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Capelin School Surface Area Index for NAFO Div. 3L, 1982-87

by

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Abstract

The aerial survey in 1987 utilized 37.0 flying hours and provided frequent coverage of the survey track. Each of the four designated transects was covered at least four times. The peak in inshore abundance as measured by total school surface area was observed on June 19 for Trinity Bay and Conception Bay. The 1987 estimate of total school surface area was the highest in the series and corresponded to the same trend observed for inshore catch rates and projected biomass from acoustic surveys.

Introduction

Background information on the use of surface area of capelin schools estimated from aerial photographs as an index of relative abundance was presented in previous reports (Nakashima 1985, 1986, 1987). This manuscript documents the methods and results of the aerial photographic survey conducted in 1987 along the shorelines of Conception Bay and Trinity Bay in NAFO Div. 3L (Fig. 1). The index of total school surface area is compared to other estimates of trends in abundance.

Materials and Methods

Particulars of the aerial surveys including aircraft type, camera and film used, survey time, and altitude flown were listed in Table 1. Each year since 1982, the survey has covered four transects as often as possible during the spawning season. The four transects were the outside of Trinity Bay from the Horse Chops to Gooseberry Cove, the inside of Trinity Bay from Gooseberry Cove to

Hopeall, the outside of Conception Bay from Caplin Cove to Harbour Grace Islands, and the inside of Conception Bay from Harbour Grace Islands to Portugal Cove (Fig. 1).

The best photographic conditions were in the morning when the sun angle was less than 50° and winds were light. Afternoon photography was usually restricted when the sun angle declined to 20°. Photography in the afternoon was more likely to be negatively influenced by winds and land shadowing.

In each photograph, capelin schools were identified and their outlines were traced on clear plastic sheets. The surface area of each school was measured with a compensating polar planimeter. Each measurement was corrected for altitude and expressed in m^2. Each time a transect was overflown, the mean and median school surface areas, the number of schools, and the total surface area of all schools observed along the transect were estimated. Schools less than 55 m^2 were not measured because they were less than the resolving power of the planimeter used.

The relative index for the year was estimated by summing the highest total school surface area observed on each of the four transects. I assumed that peak school surface area was indicative of inshore abundance for each transect for that year. The trend in the index derived from 1982-87 was compared to trends in catch rates from capelin traps and purse seines (Nakashima and Harnum 1988) and to projections of mature biomass from acoustic surveys (Anon. 1982, 1983, 1984, 1985, 1986).

Results and Discussion

All four transects were surveyed at least four times with those in Conception Bay receiving the most frequent coverage (Tables 2a, b, c, d). Unlike 1986 (Nakashima 1987), the weather conditions in 1987 were good to excellent throughout the spawning period. Aside from down time due to weather we were unable to fly June 23-25 because of mechanical problems with the aircraft. The highest number of schools and most surface area observed on the outside of Trinity Bay occurred on June 22, however schools were larger on June 18 (Table 2a). The peak in total surface area of schools on the inside of

Trinity Bay was recorded on June 19 which was also the highest amount measured for any transect since the survey began in 1982 (Table 2b). I combined the photographic data from June 27 and June 28 along the inside of Trinity Bay to provide an observation at that time (Table 2b). The sizes of schools and their amounts were very low so no bias was anticipated. Large schools in Trinity Bay were mainly observed in the Bellevue Beach area. For the outside portion of Conception Bay, the highest surface area was measured on June 16, however the most number of schools was observed on June 19 (Table 2c). On June 19,365 schools and the highest total school surface area were observed on the inside transect of Conception Bay (Table 2d). Data collected on June 30 in Conception Bay (Tables 2c, d) may be biased due to turbulence along the shoreline which obscured some beach areas. From observations conducted during the aerial survey the peak occurrence of capelin inshore was June 19-22 in Trinity Bay and June 16-19 in Conception Bay. By July 3 when the aerial survey was completed, there was a noticeable decline in the number, size, and distribution of capelin schools along the four transects.

