134	135	136	137	138	139	140
142	143	144	145	146	147 78 2 39.0	148 110 3 36.6	149	150
152	153	154	155	156	157 41 1 41.0	158 548 11 49.8	159 224 7 32.0	160
162	163	164	165	166	167	168 36 1 36.0	169 14 1 14.0	170

A

B

C

Table 3. Distribution of Catch and Effort - Nova Scotia Fishery - 1968. Catches in Metric Tons.

2	3	4	5	6	7	8	9	10	
12	13	14	15 94 1 94.0	16	17 388 6 64.6	18 307 9 34.1	19	20	
22	23	24	25 15 1 15.0	26 76 5 15.2	27 43 4 10.7	28 76 4 19.0	29	30	A
32	33	34	35 229 10 22.9	36 1385 34 40.7	37 29 1 29.0	38	39	40	
42	43	44 5 0 5.0	45 1056 42 25.1	46 37 4 9.2	47	48	49	50	
52	53 36 1 36.0	54	55	56	57	58	59	60	
62	63	64 230 5 46.0	65 954 26 36.6	66 126 4 31.5	67	68	69	70	
72	73 54 1 54.0	74 1152 19 60.6	75 1323 33 40.0	76 212 4 53.0	77	78	79	80	
82	83 139 2 69.5	84 3180 40 79.5	85 990 22 45.0	86 565 5 113.0	87	88	89	90	B
92	93 813 12 67.7	94 2529 39 64.8	95 4001 69 57.9	96 911 15 60.7	97	98	99	100	
102	103 123 3 41.0	104 1211 22 55.0	105 3296 53 62.1	106 1791 34 52.6	107	108	109	110	
112	113	114 1574 35 44.9	115 1458 36 40.5	116 1205 18 66.7	117 148 1 168.0	118 26 1 26.0	119	120	
122	123	124 1406 24 58.5	125 2390 39 61.2	126 1417 23 61.6	127 155 2 77.5	128	129 920 12 76.6	130 665 11 60.4	
132	133 52 1 52.0	134	135 109 2 54.5	136 185 5 37.0	137 291 7 41.5	138 110 1 110.0	139 451 11 41.0	140 625 10 62.5	C
142	143	144	145	146	147	148 560 15 37.3	149 262 6 43.6	150	
152	153	154	155	156 147 3 49.0	157 230 6 38.3	158 680 10 68.0	159 288 6 48.0	160	
162	163	164	165	166	167	168	169	170	

Table 4. Distribution of Catch and Effort - Nova Scotia Fishery - 1969. Catch in Metric Tons.

2	3	4	5	6	7	8	9	10	
12	13	14	15	16 57 1 57.0	17	18 147 6 24.5	19 11 1 11.0	20	
22	23	24	25 42 3 14.0	26	27 129 4 32.2	28 20 2 10.0	29	30	A
32	33	34	35 40 3 13.3	36 313 15 20.8	37 12 1 12.0	38	39	40	
42	43	44	45 570 21 27.1	46 67 3 22.3	47	48	49	50	
52	53	54 54 2 27.0	55	56	57	58	59	60	
62	63	64 262 12 21.8	65 858 24 35.7	66 97 2 48.5	67	68	69	70	
72	73 26 1 26.0	74 688 17 40.4	75 1421 24 59.2	76 33 1 33.0	77	78	79	80	
82	83 82 2 41.0	84 1292 21 61.5	85 588 7 84.0	86 14 1 14.0	87	88	89	90	B
92	93 603 10 60.3	94 1799 31 58.0	95 508 10 50.8	96 678 11 61.6	97 231 4 57.7	98	99	100	
102	103 472 8 59.0	104 354 10 35.4	105 184 8 23.0	106 353 8 44.1	107	108	109	110	
112	113 7 1 7.0	114 1980 57 34.7	115 2179 52 41.9	116 109 4 27.2	117	118	119	120	
122	123	124 1166 31 37.6	125 1709 42 40.6	126 248 5 49.6	127 2 1 2.0	128	129	130	
132	133	134	135	136 627 18 34.8	137 215 3 71.6	138	139	140	C
142	143	144	145	146	147 212 2 106.0	148 80 2 40.0	149 25 2 12.5	150	
152	153	154	155	156	157 14 1 14.0	158 369 8 46.1	159 908 16 56.7	160	
162	163	164	165	166	167	168 34 1 34.0	169 104 2 52.0	170	

