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Bay of Fundy Scallop Stocks Assessment, 1984

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ABSTRACT

The performance of the Bay of Fundy fleet is declining after the 1982 peak in landings. A sizable portion of those landings originated outside the traditional scallop fishing grounds within the Bay itself, near Digby. Catches from the traditional areas have been declining while effort has increased steadily since 1979, with a major rise from 1983 to 1984. Concurrently, catch-rates have dropped, the 1984 value (2.92 kg/hm) being the lowest on record. Catch-at-age distribution indicates that the average monthly meat weight is steadily declining with respect to previous years. Stock surveys show that older recruits (age 8+) are decreasing substantially with no great abundance of pre-recruits and young recruits.

RÉSUMÉ

La performance de la flottille de la Baie de Fundy est en train de diminuer après les débarquements record de 1982. Une importante fraction de ces débarquements ne provenait pas des bancs de pétoncles pêchés traditionnellement à l'intérieur de la Baie, près de Digby. Les captures des régions traditionnelles ont diminué alors que l'effort a augmenté graduellement depuis 1979, une élévation majeure prenant place de 1983 à 1984. Simultanément, les taux de capture sont tombés, 1984 enregistrant la plus basse valeur jamais rapportée (2.92 kg/hm). La distribution des prises à l'âge indique que le poids de chair mensuel moyen est en voie de diminuer plus rapidement (1984) par rapport aux années précédentes. Les inventaires de stocks montrent que les recrues plus âgées (âge 8+) ont diminué considérablement tandis que les pré-recrues et jeunes recrues ne sont pas particulièrement abondantes.

INTRODUCTION

The performance of the Bay of Fundy scallop fishery (Nova Scotia side) is declining after the latest peak in landings which the Bay of Fundy scallop fleet experienced in 1982. However, a sizeable portion of those landings originated outside the traditional scallop fishing grounds within the Bay itself. This report presents the status of the scallop stocks inside the Bay of Fundy which have usually sustained the Bay of Fundy scallop fishery on the Nova Scotia side of the Bay. Scallop stocks of the outer reaches of the Bay of Fundy and in the vicinity of Grand Manan Island are assessed by in Robert et al. (1985a and 1985b respectively).

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, width of the gear, and number of crews for the deep-sea fleet (vessels over 19.8 m L.O.A.). Fishing effort in terms of hours fished and width of gear, excluding number of crew best described the fishing practices of the Bay of Fundy fleet (vessels between 14 and 19.8 m L.O.A.).

Data presented here on fishery characteristics of the 1950's were handled just like data sets referring to the present as all necessary information was available.

Sampling of the catch was carried out as in past years with excellent coverage of the outside 6-mile zone.

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 (Fig. 1). A description of the survey procedures may be found in Robert et al. (1984). At the analysis stage, survey data are also poststratified according to general fishing areas and fishing zones.

Biological Data

The 1983 growth functions (mm shell height) (Robert et al. 1984) were used to analyze survey data and catch-at-age distribution. The processing of shell samples from the 1984 stock survey had not been finalized in time for the stock evaluation. It has been established that growth patterns were depth-dependent in the Bay of Fundy (Caddy et al. 1970; Robert et al. 1984); for all practical purposes, the 85 m isobath coincides with the 6-mile line which separates the inside and outside fishing zones. A different growth curve applies to each of the two fishing zones with a slightly better growth-rate in the inside zone.

Data from 1,110 scallops collected during the 1984 survey were processed to establish the relationship between shell height and meat yield.

$$\ln (\text{meat weight}) = -13.474 + 3.402 \ln (\text{shell height})$$

This relationship was used for the 1984 analysis. It does not differ significantly from the 1983 allometric results but is different from the 1982 results.

RESULTS AND DISCUSSION

The Bay of Fundy Scallop Fishery

After an important increase in the number of bigger vessels (over 25.5 G.T.; L.O.A. over 14 m), from 59 to 70, in 1980-1981 the total number of vessels carrying a Bay of Fundy scallop license has remained virtually constant (Table 1). On average 89% of Bay of Fundy-licensed vessels (supposed to keep logbooks) involved themselves in the scallop fishery and the majority provided effort information (Table 2).

