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Perspectives on the Bay of Fundy scallop stock and its fishery

By

G. Robert M.A.E. Butler-Connolly and M.J. Lundy
Invertebrates and Marine Plants Division
Biological Sciences Branch
Halifax Fisheries Research Laboratory
Department of Fisheries and Oceans
Scotia-Fundy Region
P. O. Box 550
Halifax, N. S.
B3J 2S7

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ABSTRACT

Bay of Fundy fishermen have exploited scallop beds off Digby on a commercial basis since the 1920s. Recent catches from the traditional beds have peaked in 1982-83 at about 1050 t and have declined rapidly since then to about 400 t in the 1985-86 season. On occasions, and especially during the latest decline, fishermen have supplemented their catches by fishing on the western Scotian Shelf and on Georges Bank.

The fishery has relied, over the years, on older scallops (age 8 plus). Relative number of scallops of these ages have declined in research surveys since 1982. Survey catch-rates have also decreased due to high exploitation and poor recruitment. However, the survey results for 1986 show that there was a significant increase in the number of young scallops (mainly age 2).

It is estimated that long term average seasonal catches of 200 t should be possible for the inside zone and 300 t for the outside zone. High fluctuations can be smoothed out, to a certain extent, by measures such as limiting catch and delaying harvest until after scallops have completed the phase of rapid growth.

RESUME

Les pêcheurs de la Baie de Fundy ont exploité les bancs de pétoncles près de Digby sur une base commerciale depuis 1920 environ. Récemment les captures sur les bancs traditionnels ont atteint un sommet d'à peu près 1050 t en 1982-83 pour diminuer rapidement par la suite à environ 400 t en 1985-86. A l'occasion, surtout durant le dernier déclin les pêcheurs ont ajouté à leurs prises en pêchant la partie ouest du plateau néo-écossais et le banc Georges.

Au cours des années la pêche s'est opérée sur des pétoncles âgés de 8 ans et plus. Le nombre relatif de pétoncles de ces âges a diminué dans les inventaires de recherche depuis 1982. Les taux de capture des inventaires ont aussi diminué à cause d'une exploitation intense et d'un recrutement faible. Cependant les résultats de 1986 indiquent un accroissement significatif de jeunes pétoncles (surtout âge 2).

On estime que des prises moyennes à long terme saisonnières de 200 t serait possible pour la zone de pêche en-deça de 6 miles et 300 t pour la zone au-delà. On peut modérer, jusqu'à un certain point, les fluctuations extrêmes par des mesures telles que limiter les prises et retarder la récolte jusqu'après que les pétoncles ont complété la phase de croissance rapide.

INTRODUCTION

After producing record high landings in 1981-82, the traditional scallop stocks of the Bay of Fundy near Digby, N.S. declined steadily to reach extremely low levels of catches in 1985-1986. The Bay of Fundy fleet could not be supported by this limited fishable biomass and expended considerable effort on German Bank, Browns Bank, and more particularly on Georges Bank. A small-scale fishery carried out mainly by local vessels also continued in the upper parts of the Bay of Fundy.

METHODS

Fishing Information

All vessels over 25.5 G.T. are required to maintain logbooks where daily fishing activities are recorded. Catch-rates are computed from Class 1 data when information is provided on the catch and its location, and effort in terms of hours fished and width of the gear. It is not possible to get effort data and areas fished from vessels less than 25.5 G.T. and/or under 14 m L.O.A.. However, their participation rate in the fishery and landings on a vessel basis may be estimated through sale slip records. This type of information collection was recently initiated by the Statistics Division, Department of Fisheries and Oceans, Halifax for scallop-licensed vessels.

Survey Procedures

Survey stations are randomly stratified according to the catch distribution. Stations are distributed in 3 to 4-mile bands running perpendicular to the shore. A description of the survey procedures may be found in Robert et al (1984). As in 1985 the scallop beds explored during the 1986 stock survey extended upstream, beyond the conventional survey area. Additional stations off Hampton and off Young's Cove were added to cover those grounds visited by the Bay of Fundy fleet lately. At the analysis stage, survey data are also post-stratified according to fishing areas, usually referred to by a prominent location or a headland, and fishing zones. An 'inside' fishing zone, 6 nautical miles from shore between Parker's Cove and Sandy Cove is preserved for fishing during the winter months, from October to April inclusive when weather conditions might be less than ideal for small vessels in the open waters of the Bay. An 'outside' fishing zone, by opposition to inside, defines areas in the Bay where the majority of fishing activities are carried out between May and September inclusive.

Biological Data

Data has been collected since 1982 to study ageing and somatic and gonadal growth cycles in Bay of Fundy waters. Like previous investigators we have observed (Robert et al 1985) that growth (age) measured by shell ring-reading was a function of depth. This relationship is becoming more evident with the accumulation of large volumes of data. This is an on-going study. At this point, 7051 scallops have been examined from materials sampled between 1982 and 1985. Three von Bertalanffy growth curves have been established with the following parameters:

Depth(m)	H_{∞}	t_0	k
00-85	143.210	1.3800	0.2221
86-105	133.763	1.4011	0.2414
> 105	125.989	1.4469	0.2610

The meat weight on shell height allometric relationship was fitted by a least square regression and included scallops (4157) collected during surveys of 1982 to 1985. Regression coefficient: 3.207 and intercept value: -12.473.

RESULTS

The spatial distribution of scallop beds and their exploitation by numerous scallop fishing fleets in Bay of Fundy waters is quite complex. At times it is difficult to estimate fairly, catches coming from one particular area and assign them to the proper fleet sector(s) in an attempt to compute effort and catch-rate data. In this report, Bay of Fundy waters have been divided into three main areas of scallop-producing grounds: 1) the traditional beds in the vicinity of Digby, N.S.; 2) the Saint Mary's Bay scallop beds; 3) the Upper parts of the Bay of Fundy.

The Traditional Beds in the Vicinity of Digby, N.S.

Ever since 1981 the total number of vessels carrying a Bay of Fundy scallop license has remained virtually constant both in Nova Scotia and in New Brunswick with the vast majority of vessels being in the largest category of vessels allowed (Table 1). However, there has been a continuous decline in the participation rate of these licenses from 1983-84 (Table 2); in 1986 about 80 % of the vessels over 25.5 G.T. involved themselves actively in the fishery. They did not necessarily fish Bay of Fundy waters though. There has been a severe reduction in log compliance; only 54 vessels out of 67 submitted at least one log record.

Annual landings on the Nova Scotia side of the Bay of Fundy may indicate general trends of this fishery. Tables 3 and 4 list an historical profile of landings for statistical district 37 (Digby Neck), 38 (Digby), and 39 (Annapolis). After record high landings in 1981 and 1982 they have decreased steadily and markedly, with the most severe reduction taking place in the last year, 1986. But one must keep in mind that these figures may be misleading. When the traditional Digby stocks are not as abundant, the Bay of Fundy fleet ventures opportunistically on the western Scotian Shelf and sometimes, for a considerable fraction of the fleet's landings, to Georges Bank. During the 1980's this has taken place on a regular basis. Landing figures do not make the distinction as to location of the catch.