The school surface area index for 1987 was estimated to be 834,600 m^2 when summing the highest numbers from Tables 2a, b, c, and d. This estimate included the highest value of 184,307 m^2 on June 16 on the outside of Conception Bay and 205,846 m^2 on June 19 on the inside of Conception Bay assuming no movement between the two areas had occurred. Evidence from tagging studies (unpublished data) suggested that capelin move rapidly into the bay when spawning is imminent. To minimize this concern, the two school surface areas of 112,600 m^2 (Table 2c) and 205,846 m^2 (Table 2d) were summed for Conception Bay on June 19. For Trinity Bay there was no concern because the highest outside value was on June 22 which was very similar to the June 18 value and was later than the peak observed on June 19 in the inside portion. Using this conservative approach, the total school surface area index was estimated to be 762,953 m^2 in 1987 (Table 3).

Comparison of the school surface area index with the commercial catch rates of the trap and purse seine fisheries and the projected mature biomass estimated from acoustic surveys yielded similar trends. The mature biomass for 1987 was projected to be 2,830,000 t which was supported predominantly by a strong 1983 year-class (Anon. 1986). The catch rate for capelin traps in the

1987 fishery was 8.8 t/day which was about double the highest estimate in the series. The purse seine catch rate of 18.1 t/day was slightly lower than in 1986 but was one of the highest in the series. Nakashima and Harnum (1988) observed that the purse seine fishery was seriously curtailed in 1987 due to the labour dispute which was not settled until June 19. In past years purse seiners were fishing much earlier than June 19, especially in the southern areas. The aerial survey estimate of 762,953 m^2 of total school surface area observed along the survey track was the highest in the series and twice the previously highest estimate. Thus the trap catch rate series and school surface area index supported the advice provided in June 1986 that the mature biomass available in NAFO Div. 3L in 1987 would be very large (NAFO 1986).

The clearly defined results of the aerial survey in 1987 were due to good weather which allowed us to cover all transects often, a basic criterion for a successful survey. The evidence from the survey demonstrated that peak abundance as indicated by total school surface area occurred prior to or as the fishery began on June 19. This observation supported the findings of Nakashima and Harnum (1988) who concluded that trap fishermen in Div. 3L experienced high catches when fishing commenced on June 19 in Div. 3L.

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Table 1. Summary of aerial surveys conducted from 1982 to 1987.

Year	Aircraft	Camera	Lens (mm)	Filter	Film	Radar altimeter	Survey period	Altitude (m)	Flying hours
1982	Piper Aztec	RC 10	152	Anti-vignetting	Aerocolour Neg. 2445	No	June 18-July 5	152-160	
1983	Aero-Commander	Wild RC 10	152	Anti-vignetting	Aerocolour Neg. 2445	Yes	June 19-July 9	457	21.8
1984	Cessna 310	Wild RC 10	152	Anti-vignetting	Aerocolour Neg. 2445	Yes	June 17-July 7	457	38.5
1985	Aero-Commander 500 B	Wild RC 10	152	Anti-vignetting	Aerocolour Neg. 2445	Yes	June 18-July 3	290-610	28.6
1986	Aero-Commander 500 B	Wild RC 10	152	Anti-vignetting	Aerocolour Neg. 2445	Yes	June 19-July 5	381-579	13.4
1987	Piper Aztec	Zeiss RMK	153	Anti-vignetting	Aerocolour Neg. 2445	Yes	June 16-July 3	457	37.0

Table 2a. Schooling data for the outside part of Trinity Bay from Horse Chops to Gooseberry Cove, 1982-87.