Most scallops caught in Bay of Fundy waters are landed in Digby, Statistical District 38, along with catches from different areas on the Scotian Shelf. Usually, those catches make up the smaller portion of the landings though. Landings in Tables 3 and 4 indicate a continuing reduction overall. Inshore landings (from vessels under or equal to 25.5 G.T.) are consistently decreasing while offshore landings (from vessels over 25.5 G.T.) are under a generally declining trend. It is very difficult to estimate the total catches of the inner Bay of Fundy (Robert et al. 1984) so only Class 1 catches will be considered here. There is no reason to believe that the effort and catch-rates data associated with the Class 1 catches would not be applicable to the overall fishery within the Bay. Class 1 catches have decreased slightly from 1983 to 1984 (Table 5). Effort has increased steadily since 1979 with a major rise (61%) from 1983 to 1984 (116,000 to 187,000 hm). However, the mean annual catch-rate has decreased by 18% from 3.56 to 2.92 kg/hm this past year. This is the lowest value on record.

Of the traditional fishing grounds in the vicinity of Digby, three general fishing areas contribute to the mainstay of the fishery although they may alternate rank from one year to the next (Table 6). What is most noticeable is the reduction in the percentage of the Class 1 catches; catch-rates took an even greater dip. Individual areas providing the ten best catch-rates do vary on an annual basis (Table 7). A serious decline has taken place in the level of high catch-rate values. In 1982 the ten best catch-rates ranged from 38.61 to 9.74 kg/hm; the span of best catch-rates is considerably limited in 1984 (11.79-6.82 kg/hm). Catches from traditional areas have been supplemented from scallop beds, especially some found in the upper parts of the Bay of Fundy, well upstream from Digby. A few years ago, catches upstream from Parker's Cove became significant; during the fall of 1984 a scallop bed to the southwest of Ile Haute which is located near Cape Chignecto became a focal point of the fishery with 16,589 kg (3% of total Class 1 catches) landed at a high CPUE of 6.65 kg/hm. The Annual Report of the Atlantic Biological Station for 1957-1958 mentions an upward trend in catches culminating with the 1956 and 1957 Digby catches. These record catches were partly attributed to a greater fleet size (Table 8) but also due

to an increase in stock abundance which allowed catch-rates ranging from 5.00 to 8.00 kg/hm (Table 8). Such CPUE values may be used as indicators of healthy stocks, at least momentarily, if effort information from the few vessels studied was representative of the fleet. According to the performance meter the Digby scallop grounds had had greater stock abundance from 1980 to 1982 permitting a range of catch-rates of 5.80-6.00 kg/hm (Table 5). The catch values from Table 5 may not appear exceedingly high but they only represent Class 1 data. Total mean annual catches covering this time period would approximate levels reached 25 years ago in 1956-1957 (Robert et al. 1984).

Seasonal coverage of catch sampling activities was excellent in 1984. The number of meats sampled doubled from previous years (Table 9) and information was collected for the month of September, the last fishing month of the outside 6-mile fishing zone. Average monthly meat weight is steadily declining with respect to previous years, 1984 profile being more pronounced than 1983. August 1984 average meat weight was only 10.92 g; at that time part of the fleet was exploiting the deeper waters on the New Brunswick side of the Bay. The catch-at-age data for the outside 6-mile fishing zone was transformed in a frequency distribution (Table 10) to estimate mortality (Z) rates (Table 11). On an age basis, the dominance of age 8 scallops is maintained in the catch but the frequency of younger scallops (age 6) has more than doubled (5.4% in 1983 to 11.4% in 1984). The 1984 pattern of distribution-at-age is most similar to the 1981 pattern. The 1981 instantaneous mortality rate (Z) is also the closest to the value estimated for 1984 ($Z=0.478$) (Table 11). However, for similar ages (shell sizes) it appears that scallops were more meaty in 1981 than in 1984 (Table 9). This was indicated by meat yield data collected during the respective surveys carried out in late June each year. If natural mortality is assumed at 0.1, 1984 instantaneous fishing mortality rates for the outside 6-mile fishing zone would be 0.38 and lower the average F value of the 1980's.