Moreover, it is very difficult to get a reliable estimate of the total catches of the inner Bay of Fundy because of the delineation of the statistical areas 4Xr and 4Xs and the involvement of more than one fleet in the pursuit of the Bay of Fundy scallop fishery. In the early 1980s stocks in the Brier Island area located in the approaches to the Bay of Fundy sustained a fair exploitation according to logged catches (Robert et al 1984); statistically speaking, these catches were recorded from NAFO sub-subarea 4Xr to the same extent as

catches from the traditional grounds. During 1986, fishing around Brier Island has been minimal. Statistical catches from NAFO sub-subarea 4Xs include catches from the Upper Bay of Fundy fleet near the upper end of the Bay, some of the catches from the distant side of the traditional grounds and all the catches from the Grand Manan area and the nearshore beds along the New Brunswick coast fished mainly by the 7-mile license holders of New Brunswick.

Total catches may not be obtained for the traditional grounds as, for one main reason, all catches which should be logged are not. Since this fishery operates on the equivalent of seasonal closures i.e. inside and outside fishing zones, catches may be partitioned according to the zones and we may assume that catches from October to April, coming from the inside 6-mile zone and statistical catches for sub-subarea 4Xr covering that time period should match relatively well. We further assume that effort and catch-rates associated with Class 1 catch data for that area during that time period are representative of the overall fishing performance. Statistical catches from the outside fishing zone (4Xr + 4Xs) i.e. May-September fit more loosely with Class 1 logged catches (Table 5). If we relate the inside statistical catches and catch-rates on a per season basis (Table 5), catch-rates around 7 kg/hm and about 250 t per season were maintained prior to 1980-81. Then catches increased sharply, up to 565 t in 1982-83, while CPUE went down to 5 kg/hm. This was followed by a dramatic decline both in terms of quantities caught and catch-rates with a very poor performance for 1985-86. The last few months of 1986 did not reveal any improvement to the dismal stock condition of the inside fishing zone. A 65-year time series of catches for the inside zone (or time period October-May when a restricted fishing zone was not in effect) illustrates (Fig. 1) that sharp rises and steep downfalls have taken place quite often during the existence of this fishery. However, the amplitude of the last fluctuation cycle (1975-1985?) is quite spectacular and has been matched only once previously in the 1930s. If historical trends have any inference to the future, catches could be lower than the 1985-86 values (last point in fig. 1) for quite a number of seasons.

Fishing grounds in the immediate vicinity of Digby, off Digby Gut and Gulliver's Head still provide the mainstay of the fishery. Grounds off Centreville and Digby Neck are no longer important contributors. More intensive coverage had lately been given to fishing areas upstream from Digby, i.e. Parker's Cove, Hampton, Young Cove, and Ile Haute (in 1984 and 1985). Figure 2 shows the extensive coverage given by the fleet to the traditional beds and other marginal areas during 1985; figure 3 represents same for 1986. The declining fishery performance generated considerably less interest in, covering the grounds extensively once more or further exploring marginal areas.

Good seasonal coverage of catch sampling is given to the outside fishing zone (Table 6). The average monthly meat weight diminished gradually from 1980 onward. Table 6 indicates that the fleet shucked even smaller size scallops in 1986 since the monthly meat weight has declined to 10-11 g meats. The gradual depletion of the abundance of older year-classes with large meats has forced the fleet to shuck smaller size scallops to maintain landing levels. When the data is transformed to present the information by age group instead of meat weight group as in table 7, similar trends are outlined. Age 8 scallops used to be the major age class fished on a consistent basis but the pattern shifted greatly toward younger age-classes especially in 1986.

Results from annual stock surveys are presented in tables 8 to 13, with detailed results of the two most recent surveys in tables 9 and 10. Survey locations for 1986 are plotted in figure 4. Quite an extensive area was covered with the expansion of the fleet's activities upstream from Digby, to Young Cove. Detailed survey results (Tables 9 and 10) announce an improvement in the recruitment to the stocks on the traditional beds. The 1986 survey discovered significant quantities of small scallops (ages 2 and 3) in certain areas. Although the lined gear is not 100 % efficient at catching small size animals, numbers obtained are an indication of significant changes from the bleak recruitment picture offered by the 1985 survey results. This strong recruitment pulse was, however, preceded by a few year-classes of much lower abundance. Commercial size stocks remain fairly stable at

low levels or, in some instances, have decreased further since 1985 (i.e. upstream from Digby). While the inside zone carries high quantities of juveniles (Table 13), the outside zone typically, has greater numbers of older scallops. This phenomenon is accentuated even more by the 1986 data. According to the 1986 survey, it is possible to delimit in some detailed fashion the distribution of the high aggregations of juvenile scallops. The general area of the strong recruitment pulse is stippled in figure 4.

The Saint Mary's Bay Scallop Beds

In early 1985, a few (5-10) vessels exploited scallop beds in the vicinity of ledges on the Long Island side of Saint Mary's Bay and near the tip of Digby Neck in depths of 27 to 66 m. Lobster fishermen in the Bay got concerned as to the impact of scallop gear on lobster bottoms. The Bay was temporarily closed off to scallop draggers. By June a gentlemen's agreement was reached between the two groups with scallop dragging allowed between January 15th and February 28th and during the month of June. Catches approximated 7000 kg in 1985 with a mean catch-rate of 2.98 kg/hm; 1986 catches fell by 50 % to 3671 kg with a slightly lower CPUE at 2.26 kg/hm. It appears that the fishable biomass is being depleted rapidly in this area. No biological information is available for those scallop beds.

The Upper Parts of the Bay of Fundy

The Upper parts of the Bay of Fundy designation applies to the waters of the Bay included in the Upper Bay Management Zone. This zone includes the area east of a line drawn between Annapolis and Kings County on the Nova Scotia side of the Bay and between Saint John and Albert Co. on the New Brunswick side. Historically speaking, Minas Basin and Chignecto Bay at the upper end of the Bay of Fundy are not scallop-producing areas. Landings of less than 10 t of meats per year have been recorded. Local fishermen have become interested in the scallop fishery in recent years. To participate in the fishery, vessels, all under 14 m L.O.A., are issued a "3-mile" scallop license. Up to 1986 there had been 14 licenses issued annually with only one vessel over 25.5 G.T. (Table 14); in 1986 there were 16 licenses. Less than 60 % of these licenses used the privilege. A few of these licenses are issued in New Brunswick (Albert Co. where there are also 7-mile scallop license holders) with the remainder in Colchester and Cumberland Counties, Nova Scotia. In all likelihood these small vessels land their catches at home ports in Cumberland Co. (statistical districts 24 and 44) and Albert Co. (79). Landings from these districts reflect the productivity of the Upper Parts of the Bay of Fundy. Since 1983, landings were gradually increasing (Table 15) with fishing taking place between April and October, then 1986 shows a downward trend. Landings for district 79 include catches from both 7-mile license holders and 3-mile license holders. Landings by statistical district compare well with the summation of landings of all vessels located in the area (for 1985 and 1986 when data is also available on a per vessel basis). Thus in 1985 active vessels (10 including 7-mile license holders) averaged 1630 kg; in 1986 the mean annual landing by vessel (total 13 including 7-mile license holders) is about 1450 kg. Some vessels have landed considerably more than average while others landed as little as 100 kg. The figure is not necessarily high but stable. Scallop fishing may only be considered as an accessory activity in a multi-fishery system. Since these vessels are under 25.5 G.T. they are not required to provide effort data by logbooks; hence there is little fishery information available.