Table 5. Distribution of Catch and Effort - Nova Scotia Fishery - 1970. Catches in Metric Tons.

2	3	4	5	6	7	8	9	10
						1o 1 18.1	15 1 15.0	
12	13	14	15	16	17	18	19	20
			36 1 36.0		167 9 18.5	536 19 28.2		
22	23	24	25	26	27	28	29	30
				13 2 6.5	471 14 33.6	2 1 2.0		
32	33	34	35	36	37	38	39	40
				747 40 18.6	218 6 36.3			
42	43	44	45	46	47	48	49	50
		18 1 18.0	864 32 27.0	202 7 28.8				
52	53	54	55	56	57	58	59	60
		29 1 29.0	33 1 33.0	116 3 38.6	142 3 47.3			
62	63	64	65	66	67	68	69	70
	54 1 54.0	359 10 35.9	1757 44 39.9	191 8 23.8				
72	73	74	75	76	77	78	79	80
64 1 64.0		1149 35 32.8	3681 95 38.7	83 2 41.5				
82	83	84	85	86	87	88	89	90
		2269 48 47.2	3547 69 51.4	110 3 36.6				
92	93	94	95	96	97	98	99	100
28 1 28.0	620 13 47.6	1250 29 43.1	3216 64 50.2	574 11 52.1				
102	103	104	105	106	107	108	109	110
	64 2 32.0	417 7 59.5	1089 26 41.8	1477 34 43.4				
112	113	114	115	116	117	118	119	120
		656 20 32.8	1187 44 26.9	912 19 48.0	319 9 48.0	66 1 66.0		
122	123	124	125	126	127	128	129	130
		609 17 35.8	708 24 29.5	513 13 39.4	386 10 38.6			
132	133	134	135	136	137	138	139	140
			76 1 76.0	1281 35 36.6	49 2 24.5			
142	143	144	145	146	147	148	149	150
			83 2 41.5			171 2 85.5		
152	153	154	155	156	157	158	159	160
					68 2 34.0	348 4 87.0	90 1 90.0	
162	163	164	165	166	167	168	169	170
		23 1 23.0				152 3 50.6		

Table 6. Distribution of Catch and Effort - Nova Scotia Fishery - 1971. Catches in Metric Tons.

2	3	4	5	6	7	8	9	10
							10 2 5.0	
12	13	14	15	16	17	18	19	20
					34 2 17.0	69 8 8.6		
22	23	24	25	26	27	28	29	30
				47 4 11.7	180 11 16.3			
32	33	34	35	36	37	38	39	40
		28 1 28.0	291 18 16.1	246 14 17.5				
42	43	44	45	46	47	48	49	50
	3 1 3.0	5 1 5.0	807 29 27.8	321 12 26.7				
52	53	54	55	56	57	58	59	60
62	63	64	65	66	67	68	69	70
			178 7 25.4					
72	73	74	75	76	77	78	79	80
		127 4 31.7	1241 28 44.3	95 5 19.0				
82	83	84	85	86	87	88	89	90
		1085 29 37.4	3770 87 43.3	214 5 42.8				
92	93	94	95	96	97	98	99	100
		17 2 8.5	1302 28 46.5					
102	103	104	105	106	107	108	109	110
			369 10 36.9	480 22 21.8				
112	113	114	115	116	117	118	119	120
		2 1 2.0	1251 38 32.9	1056 38 29.3	791 20 37.5	13 1 13.0		
122	123	124	125	126	127	128	129	130
		159 9 17.6	40 3 13.3	1432 37 38.7	336 14 24.0			
132	133	134	135	136	137	138	139	140
			124 3 41.3	27 1 27.0	48 2 24.0			
142	143	144	145	146	147	148	149	150
152	153	154	155	156	157	158	159	160
						0 1 0		
162	163	164	165	166	167	168	169	170

A

B

C

Table 7. Catch and Effort for Sections of the Southwest Nova Scotia Purse Seine Fishery.