Date	No. of schools	Total surface area (m^2)	School size (m^2)	
			Mean ± SD	Median
June 19, 1982	7	2963	423 ± 502	125
June 26, 1982	0	0		
July 3, 1982	1	522	522 ±	522
June 23, 1983	7	11330	1619 ± 1315	1283
June 24, 1983	10	13671	1367 ± 1260	1088
June 25, 1983	7	11662	1666 ± 2151	725
June 29, 1983	8	2288	286 ± 228	195
June 30, 1983	13	18470	1420 ± 1613	1116
July 1, 1983	3	6417	2139 ± 2176	1172
June 18, 1984	9	3236	360 ± 423	223
June 19, 1984	8	3962	495 ± 703	279
June 25, 1984	22	30467	1385 ± 1959	502
June 26, 1984	38	37219	979 ± 1718	167
June 29, 1984	9	2790	310 ± 223	279
July 3, 1984	48	43412	904 ± 3010	223
July 6, 1984	34	16015	471 ± 485	167
June 21, 1985	0	0		
June 25, 1985	0	0		
June 29, 1985	18	15536	863 ± 983	316
July 1, 1985	32	48808	1525 ± 1622	893
July 2, 1985	24	49216	2051 ± 2965	949
July 3, 1985	9	2498	278 ± 183	270
June 18, 1987	59	41348	701 ± 985	391
June 22, 1987	81	45421	561 ± 780	279
June 28, 1987	15	5189	346 ± 384	223
July 3, 1987	9	12220	1358 ± 3042	279

Table 2b. Schooling data for the inside part of Trinity Bay from Gooseberry Cove to Hopeall, 1982-87.

Date	No. of schools	Total surface area (m^2)	School size (m^2) Mean ± SD	Median
June 19, 1982	31	12724	411 ± 712	149
June 26, 1982	29	35607	1228 ± 2755	299
June 29, 1982	11	62397	5672 ± 8378	592
July 2, 1982	8	31365	3921 ± 9281	705
July 3, 1982	2	1920	960 ± 17	960
June 23, 1983	11	69583	6326 ± 6299	4241
June 24, 1983	26	39004	1500 ± 1880	753
June 25, 1983	30	174487	5816 ± 12759	781
June 29, 1983	35	152557	4359 ± 11139	781
June 30, 1983	46	199373	4334 ± 6927	558
July 1, 1983	25	189497	7580 ± 19791	2288
June 19, 1984	13	15624	1202 ± 1770	335
June 23, 1984	9	8314	924 ± 888	502
June 25, 1984	96	31526	328 ± 505	117
June 26, 1984	96	40510	422 ± 679	223
June 29, 1984	47	12053	256 ± 314	167
July 3, 1984	57	23827	418 ± 814	167
July 7, 1984	77	43245	562 ± 1124	223
June 21, 1985	13	7041	542 ± 706	270
June 25, 1985	35	22459	642 ± 1144	211
June 26, 1985	30	16540	551 ± 721	214
July 1, 1985	125	60245	482 ± 963	181
July 2, 1985	130	195659	1503 ± 6046[a]	179
June 28, 1986	59	95898	1625 ± 4502	340
June 17, 1987	45	167567	3724 ± 17727	223
June 19, 1987	91	399026	4385 ± 31197	167
June 27-28, 1987	37	59315	1603 ± 5612	446
July 3, 1987	5	1786	357 ± 322	279

a calculation excludes capelin in traps

Table 2c. Schooling data for the outside of Conception Bay from Capelin Cove to Harbour Grace Islands, 1982-87.