DISCUSSION

Short Term Outlook

Most indicators (catch profile, catch-rates, catch-at-age data, survey results) lead to the same conclusion. The performance of the scallop fishery in Bay of Fundy waters in 1986 has been dismal, continuing downward trends started some years before. In addition to the traditional areas in the vicinity of Digby the Bay of Fundy fleet had extended its

exploited grounds considerable distances to sustain high landing patterns; effort had also increased by double-crewing and extending the length of fishing trips. These measures have reached their utmost limits. At this point, 1985, some Bay of Fundy license holders had elected not to actively participate in the scallop fishery. There is, however, limited incentive to gear for other fisheries for dual-license vessel owners due to quota restrictions in the groundfish fishery.

The catch-at-age data revealed that in 1986, fishermen were prepared to shuck much smaller size scallops than usual to maintain or improve landings. But there is a considerable loss of yield (Robert et al 1985) in doing so, up to 33%, in terms of the 1987 fishery and beyond. Because survey results indicate that although a strong peak of juvenile scallops has been noticed, year-classes that will sustain the fishery in the immediate future i.e. 1987, 1988 are certainly not as abundant. So poor fishery performance will continue; unless the Bay of Fundy fleet elects to shuck aspirin-size scallops, and by doing so: 1) improve short-term performance, 2) loose tremendous quantities of yield out of this strong recruitment pulse, and 3) extend the period of poor fishing years thereafter.

Long Term Perspectives

The Bay of Fundy fishery on the traditional scallop beds off Digby started in 1922 as an expansion of the fishery that was conducted in the Annapolis Basin. It is possible to retrieve landing figures since the initial stages and obtain quite a long time series to profile catches (fig. 1). After a start-up expansion, restrictive measures began to appear (season [fishing allowed between October and April] and shell size limit had been in place very early) limiting the total drag width to 5.5 m in 1937. The duration of the open fishing season was heavily manipulated until at least 1950 when an inside fishing zone of 7-mile was closed off during the summer months (as narrated by Caddy 1976) at a point in time when landings had fallen steeply. He further stipulates that during the 1960s the ups and downs of the fishery were not solely determined by fluctuations in scallop abundance but were also caused by a larger influx of fishing units (although not comparable to today's number of resource users) because other fisheries were doing poorly in the Bay. It even reached the point that the summer closure was lifted in 1966. Production levels remained low so, in 1971, the inside fishing zone was closed again to be experimentally reopened in 1972. At this time data was collected on catch and effort. The closure was reestablished in 1973 at 6 nautical miles and, at this point, the fleet size was frozen at 54 boats. The last implementation of the summer closure remains in effect (until the end of 1986) and it might have contributed to the betterment of this fishery. But the limited entry principle was, by no means, adhered to (Table 1). Today, there are more Bay of Fundy license holders than there has ever been since the inception of that fishery. Even if all licenses are not active, the potential fishing power is very large, an overcapacity for the available resources.

Despite its extreme stock fluctuations, the 65-year catch profile shows that (Fig. 1) it is not unusual for these stocks to be at levels that one may qualify as low, say 150 t. Very high landings could never be sustained for more than 2-3 years in a row. Over that time span (1922-23 to 1984-85) the average productivity for the inside zone has been 199 t (range: 841 t in 1936-37 to only 12 t in 1974-75; standard deviation = 154.45 t).

Although growing conditions in the outside zone which encompasses greater depths are not as good as in the inside zone, this area is much larger, geographically speaking, and from a statistical point of view, the scallop beds of Brier Island area in the approaches to the Bay of Fundy are also included to contribute to higher landing figures for the area. Over the last ten years these marginal areas have contributed significantly to the catches of the Bay of Fundy fleet (Table 5). A mean catch for the outside fishing zone covering the period May to September inclusive equals 299 t since 1976-77 (range: 123 t in 1976-77 to 479 t in 1982-83; standard deviation = 123.82 t).

The long term average production of the inside zone (199 t) plus the outside zone including the approaches to the Bay (299 t) amounts to 500 t on an annual basis. It seems improbable that this estimate realise most of the expectations of this extra-large fleet capacity.

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Table 1.- Number of vessels carrying a Bay of Fundy scallop license from 1979 to 1986. A Bay of Fundy license entitles the holder to drag for scallops in the Bay of Fundy and other areas of NAFO SA 4X and, under special trip permit, in Subdivision 5Ze. Source: Licensing Unit, Fisheries and Oceans, Halifax. Number of vessels based in Nova Scotia + number of vessels based in New Brunswick.

Year	under 25.5 G.T.		over 25.5 G.T.		Total
	under 14m	14-19.8m	under 14m	14-19.8 m	
1979	9 + 13	2 + 0	1 + 0	41 + 7	73
1980	5 + 13	1 + 0	2 + 0	52 + 7	80
1981	8 + 14	1 + 0	3 + 0	64 + 6	96
1982	8 + 8	1 + 0	4 + 4	65 + 4	94
1983	3 + 7	1 + 0	7 + 5	67 + 5	95
1984	2 + 7	0 + 0	7 + 5	70 + 5	96
1985	2 + 7	0 + 0	7 + 4	71 + 3	94
1986	1 + 7	0 + 0	7 + 5	70 + 3	93

Table 2.- Number of (1) Bay of Fundy licensed vessels (Source: Licensing Unit, Fisheries and Oceans, Halifax), (2) active fishing licenses for vessels over 25.5 G.T. supposed to follow log procedures, and (3) vessels complying with log procedures.

Year	(1)	(2)	(3)
1981	96	68	65
1982	94	66	63
1983	95	77	74
1984	96	82	76
1985	94	70	67
1986	93	67	57

Table 3.- Annual landings (t of scallop meats) by statistical district (Digby Neck, Digby, and Annapolis); by vessel tonnage, (1): ≤ 25.5 G.T., (2): > 25.5 G.T. Prior to 1967, landings were not segregated by vessel tonnage. Source: Statistics Division., Fisheries and Oceans, Halifax.