YEAR	SECTION A			SECTION B			SECTION C			TOTAL		
	Catch	Nights	C/N	Catch	Nights	C/N	Catch	Nights	C/N	Catch	Nights	C/N
1966	534	16	33.3	9580	148	64.7	583	13	44.8	10697	177	60.4
1967	133	2	66.5	5072	89	56.9	4128	76	54.3	9333	167	55.9
1968	3776	122	30.9	23965	413	58.0	15701	287	54.7	43442	822	52.8
1969	1462	62	23.5	10544	212	49.7	10083	253	39.8	22089	527	41.9
1970	3627	142	25.5	21999	503	43.7	7695	210	36.6	33321	855	39.0
1971	2041	103	19.8	8880	227	39.1	5240	166	31.5	16161	496	32.6

Table 8. Catch per night for individual boats over the period 1966-1971.

Boat	1966	1967	1968	1969	1970	1971	% Decline	Period of Decline
1			31.6	26.1	21.0	14.2	55.1	68-71
2	61.3	69.1	56.1	41.5	35.9	27.1	60.8	67-71
3			77.7	39.7		51.0	34.4	68-71
4			44.7	33.9	25.8	25.0	44.1	68-71
5			56.1	29.5	43.0	21.2	62.2	68-71
6			50.1	59.3	18.6		62.9	68-70
7				57.5	48.0	45.0	21.7	69-71
8			42.6	34.8	38.5	34.5	19.0	68-71
9		46.9	51.2	50.4	39.7	28.2	44.9	68-71
10		55.3	60.4	47.6	51.3	40.7	32.6	68-71
11			63.7	41.7	44.4	40.7	36.1	68-71
12		31.3		42.8	38.7	17.4	60.7	69-71
13			55.5		48.5	15.6	71.9	68-71
14	70.5	71.4	61.5		36.0		49.6	67-70
	*65.9	54.8	54.2	42.0	37.6	30.0	46.9	2.85 Means
	**64.7	63.2	54.8	41.3	38.9	31.4		