Date	No. of schools	Total surface area (m^2)	School size (m^2) Mean ± SD	Median
June 29, 1982	10	6577	658 ± 366	642
July 2, 1982	2	1357	679 ± 554	679
June 23, 1983	34	51838	1374 ± 2266[a]	530
June 24, 1983	16	10658	666 ± 823	447
June 25, 1983	4	4408	349 ± 184	279
July 1, 1983	5	5413	1083 ± 1884	112
June 18, 1984	1	391	391	
June 19, 1984	0	0		
June 25, 1984	49	63779	1294 ± 2874	391
June 26, 1984	67	65956	697 ± 1091[a]	279
June 30, 1984	21	22320	818 ± 1509[a]	223
July 3, 1984	4	1786	446 ± 599	195
June 20, 1985	0	0		
June 24, 1985	0	0		
June 27, 1985	30	8840	268 ± 378[a]	120
June 28, 1985	125	50837	368 ± 800[a]	132
June 29, 1985	22	19253	875 ± 1169	291
July 1, 1985	28	28036	991 ± 1616[a]	264
July 2, 1985	66	69166	914 ± 2064[a]	223
June 19, 1986	88	132455	1462 ± 2853[a]	279
June 16, 1987	139	184307	1322 ± 2924[a]	391
June 19, 1987	143	112660	766 ± 1516[a]	279
June 27, 1987	21	12164	539 ± 559[a]	391
June 30, 1987	37	29462	790 ± 1481[a]	279

a calculation excludes capelin in traps

Table 2d. Schooling data for the inside of Conception Bay from Harbour Grace Islands to Portugal Cove, 1982-87.

Date	No. of schools	Total surface area (m^2)	School size (m^2) Mean ± SD	Median
June 26, 1982 AM	33	19408	571 ± 907[a]	135
June 26, 1982 PM	20	36513	1826 ± 1914	2089
June 27, 1982	48	151214	3134 ± 6015[a]	527
June 29, 1982	27	30275	1121 ± 1707	418
July 4, 1982	3	13042	4347 ± 4951	1409
July 5, 1982	7	5127	732 ± 582	592
June 23, 1983	53	97595	1787 ± 2754[a]	558
June 24, 1983	30	56860	1819 ± 2965[a]	558
June 25, 1983	29	79961	2677 ± 3725[a]	781
June 30, 1983	7	8091	1156 ± 1181	558
July 1, 1983	1	2009	2009	
June 18, 1984	0	0		
June 23, 1984	8	17689	2085 ± 2556[a]	949
June 25, 1984	70	63891	879 ± 1789[a]	223
June 26, 1984	33	23603	703 ± 1708[a]	223
June 30, 1984	29	16852	508 ± 467[a]	335
July 3, 1984	18	9040	329 ± 254[a]	223
July 5, 1984	0	0		
June 20, 1985	0	0		
June 24, 1985	2	1600	800 ± 834	800
June 26, 1985	17	10124	596 ± 1145	314
June 27, 1985	76	16552	214 ± 426[a]	78
June 28, 1985	120	33858	274 ± 938[a]	67
July 1, 1985	16	43228	2702 ± 5140	308
July 2, 1985	17	13436	676 ± 1872[a]	191
June 19, 1986	39	31574	786 ± 1105[a]	357
June 20, 1986	4	3515	698 ± 769[a]	363
June 22, 1986	86	30930	343 ± 616[a]	131
July 2, 1986	10	5019	502 ± 600	358
June 17, 1987	196	53066	263 ± 350[a]	167
June 19, 1987	365	205846	556 ± 1482[a]	167
June 21, 1987	179	74128	393 ± 699[a]	167
June 27, 1987	138	94747	681 ± 2389[a]	167
June 28, 1987	63	68969	1036 ± 2402[a]	167
June 30, 1987	41	51336	1226 ± 2892[a]	391
July 3, 1987	47	34863	742 ± 1400	279

a calculation excludes capelin in traps

Table 3. Comparison of three indices for estimating trends in relative spawning biomass. The catch/day index was based on capelin trap and purse seine data from logbook surveys (Nakashima and Harnum 1988), the mature biomass index originated from NAFO Scientific Council Reports (Anon. 1982-86), and the school surface area index came from this study.