District	37		38		39	
Tonnage	(1)	(2)	(1)	(2)	(1)	(2)
1960		102.17		157.23		0.84
1961		80.60		303.49		1.93
1962		-		355.42		8.43
1963		17.47		512.29		0.48
1964		90.48		530.48		2.89
1965		-		476.99		19.16
1966		-		234.94		7.23
1967	0.96	5.42	39.04	115.66	-	4.94
1968	-	5.42	53.49	329.28	-	5.42
1969	4.10	56.27	33.13	176.87	-	6.75
1970	2.29	74.82	18.55	161.93	0.48	1.81
1971	4.94	69.88	10.00	104.34	3.61	3.61
1972	17.23	24.94	16.75	222.77	-	4.10
1973	0.96	10.00	16.39	130.24	-	7.23
1974	-	0.60	11.69	54.22	-	3.13
1975	-	-	22.29	96.99	-	6.27
1976	-	21.81	24.46	479.76	-	21.33
1977	10.00	96.75	35.66	766.99	1.08	24.22
1978	-	120.00	33.49	570.24	1.45	20.96
1979	2.29	54.94	22.53	685.42	6.27	15.90
1980	10.60	49.40	18.31	696.02	4.34	5.90
1981	28.55	147.35	3.98	1080.24	0.48	1.69
1982	28.31	106.51	21.20	915.42	-	7.95
1983	12.05	43.61	19.28	722.53	0.72	26.99
1984	5.90	53.98	7.59	564.22	0.24	29.88
1985	-	28.67	8.18	554.34	0.48	18.31
1986	-	45.05	2.52	398.43	1.68	10.34

Table 4.- Annual landings (t of scallop meats) by vessel category for Digby Neck (statistical district 37), Digby (38), and Annapolis (39). Inshore landings originate from vessels ≤ 25.5 G.T., while offshore landings refer to vessels > 25.5 G.T. Source :Statistics Division, Fisheries and Oceans, Halifax.

Year	37			38			39		
	IN	OFF		IN	OFF		IN	OFF	
		$\leq 14m$	$> 14m$		$\leq 14m$	$> 14m$		$\leq 14m$	$> 14m$
1979	2.29	-	54.82	22.53	10.60	647.71	6.27	-	15.90
1980	10.48	6.02	36.63	18.19	8.67	668.80	4.34	-	5.90
1981	28.31	30.84	110.60	4.10	12.77	1046.39	0.48	-	1.81
1982	28.43	19.28	87.11	21.08	15.90	888.43	-	0.36	7.59
1983	12.05	20.00	21.93	19.28	24.10	698.31	0.72	2.89	23.98
1984	5.90	29.64	24.34	7.59	20.48	543.74	0.24	0.48	29.40
1985	-	20.12	8.55	8.18	50.72	503.62	0.48	-	18.31
1986	-	11.56	33.49	2.52	30.72	367.71	1.68	0.36	9.98

Table 5.- Fishery characteristics for Bay of Fundy licensed vessels (14-19m) on a fishing zone basis. Statistical catches (Stats) for the inside zone corresponds to NAFO sub-subarea 4Xr; statistical catches for the outside zone are for NAFO sub-subareas 4Xr plus 4Xs. Class 1 logged catches were used to estimate CPUE.

Year	Inside zone (Oct-Apr)			Outside zone (May-Sep)		
	Catches (t meats)		CPUE	Catches (t meats)		CPUE
	Stats	Class 1	kg/hm	Stats	Class 1	kg/hm
1976-77	251.71	99.83	7.99	122.80	24.33	3.38
1977-78	238.27	180.18	7.29	188.02	141.84	4.88
1978-79	247.70	220.01	6.85	214.02	167.89	4.54
1979-80	280.22	245.44	6.95	161.33	131.80	3.88
1980-81	413.60	290.15	6.87	390.07	173.04	4.78
1981-82	417.80	304.40	6.86	429.65	160.74	4.65
1982-83	565.16	372.57	5.03	479.49	205.00	4.71
1983-84	319.15	267.66	3.59	397.35	267.22	3.06
1984-85	270.26	277.85	3.15	322.77	262.13	2.56
1985-86	121.33	142.37	2.36	282.51	274.86	2.25
1986-87	22.31*	21.21	1.81	90.54	56.62	1.92

*Oct-Dec only.

Table 6 .- Average monthly meat weight (g) on an annual basis for the outside 6-mile fishing zone. N: sample size.

Year	Month	N	Mean	Min.	Max.	S.E.
1979	May	2527	13.52	2.56	35.00	0.06
	June	2111	11.76	1.16	52.75	0.05
	July	4286	12.13	2.97	73.73	0.04
	Aug	2351	14.49	1.78	38.57	0.06
	Sept	440	16.71	5.27	47.12	0.19
		11715				
1980	May	648	16.83	5.76	40.27	0.16
	June	3646	16.45	3.37	43.65	0.07
	July	4475	14.52	2.43	41.00	0.06
	Aug	3607	15.45	2.52	79.43	0.07
	Sept	1788	18.01	1.65	83.74	0.12
		14164				
1981	May	2067	14.92	2.57	39.16	0.09
	June	2703	16.82	4.59	43.33	0.09
	July	3228	17.03	3.51	50.27	0.08
	Aug	2193	16.38	4.05	42.00	0.09
	Sept	1489	17.00	3.91	45.40	0.12
		11680				
1982	May	0	-	-	-	-
	June	3870	14.30	3.05	41.87	0.07
	July	3500	13.20	3.32	37.59	0.05
	Aug	3754	14.12	2.62	48.27	0.06
	Sept	0	-	-	-	-
		11124				
1983	May	3294	12.09	2.54	36.89	0.06
	June	2184	12.60	2.44	32.34	0.07
	July	1998	13.84	3.66	50.27	0.07
	Aug	2880	14.23	3.77	31.68	0.05
	Sept	0	-	-	-	-
		10356				
1984	May	5878	13.78	2.42	38.54	0.04
	June	3350	12.38	2.24	32.80	0.06
	July	5439	12.53	2.20	42.43	0.05
	Aug	4104	10.92	2.22	46.59	0.07
	Sept	2277	12.53	2.74	48.22	0.09
		21048				

Table 6.- continued

Year	Month	N	Mean	Min.	Max.	S.E.
1985	May	3829	14.37	3.37	39.34	0.06
	June	2211	12.95	2.68	30.26	0.06
	July	4886	12.84	2.59	36.65	0.05
	Aug	3160	14.30	3.36	82.51	0.09
	Sept	3617	13.08	2.51	39.31	0.06
		<hr/> 17703				
1986	May	2461	10.06	2.22	34.66	0.06
	June	3591	10.03	2.21	29.70	0.05
	July	3835	10.29	2.32	28.82	0.05
	Aug	2089	11.07	2.32	35.59	0.06
	Sept	2875	10.72	2.81	47.32	0.07
		<hr/> 14851				

Table 7 .- On a percentage basis, number of scallops at age from the catch of the outside 6-mile fishing zone.