Growth and mean yield tend to vary significantly from year to year according to the 1982 and 1983 biological data. Since growth values are not yet available for 1984 we can only rate the performance of the 1984 fishery yield according to 1983 biological factors. Slight gains in yield could have been possible for the ages mainly fished at higher fishing mortality rates (Fig. 3). However, a yield per recruit analysis shows that the best yields, both for the inside and outside fishing zones, are reached when much older scallops (age 11) are caught at F values greater than 1.0.

Stock Surveys Within the Bay of Fundy

Survey results from 1981 to 1984 inclusive are presented in Tables 12-19. Tables pertaining to the stock surveys of 1981, 1982, and 1983 supersede the ones in Robert et al. (1984) which should not be referred to because of misprints.

Even though the survey gear is lined, it does not catch considerably more small scallops (pre-recruits) than the unlined regular fishing gear. Because of its design and construction, this gear is specifically targeting age-classes which shell heights are greater than 100 mm i.e. age greater than 6. It is therefore not surprising that considerably few young recruits (ages 4-5) are showing up in survey results (Tables 13-16). According to a

study initiated in 1946 (Anon. 1950; 1951; and 1952) 83 mm (3 1/4-inch) (inside diameter) rings would catch just as many scallops larger than 100 mm but only half as many scallops less than 100 mm as 67 mm (2 5/8-inch) rings.

Detailed distributions-at-age of young recruits has varied little from 1983 to 1984 (Tables 15 and 16). Over a longer term, the fishery should not expect higher landings as the average number of pre-recruits and young recruits has decreased slightly indicating weak recruitment pulses lately (Tables 17-19). The fishery relies on older recruits (age 8+) which Tables 17, 18, and 19 indicate are declining substantially, especially in the outside 6-mile fishing zone.

CONCLUSIONS

Offshore landings of the Nova Scotia side of the Bay of Fundy are generally declining. After a steady increase in effort up to 1983, the expended effort has reached an even higher level according to the 1984 data while catch-rates dropped by 18%, to the lowest value on record. This overall reduction in stock abundance on the traditional fishing grounds is confirmed by the decline in the contribution of the three principal fishing areas, the increasingly greater input of lightly exploited areas in the upper reaches of the Bay (Ile Haute), and the index of abundance of recruits established from stock surveys. The fishery is targeting ages 6-9 scallops, age 8 being dominant. Shucking of younger scallops (age 6) has more than doubled from 1983 to 1984 in an attempt to maintain landing patterns. With an overall fishing mortality rate around 0.4, yield losses with respect to the age-classes caught are small. It would be possible to maximize yield gains by fishing older scallops (age 11) at much greater fishing rates.

There is evidence that growth-rates and meat yields vary depending on an environmental variable such as depth; results accumulated so far tend to suggest a strong temporal (annual) component to these biological factors. Such variations have a direct effect on the fishery yield. If one compares values available for 1982 and 1983 (Fig. 2 and 3), yield differences by zones within a year are relatively small (same age caught at same F, say age 8 at F=0.4). A larger gradient exists for a fishing zone from year to year; for the outside 6-mile fishing zone, age 8 scallops at F=0.4 yielded 12.2 g each in 1982, only 9.2 g in 1983, a 25% drop.

If a longer biological data series on scallop growth confirms that yield-at-age for a given stock in the Bay has important annual fluctuations and if a meat count strategy is envisaged as a management tool, the amplitude of these fluctuations should be considered in choosing a management strategy.

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Table 1.- Number of vessels carrying a Bay of Fundy scallop license from 1979 to 1984. 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 25.5G.T.		over 25.5G.T.		Total
	under 14m	14-19.8m	under 14m	14-19.8m	
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

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

Year	1981	1982	1983	1984
1) Bay of Fundy licenses	96	94	95	96
2) active licenses supposed to log	68	66	77	82
3) complied to log	65	63	74	76

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 Div., 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

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 Div., 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

Table 5.- Class 1 catches, effort levels and CPUE values for scallop fishing grounds inside the Bay of Fundy.

	Catch t	Effort hm	CPUE kg/hm
1979	333.72	63871	5.22
1980	456.46	75636	6.03
1981	479.04	81163	5.90
1982	558.30	95654	5.84
1983	568.88	115896	3.56
1984	545.68	186774	2.92

Table 6.- Percentage of the Class 1 catches and respective mean CPUE values (kg/hm) coming from the three most productive areas within the Digby grounds on an annual basis. I: inside 6-mile, closed zone from May to October, O: outside 6-mile fishing zone, DG: Digby Gut, GH: Gulliver's Head.