Year	Catch (t)/day		Mature biomass (t)	School surface area (m^2)
	Purse seine	Trap		
1982	16.4	3.1	≥346,000	223,150
1983	18.8	3.4	648,000	367,280
1984	14.3	2.9	384,000	216,500
1985	16.4	4.6	596,000	357,270
1986	19.0	4.6	1,300,000	283,150
1987	18.1	8.8	2,830,000	762,953

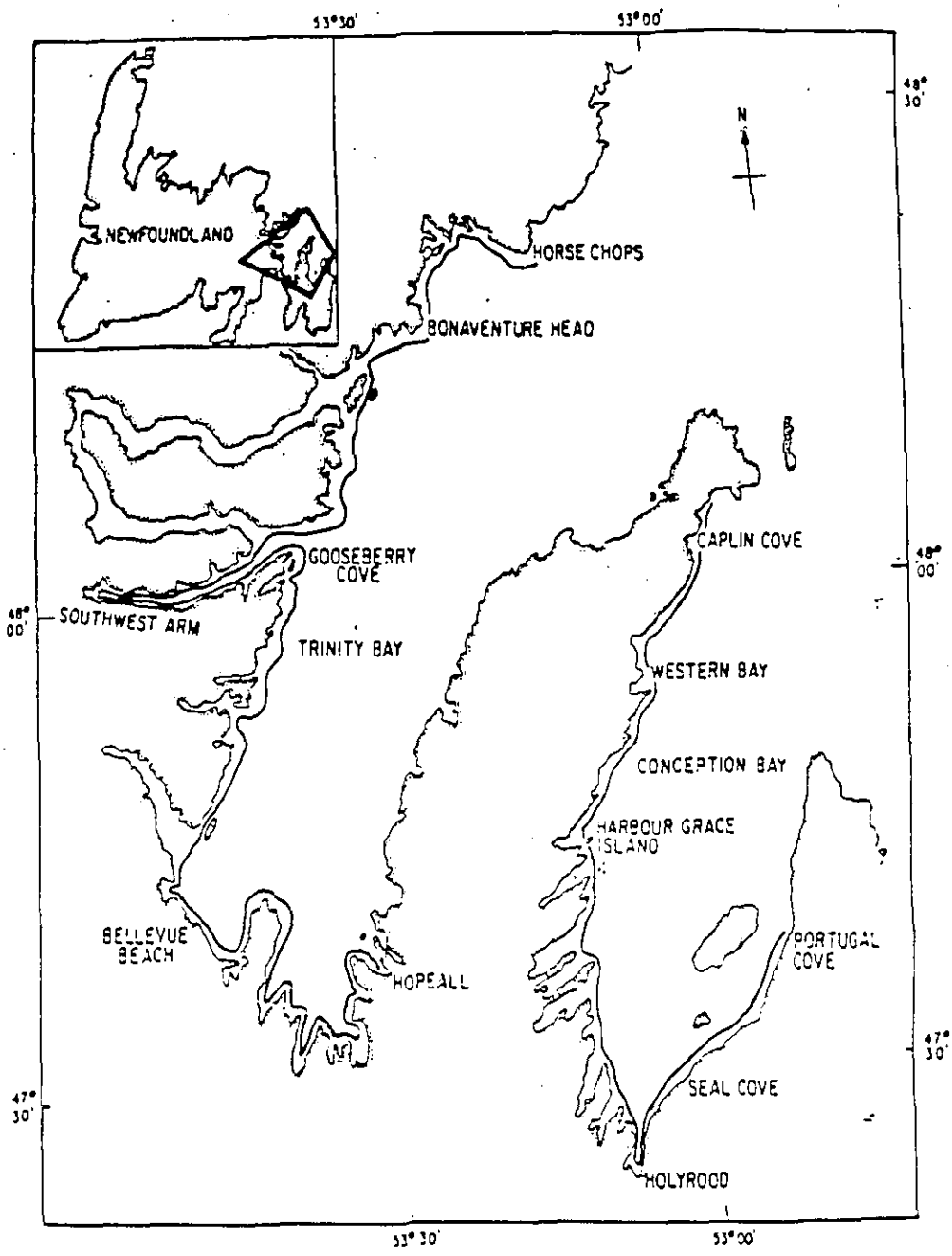

Fig. 1. Survey track for aerial survey.