Year	Age (years)												
	6	7	8	9	10	11	12	13	14	15	16	17	
1979	16.0	37.8	27.3	11.5	3.8	1.2	0.4	0.2					
1980	13.0	21.5	22.7	19.2	10.7	5.5	2.6	1.4	0.7	0.4	0.2	0.1	
1981	11.6	19.6	21.9	19.9	12.3	6.3	3.2	1.5	1.0	0.5	0.3	0.2	
1982	18.7	28.9	20.4	15.0	8.5	2.6	1.5	0.6	0.3	0.2	0.1	0.1	
1983	5.4	16.0	24.0	22.8	16.1	8.3	3.7	1.6	0.7	0.4	0.2	0.1	
1984	11.4	18.5	21.5	18.4	12.7	6.9	3.8	2.0	1.0	0.7	0.4	0.2	
1985	6.0	19.4	22.2	17.7	14.1	8.4	5.0	2.6	1.3	0.9	0.5	0.4	
1986	23.0	24.7	18.4	12.3	7.7	4.2	2.3	1.3	0.8	0.4	0.2	0.2	

Table 8. - Number of survey stations in the Digby area by year and by stratum types.

	1981	1982	1983	1984	1985	1986
Catch stratum:						
low (0-1%)	15	29	40	40	48	49
medium (1-3%)*	17	20	20	20	28	27
high (>3%)*	38	22	15	15	14	14
exploratory	-	30	25	25	30	30
total	70	101	100	100	120	120
Area stratum:						
Centreville	3	19	20	20	21	16
Gulliver's Head	22	20	28	23	29	21
Digby Gut	41	49	35	40	30	42
Delaps Cove	4	9	14	12	18	14
Parker's Cove	-	4	3	5	14	12
Hampton	-	-	-	-	8	12**
Zone stratum:						
inside 6-mile	27	50	40	49	58	48
outside 6-mile	43	51	60	51	62	72

* 2% in 1981.

** 3 stations near Young Cove

Table 9 .- 1985 stock survey. Average number of scallops at age caught in a seven-gang Digby drag projected from an end, unlined bucket for recruits (age >3 years) and from a centre, lined bucket for prerecruits (age ≤3 years). (u):unlined, (l): lined.

	Age (years)										Mean	s.d.	
	1	2	3	4	5	6	7	8	9	10+			
Catch stratum:													
low (u)	0	0	1	5	15	28	29	27	21	30	221	116	
(l)	0	1	2	5	9	11	11	10	6	9	138	79	
medium (u)	0	1	2	11	19	17	18	16	12	25	153	65	
(l)	0	1	4	11	14	11	11	10	7	15	112	57	
high (u)	0	0	1	4	10	4	10	9	8	28	102	40	
(l)	0	2	4	4	10	5	9	7	5	15	96	69	
exploratory (u)	0	0	2	8	23	24	28	21	11	27	187	80	
(l)	0	1	6	13	17	14	13	11	6	14	123	78	
Area stratum:													
Centreville (u)	0	0	0	12	27	23	32	28	18	31	200	76	
(l)	0	2	6	18	21	13	18	14	10	15	153	82	
Gulliver's Head (u)	0	1	1	6	23	30	26	22	10	27	179	92	
(l)	0	1	3	9	19	17	17	14	7	11	142	91	
Digby Gut (u)	0	0	2	6	12	18	23	21	16	27	162	95	
(l)	0	2	5	7	8	9	10	9	6	15	94	46	
Delaps Cove (u)	0	1	5	10	17	18	20	15	15	41	150	91	
(l)	0	0	3	6	7	7	6	7	4	15	91	44	
Parker's Cove (u)	0	0	1	2	10	18	17	12	8	13	290	63	
(l)	0	0	0	3	7	8	4	4	2	5	111	25	
Hampton (u)	0	0	0	3	4	15	20	25	27	15	290	188	
(l)	0	0	0	0	4	3	1	4	4	8	193	00	
Zone stratum:													
inside 6-mile (u)	0	1	1	6	13	10	11	11	9	27	135	73	
(l)	0	1	2	6	11	7	5	5	4	13	96	64	
outside 6-mile (u)	0	0	2	8	21	33	37	30	20	27	217	98	
(l)	0	1	4	10	14	15	17	15	8	12	140	72	

Table 10.- 1986 stock survey. Average number of scallops at age caught in a seven-gang Digby drag projected from an end; unlined bucket for recruits (age >3 years) and from a centre, lined bucket for prerecruits (age ≤3 years). (u):unlined, (l):lined

	Age (years)										Mean	s.d.	
	1	2	3	4	5	6	7	8	9	10+			
Catch stratum:													
low (u)	1	19	5	8	33	41	38	25	15	18	226	189	
(l)	4	146	19	12	12	14	10	10	6	12	279	370	
medium (u)	0	25	14	8	18	20	21	17	16	23	189	125	
(l)	1	556	157	16	13	13	14	9	8	14	941	1143	
high (u)	3	3	2	6	19	19	18	18	13	20	121	57	
(l)	2	482	110	25	17	15	14	14	8	26	713	521	
exploratory (u)	0	34	13	8	16	24	29	26	20	42	210	149	
(l)	2	534	136	23	22	12	15	20	16	30	810	979	
Area stratum:													
Centreville (u)	0	0	1	4	13	29	37	33	22	35	173	112	
(l)	1	77	24	22	27	21	19	22	17	28	260	157	
Gulliver's Head (u)	0	6	8	7	22	29	33	30	19	27	180	132	
(l)	0	201	72	20	15	18	18	16	11	20	390	314	
Digby Gut (u)	1	29	12	9	20	21	24	25	22	34	196	135	
(l)	2	671	176	22	17	10	12	15	12	27	965	1037	
Delaps Cove (u)	4	86	21	10	24	20	21	19	13	24	242	174	
(l)	2	744	97	19	13	10	12	7	3	11	919	1029	
Parker's Cove (u)	0	3	1	8	34	44	25	10	2	4	196	305	
(l)	0	15	5	3	5	9	2	1	0	0	81	61	
Young Cove (u)	0	0	0	3	27	51	69	6	4	6	166	82	
(l)	2	40	4	0	10	11	15	8	2	3	95	83	
Hampton (u)	1	3	5	7	45	51	39	8	7	7	295	193	
(l)	13	48	7	7	10	13	6	5	3	5	175	299	
Zone stratum:													
inside 6-mile (u)	2	43	15	6	10	16	17	10	9	17	158	164	
(l)	0	591	186	18	11	9	8	5	5	15	947	1139	
outside 6-mile (u)	0	8	5	9	33	38	38	31	21	30	229	145	
(l)	4	230	26	17	19	16	16	18	12	21	406	432	

Table 11.- Summary of average number of scallops at age caught for prerecruits and recruits by catch stratum.

	Age (years)		
	1-3	4-7	8 +
<u>1981</u>			
low	14	153	123
medium	43	281	81
high	56	192	89
<u>1982</u>			
low	2	176	102
medium	4	125	105
high	7	224	81
exploratory	12	184	85
<u>1983</u>			
low	11	152	84
medium	14	140	75
high	23	77	59
exploratory	16	148	79
<u>1984</u>			
low	10	87	43
medium	24	122	64
high	7	61	51
exploratory	13	106	54
<u>1985</u>			
low	2	78	77
medium	5	65	52
high	6	28	44
exploratory	7	83	58
<u>1986</u>			
low	168	120	58
medium	714	67	55
high	593	61	51
exploratory	672	76	87

Table 12.- Summary of average number of scallops at age caught for prerecruits and recruits by area stratum.