1979	DG-O	21%	4.56	GH-I	21%	7.57	DG-I	18%	7.21	60%
1980	DG-I	24%	7.41	DG-O	23%	6.31	GH-I	12%	8.28	59%
1981	DG-I	27%	7.92	GH-I	18%	7.93	DG-O	18%	5.67	63%
1982*	GH-I	21%	7.68	DG-I	15%	6.78	DG-O	12%	5.46	48%
1983*	DG-I	20%	4.64	DG-O	18%	3.64	GH-O	10%	3.89	48%
1984*	DG-I	16%	3.26	DG-O	13%	2.35	GH-I	10%	3.72	39%

*after 1982 an important portion of the catch cannot be assigned by fishing areas, therefore the total is underestimated.

Table 7.- Fishing areas on an annual basis with the ten best catch-rates (kg/hm). 8.0Centreville = 8 miles from Centreville.

1979		1980	
8.0Centreville	25.61	2.5Centreville	27.09
2.5Hardwood Point	11.58	0.5Centreville	25.40
5.5Digby Gut	11.50	Gulliver's Head	14.80
1.5Centreville	10.71	3.5Sandy Cove	14.51
2.0Delaps Cove	10.50	443655	12.11
3.0Centreville	9.52	1.5Gulliver's Head	12.04
4.5Broad Cove	9.25	443660	11.55
2.5Delaps Cove	8.85	444655	11.30
1.5Gulliver's Head	8.77	12.5Centreville	11.21
5.5Gulliver's Head	8.69	6.5Centreville	11.08
1981		1982	
445655	40.55	Delaps Cove	38.61
9.0Parker's Cove	12.80	10.5Delaps Cove	18.82
443660	12.55	22.0Digby Gut	18.78
3.0Parker's Cove	12.07	12.0Hampton	12.39
5.0Centreville	11.37	1.0Gulliver's Head	10.72
443655	10.15	Centreville	9.99
5.5Gulliver's Head	10.04	1.5Gulliver's Head	9.91
2.5Centreville	9.98	443655	9.81
Gulliver's Head	9.80	2.5Centreville	9.75
2.0Gulliver's Head	9.75	3.0Hampton	9.74
1983		1984	
9.0Broad Cove	8.96	6.0Ile Haute	11.79
3.5Centreville	8.80	7.0Broad Cove	9.39
Delaps Cove	8.42	4.5Hillsburn	9.06
4.5Delaps Cove	7.27	3.0Ile Haute	7.71
5.0Broad Cove	7.26	5.0Ile Haute	7.53
8.0Broad Cove	6.84	12.5Hampton	7.32
7.5Parker's Cove	6.75	4.0Young Cove	7.18
3.0Gulliver's Head	6.71	16.0St. Martins	7.09
5.5Delaps Cove	6.59	13.5Parker's Cove	6.98
2.5Gulliver's Head	6.56	0.5Parker's Cove	6.82

Table 8.- Fishery characteristics of the inside of the Bay of Fundy scallop fishing grounds during the 1950s. Landing figures from Caddy (1979).

Year	no. boats	landings (kg)		no. boats	class 1 catch	CPUE
		inshore	offshore & Lurcher		(kg)	kg/hm
1952-53	18	166,330	43,230			
1953				5	8,243	11.95
1953-54	18	251,790	92,080			
1954				11	40,864	7.64
1954-55	12	155,810	104,100			
1955				8	58,277	5.08
1955-56	34	152,450	97,340			
1956				4	49,662	7.03
1956-57	29	238,140	166,920			
1957				2	17,415	5.72
1957-58	34	272,790	278,450			
1958				1	5,241	4.80
1958-59	28	75,610	129,790			

Table 9.- 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 10.- 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

Table 11.- Annual instantaneous mortality rate (Z) estimated from catch at age on a percentage basis for the outside 6-mile fishing zone.