* Unweighted Mean

** weighted Mean

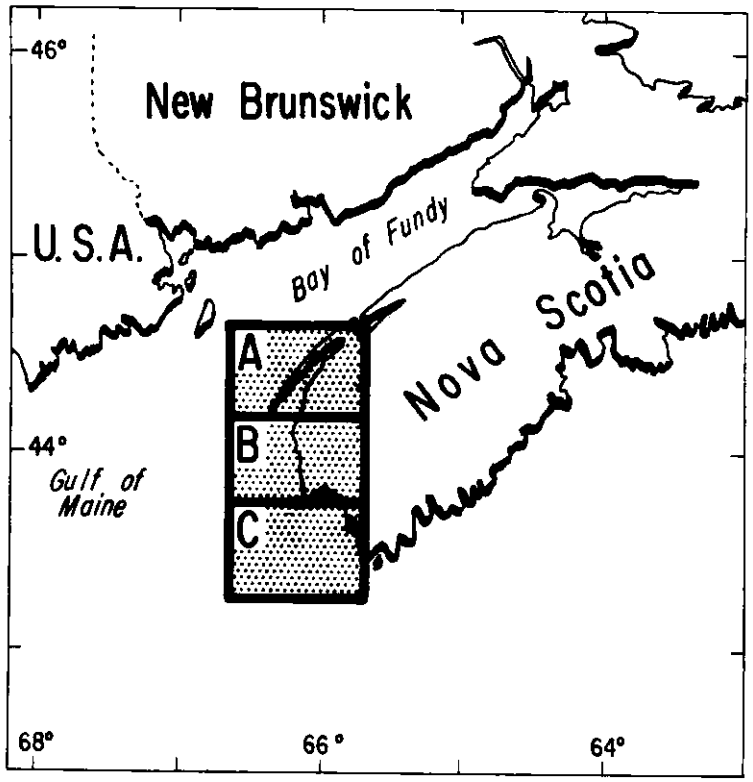

Fig. 1a. The area covered by the S.W. Nova Scotia herring purse seine fishery.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170

A

B

C

Fig. 1b. The Grid System used in the analysis of catch and effort data for the S.W. Nova Scotia herring purse seine fishery.

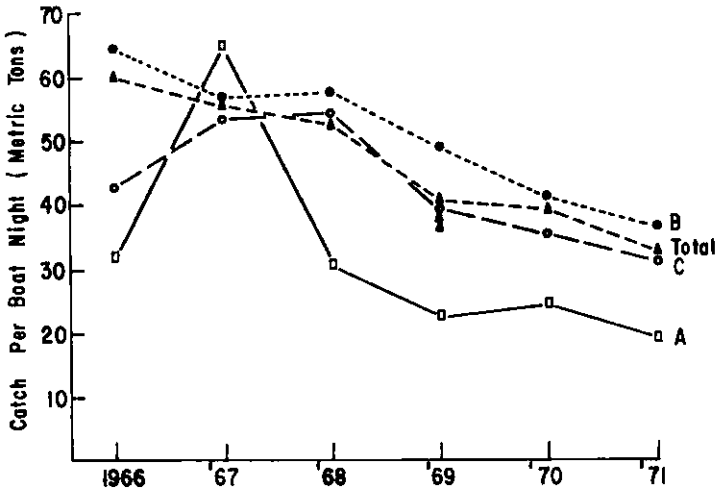

Fig. 2. Catch per boat night in the Nova Scotia herring purse seine fishery.

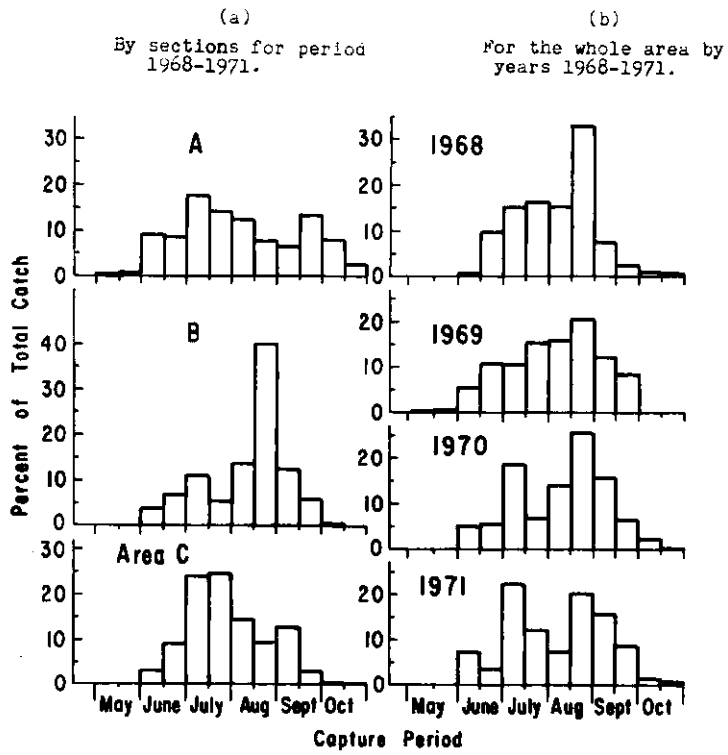

Fig. 3. Seasonal distribution of catch by half-monthly periods for Nova Scotia herring fishery.