	Age (years)		
	1-3	4-7	8 +
<u>1981</u>			
Centreville	18	222	174
Gulliver's Head	93	277	85
Digby Gut	23	182	94
Delaps Cove	7	38	172
<u>1982</u>			
Centreville	15	255	129
Gulliver's Head	9	211	123
Digby Gut	4	160	74
Delaps Cove	0	120	90
Parker's Cove	0	4	29
<u>1983</u>			
Centreville	16	114	73
Gulliver's Head	20	176	75
Digby Gut	14	128	81
Delaps Cove	8	150	96
Parker's Cove	0	3	0
<u>1984</u>			
Centreville	22	75	44
Gulliver's Head	20	164	71
Digby Gut	9	83	49
Delaps Cove	8	62	50
Parker's Cove	0	33	4
<u>1985</u>			
Centreville	8	95	77
Gulliver's Head	4	86	60
Digby Gut	7	59	64
Delaps Cove	3	65	71
Parker's Cove	0	48	33
Hampton	0	42	67

Table 12.- Summary of average number of scallops at age caught for prerecruits and recruits by area stratum.

	Age (years)		
	1-3	4-7	8 +
<u>1986</u>			
Centreville	102	83	89
Gulliver's Head	273	90	75
Digby Gut	848	73	81
Delaps Cove	843	75	56
Parkers Cove	20	111	15
Young Cove	45	150	16
Hampton	68	142	22

Table 13.- Summary of average number of scallops at age caught for prerecruits and recruits by zone stratum.

	Age (years)		
	1-3	4-7	8 +
<u>1981</u>			
inside 6-mile	20	163	103
outside 6-mile	59	231	97
<u>1982</u>			
inside 6-mile	7	131	90
outside 6-mile	6	226	98
<u>1983</u>			
inside 6-mile	19	73	67
outside 6-mile	11	180	184
<u>1984</u>			
inside 6-mile	17	65	57
outside 6-mile	9	122	45
<u>1985</u>			
inside 6-mile	3	40	47
outside 6-mile	6	99	77
<u>1986</u>			
inside 6-mile	777	49	36
outside 6-mile	259	117	82

Table 14. Vessels licensed for scallop fishing in the upper parts of the Bay of Fundy, 'Cumberland' or 3-mile license. All vessels are less than 14m long. Numbers in parenthesis indicate active licenses that submitted at least one sales slip during the year.

Year	under 25.5 G.T.	over 25.5 G.T.	total
1983	14 (N/A)	0	14
1984	13 (N/A)	1 (1)	14
1985	13 (6)	1 (1)	14 (7)
1986	16 (10)	0	16(10)

Table 15 Landings in t of scallop meats by statistical districts in the upper parts of the Bay of Fundy. Districts 24 and 44 are in Cumberland Co., Nova Scotia; district 79 is in Albert Co., New Brunswick. Source: Statistics Div., Fisheries and Oceans.

Year	District	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1983	24	-	-	-	0.24	-	-	-	-	-	-	-	-
	44	-	-	-	0.60	0.12	1.57	2.17	0.84	0.36	0.48	0.48	-
	79	-	-	-	2.77	0.24	0.72	0.84	4.22	2.89	0.60	-	0.24
		-	-	-	3.61	0.36	2.29	3.01	5.06	3.25	1.08	0.48	0.24
	total for year:	19.38											
1984	24	-	-	-	-	-	-	-	0.12	-	-	-	-
	44	0.12	0.24	0.84	-	-	-	-	-	-	-	-	-
	79	0.12	-	0.84	1.69	4.10	5.18	1.93	3.86	3.25	2.65	0.84	0.36
		0.24	0.24	1.68	1.69	4.10	5.18	1.93	3.98	3.25	2.65	0.84	0.36
	total for year:	26.14											
1985	24	-	-	-	-	-	-	-	-	-	-	-	-
	44	-	-	-	-	-	-	-	0.48	0.48	0.36	-	-
	79	-	-	-	4.46	4.94	3.01	3.37	6.14	4.10	0.72	-	-
		-	-	-	4.46	4.94	3.01	3.37	6.62	4.58	1.08	-	-
	total for year:	28.06											

Table 15.-continued.

Year	District	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	40	-	-	-	-	0.12	-	0.24	0.12	0.24	-	-	-
	44	0.12	0.24	-	0.24	0.72	0.24	0.36	0.24	0.12	0.12	-	0.24
	79	-	-	-	2.65	4.34	2.29	1.93	2.41	1.69	0.24	-	-
		0.12	0.24	-	2.89	5.18	2.53	2.53	2.77	2.05	0.36	0.00	0.24
		total for year: 18.91											