Year	Z	s.e.	95% confidence interval	
1979	0.963	0.1537	0.655	- 1.270
1980	0.544	0.0696	0.405	- 0.683
1981	0.503	0.0624	0.378	- 0.628
1982	0.553	0.0639	0.426	- 0.681
1983	0.630	0.0882	0.454	- 0.807
1984	0.478	0.0591	0.360	- 0.597

Table 12.- Number of survey stations in the Digby area by year and by stratum types.

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

* 2% in 1981.

Table 13.- 1981 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	1	8	7	30	58	58	57	41	25	305	188
(l)	0	2	12	13	27	42	45	35	28	17	222	197
medium (u)	0	1	35	68	41	78	94	62	28	11	419	335
(l)	0	11	32	23	33	45	59	52	21	9	285	154
high (u)	0	1	3	23	47	66	56	37	28	24	284	151
(l)	0	13	43	233	101	36	32	23	16	17	513	1543
Area stratum:												
Centreville (u)	0	1	1	0	42	74	106	87	50	37	397	245
(l)	0	2	16	13	68	79	98	54	47	18	396	308
Gulliver's Head (u)	0	0	30	69	47	79	82	40	29	16	411	322
(l)	0	21	72	382	162	52	53	41	21	17	822	1994
Digby Gut (u)	0	1	4	15	42	65	60	49	27	18	281	138
(l)	0	5	18	24	25	34	34	27	16	12	194	117
Delaps Cove (u)	0	0	0	3	12	14	9	44	64	64	209	128
(l)	0	2	5	6	9	2	7	23	22	35	112	76
Zone stratum:												
inside 6-mile (u)	0	1	5	20	49	60	34	34	34	35	282	164
(l)	0	4	16	293	136	43	21	25	20	26	585	1820
outside 6-mile (u)	0	1	16	37	37	71	86	56	29	12	345	247
(l)	0	14	45	35	27	37	53	37	19	8	276	242

Table 14.- 1982 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	2	21	35	51	69	55	29	18	280	189
(l)	0	0	2	13	19	17	29	25	9	7	125	106
medium (u)	0	2	4	18	35	27	45	53	33	19	237	132
(l)	0	2	2	11	16	10	16	18	12	9	97	79
high (u)	0	1	1	44	64	66	50	36	20	25	307	149
(l)	0	4	3	24	29	28	19	16	11	18	152	104
exploratory (u)	0	0	2	28	45	56	55	43	19	23	300	178
(l)	0	4	8	30	28	32	30	20	12	17	201	139
Area stratum:												
Centreville (u)	0	1	2	18	49	80	108	69	37	23	386	179
(l)	0	8	7	20	34	37	45	30	14	12	207	116
Gulliver's Head (u)	0	1	3	36	62	61	52	61	36	26	340	143
(l)	0	4	5	32	33	31	27	21	9	16	187	123
Digby Gut (u)	0	0	2	30	39	43	48	39	18	17	240	151
(l)	0	1	3	19	17	16	20	16	9	10	114	106
Delaps Cove (u)	0	0	2	27	38	31	24	31	24	35	214	137
(l)	0	0	0	10	23	20	9	22	20	24	128	102
Parker's Cove (u)	0	0	0	3	0	0	1	7	7	15	64	72
(l)	0	0	0	0	0	4	2	7	6	13	66	74
Zone stratum:												
inside 6-mile (u)	0	1	2	21	39	37	34	34	24	32	232	159
(l)	0	5	2	18	23	19	15	15	11	21	137	98
outside 6-mile (u)	0	0	2	34	49	65	78	60	27	11	331	160
(l)	0	0	6	23	24	27	33	25	11	5	156	132