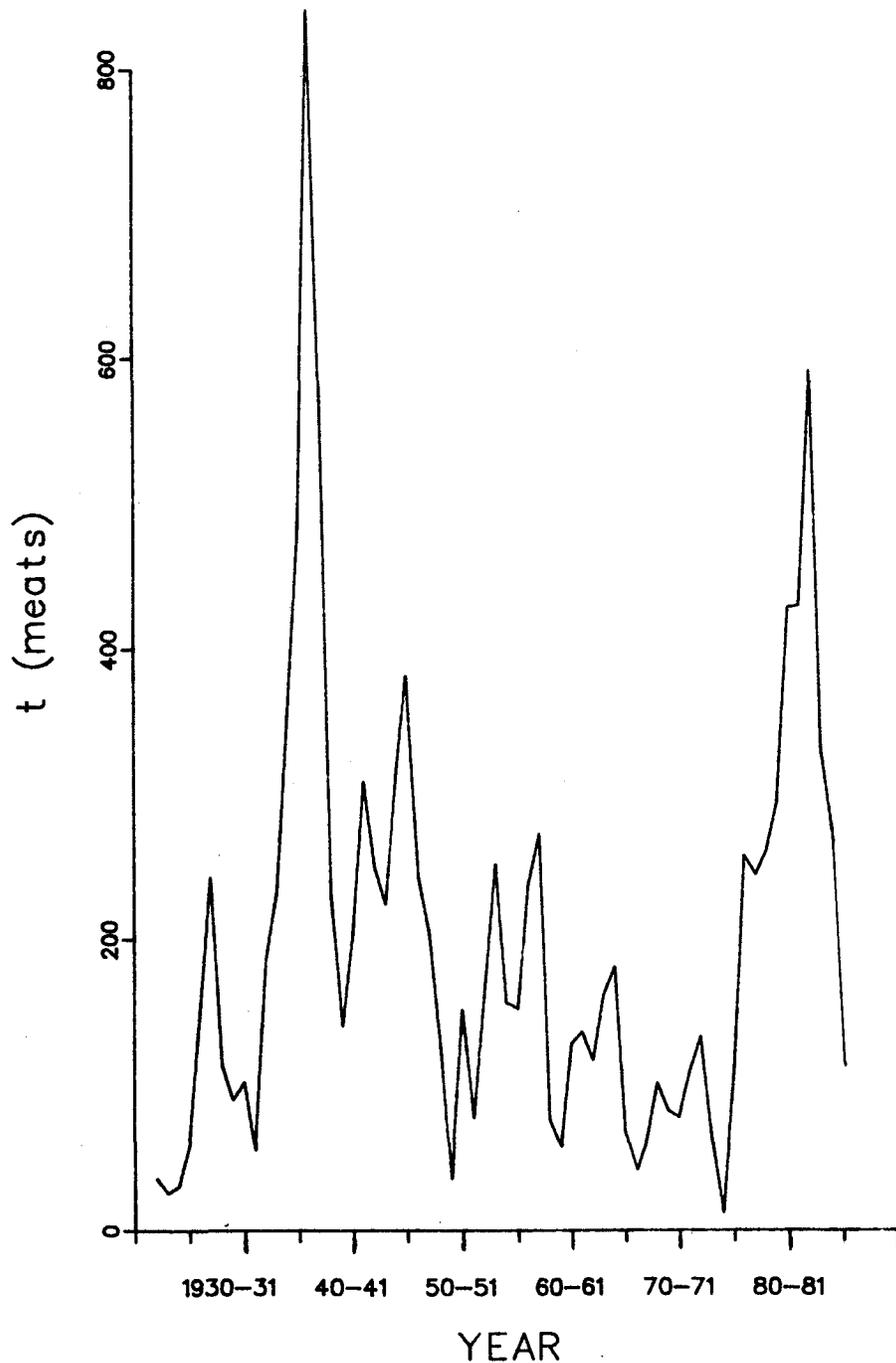


Figure 1.- Catch profile of a 65-year time series for the traditional grounds off Digby of the inside 6-mile fishing zone or catches recorded from October to April in NAFO sub-subarea 4Xr when a fishing zone did not exist. Source: Caddy (1979) up to 1972; then catches in NAFO sub-subarea 4Xr from October to April for vessels under 19.8m, Statistics Division, Fisheries and Oceans, Halifax. Catches for 1985-86 are preliminary.

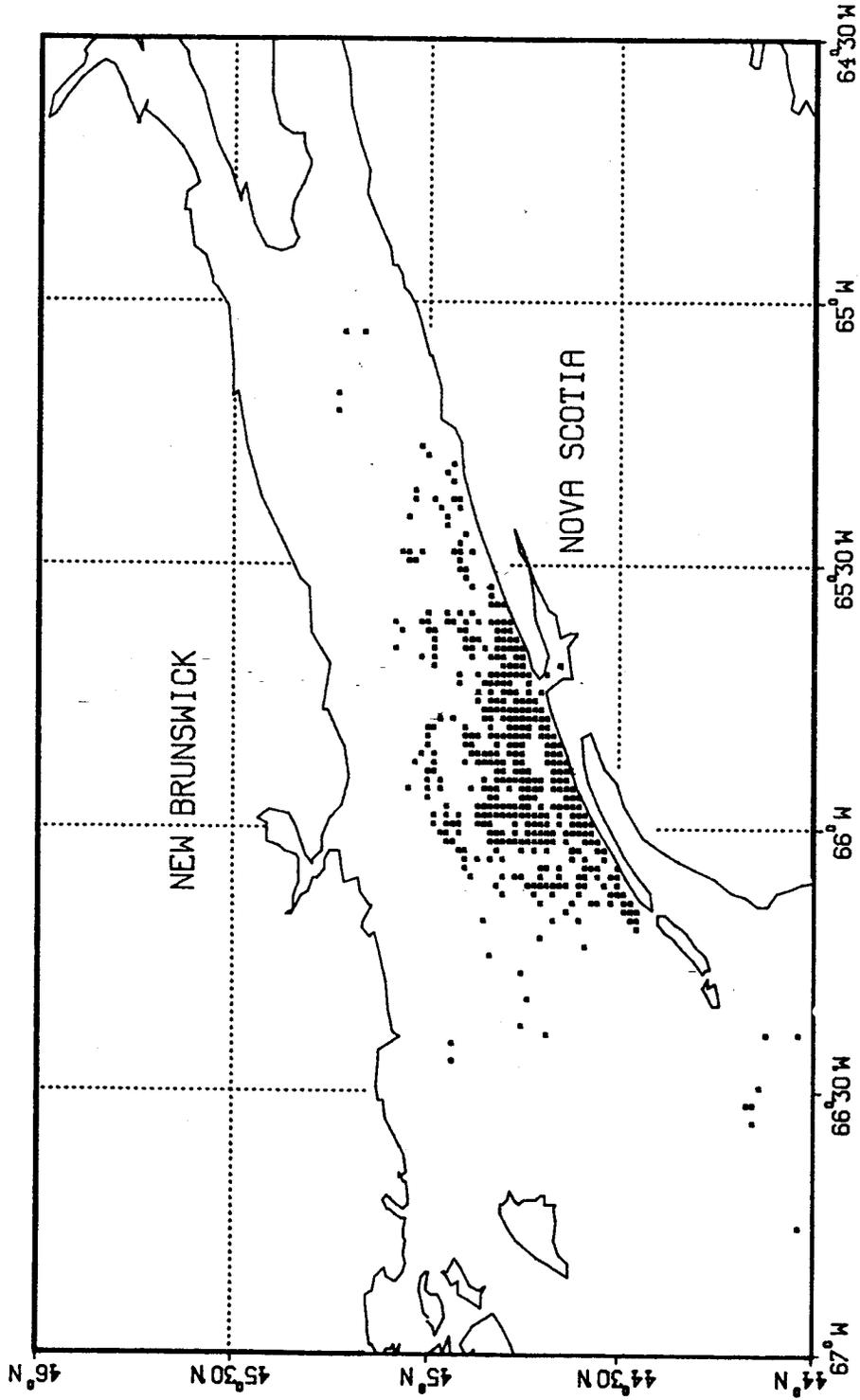


Figure 2.- Fishing locations representative of the areas fished by the Bay of Fundy fleet in 1985, within the Bay according to log information.