Table 15.- 1983 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	2	6	35	53	58	44	21	19	266	157
(l)	0	4	7	10	17	23	24	19	11	14	173	101
medium (u)	0	0	2	11	23	49	57	37	27	11	291	174
(l)	0	3	11	16	15	20	21	22	13	9	162	94
high (u)	0	0	0	4	13	30	30	20	9	30	186	86
(l)	1	13	9	28	15	29	26	18	10	22	214	102
exploratory (u)	0	0	1	6	21	54	67	39	24	16	286	166
(l)	0	4	12	15	20	29	37	21	9	13	211	149
Area stratum:												
Centreville (u)	0	0	0	1	12	36	65	42	20	11	249	146
(l)	0	4	12	8	10	14	32	29	15	10	179	111
Gulliver's Head (u)	0	0	2	10	36	62	68	42	19	14	307	171
(l)	1	9	10	19	21	33	34	22	10	15	222	125
Digby Gut (u)	0	0	1	6	27	46	49	34	22	25	246	112
(l)	0	4	10	18	23	33	26	20	11	13	191	103
Delaps Cove (u)	0	1	4	11	31	60	48	40	31	25	270	214
(l)	0	2	6	14	8	10	13	8	8	21	125	95
Parker's Cove (u)	0	0	0	0	0	0	3	0	0	0	10	0
(l)	0	0	0	0	0	0	0	3	0	0	10	0
Zone stratum:												
inside 6-mile (u)	0	0	1	8	12	26	27	20	19	28	191	118
(l)	0	9	10	17	9	14	17	10	9	20	148	103
outside 6-mile (u)	0	0	2	6	35	64	75	49	23	12	307	161
(l)	0	2	9	14	22	32	34	27	12	10	212	114

Table 16.- 1984 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	1	4	7	17	34	29	17	13	13	149	95
(l)	0	2	8	8	12	16	16	10	6	10	106	62
medium (u)	0	0	6	13	29	38	42	31	15	18	202	131
(l)	0	3	21	13	13	17	17	19	9	7	148	93
high (u)	0	0	3	11	12	18	20	14	14	23	143	72
(l)	0	1	6	7	10	11	12	8	6	7	73	44
exploratory (u)	0	0	3	7	26	38	35	19	11	24	194	126
(l)	0	1	12	7	9	22	14	8	10	12	99	80
Area stratum:												
Centreville (u)	0	0	2	4	14	32	25	15	15	14	135	91
(l)	0	4	18	9	9	20	14	10	7	11	114	79
Gulliver's Head (u)	0	0	8	17	40	49	58	34	16	21	253	123
(l)	0	2	18	13	13	21	21	16	10	9	158	95
Digby Gut (u)	0	1	3	8	18	30	27	18	14	17	159	80
(l)	0	2	7	8	12	16	16	12	8	8	90	53
Delaps Cove (u)	0	0	3	5	13	24	20	14	7	29	139	123
(l)	0	1	7	4	13	11	6	4	8	16	83	54
Parker's Cove (u)	0	0	2	3	6	21	3	2	1	1	47	39
(l)	0	0	0	0	3	4	1	0	0	0	20	19
Zone stratum:												
inside 6-mile (u)	0	0	4	7	15	21	22	17	12	28	151	99
(l)	0	3	14	9	10	10	11	11	7	14	99	70
outside 6-mile (u)	0	1	4	10	26	45	41	22	14	9	187	118
(l)	0	1	8	8	12	23	19	11	8	5	114	77

Table 17.- Summary of average number of scallops at age caught for prerecruits and recruits by catch stratum.

	Age (years)		
	1-3	4-7	8 +
<hr/>			
1981			
low	14	153	123
medium	43	281	81
high	56	192	89
1982			
low	2	176	102
medium	4	125	105
high	7	224	81
exploratory	12	184	85
1983			
low	11	152	84
medium	14	140	75
high	23	77	59
exploratory	16	148	79
1984			
low	10	87	43
medium	24	122	64
high	7	61	51
exploratory	13	106	54

Table 18.- Summary of average number of scallops at age caught for prerecruits and recruits by area stratum.

	Age (years)		
	1-3	4-7	8 +
<hr/>			
1981			
<hr/>			
Centreville	18	222	174
Gulliver's Head	93	277	85
Digby Gut	23	182	94
Delaps Cove	7	38	172
1982			
<hr/>			
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
1983			
<hr/>			
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
1984			
<hr/>			
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
<hr/>			

Table 19.- Summary of average number of scallops at age caught for prerecruits and recruits by zone stratum.