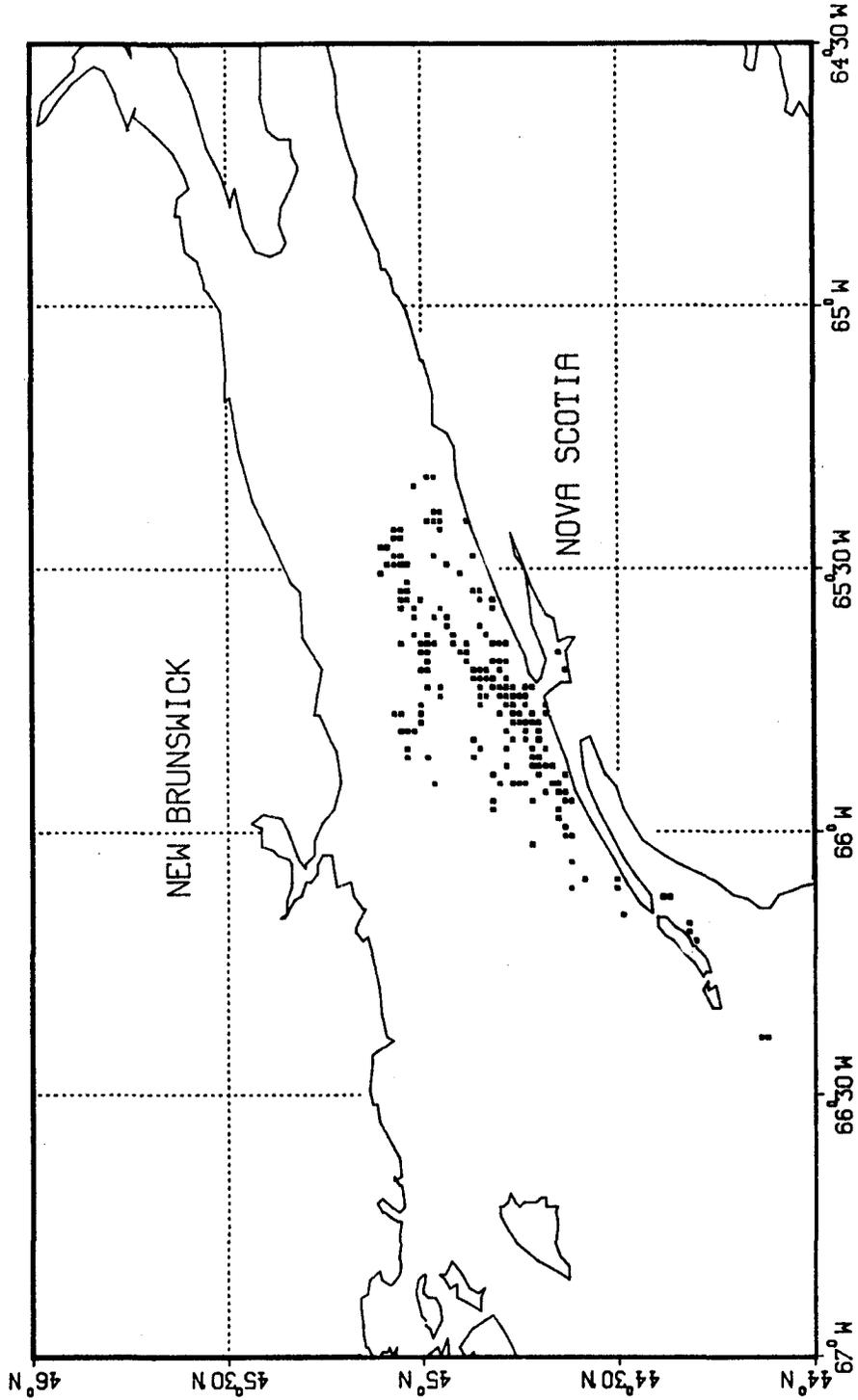


Figure 3.- Fishing locations representative of the areas fished by the Bay of Fundy fleet in 1986, within the Bay according to log information.

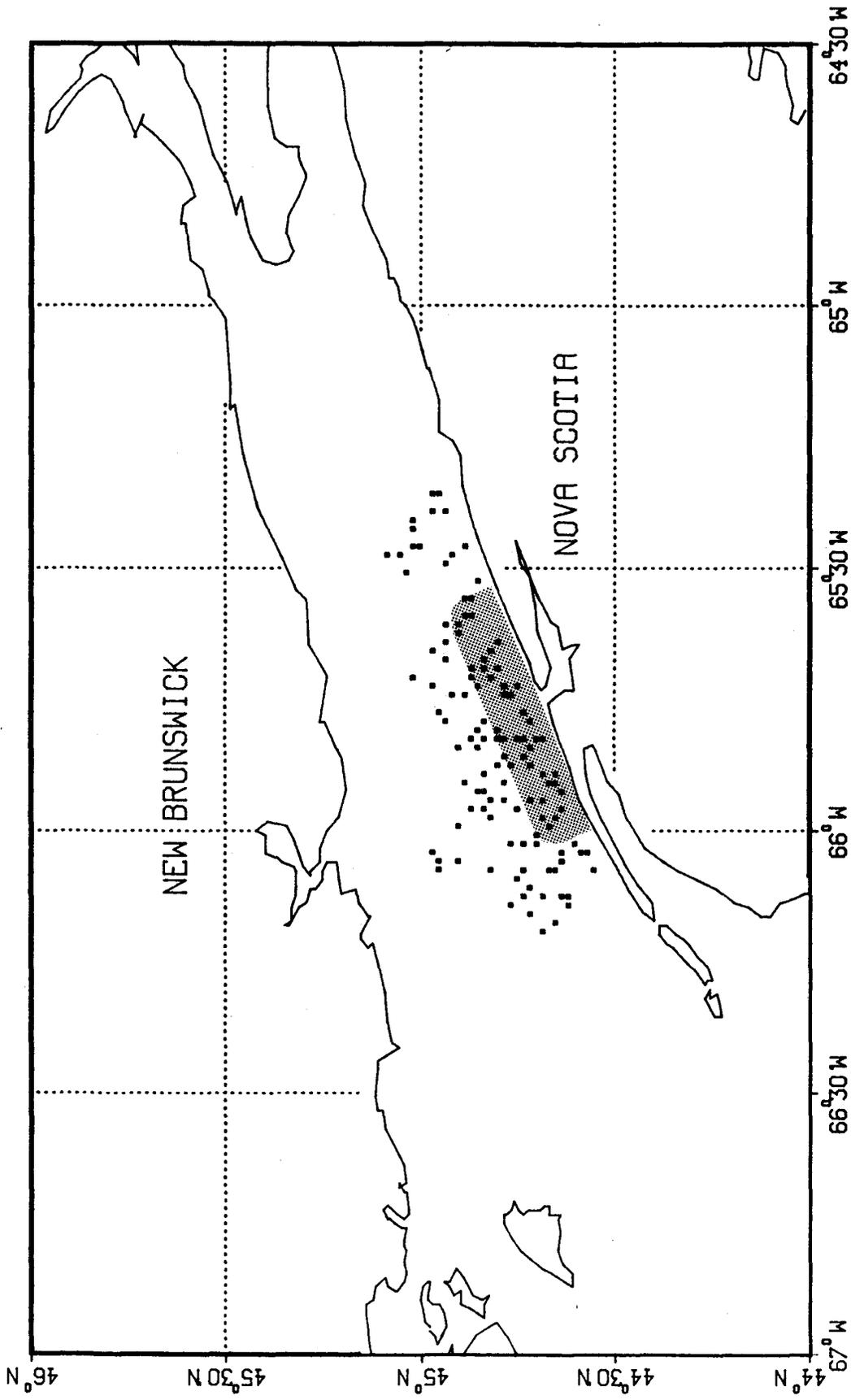


Figure 4.- Location of survey stations of the 1986 inventory of the traditional scallop beds near Digby, N.S.. The area where important concentrations of juveniles were observed is stippled.