	Age (years)		
	1-3	4-7	8 +
<hr/>			
1981			
inside 6-mile	20	163	103
outside 6-mile	59	231	97
1982			
inside 6-mile	7	131	90
outside 6-mile	6	226	98
1983			
inside 6-mile	19	73	67
outside 6-mile	11	180	184
1984			
inside 6-mile	17	65	57
outside 6-mile	9	122	45
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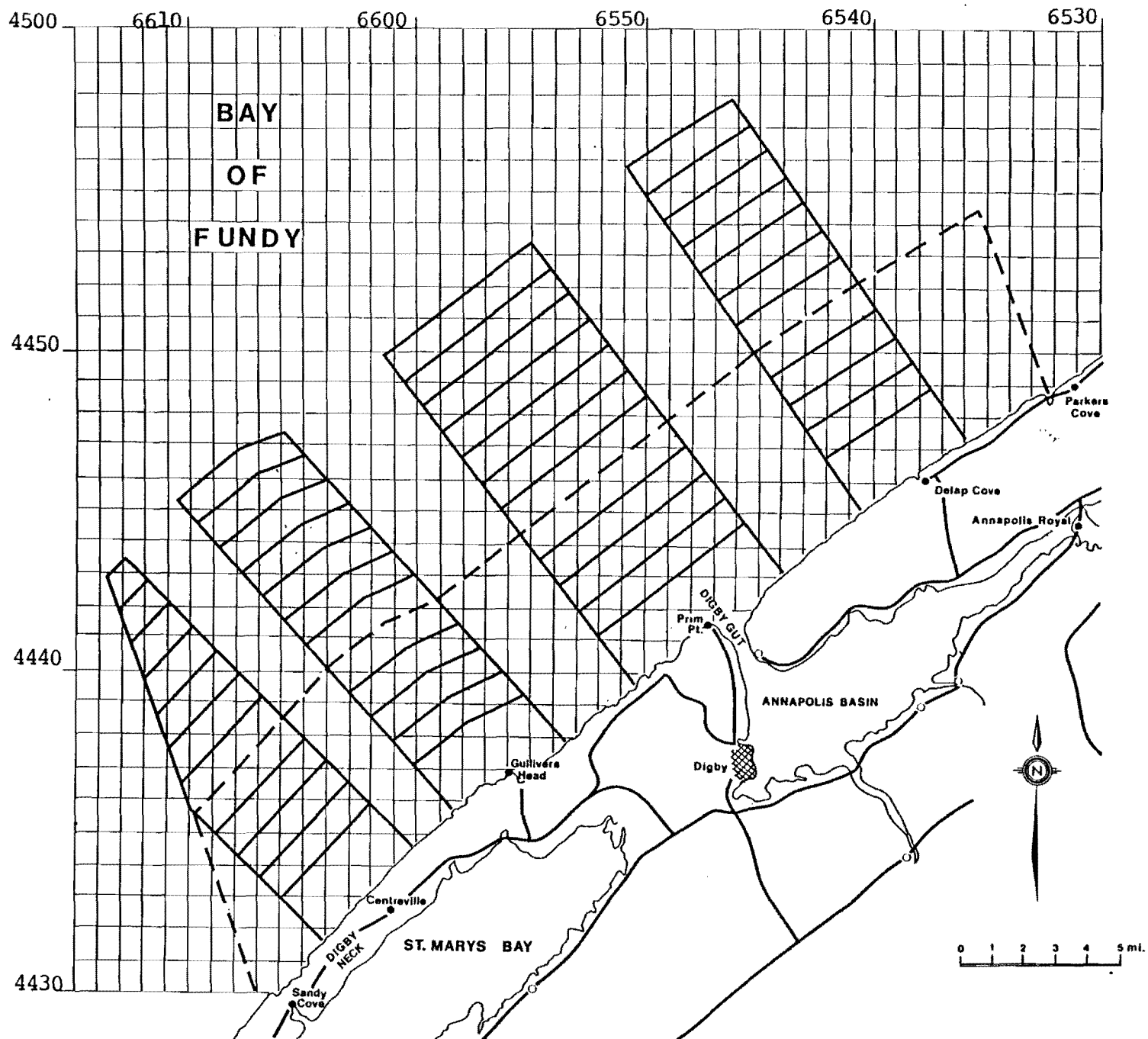


Figure 1.- Map of the traditional fishing grounds in the vicinity of Digby, N.S. Width of bands is one nautical mile. The dashed line encloses the inside 6-mile winter fishing zone from Parker's Cove to Sandy Cove.

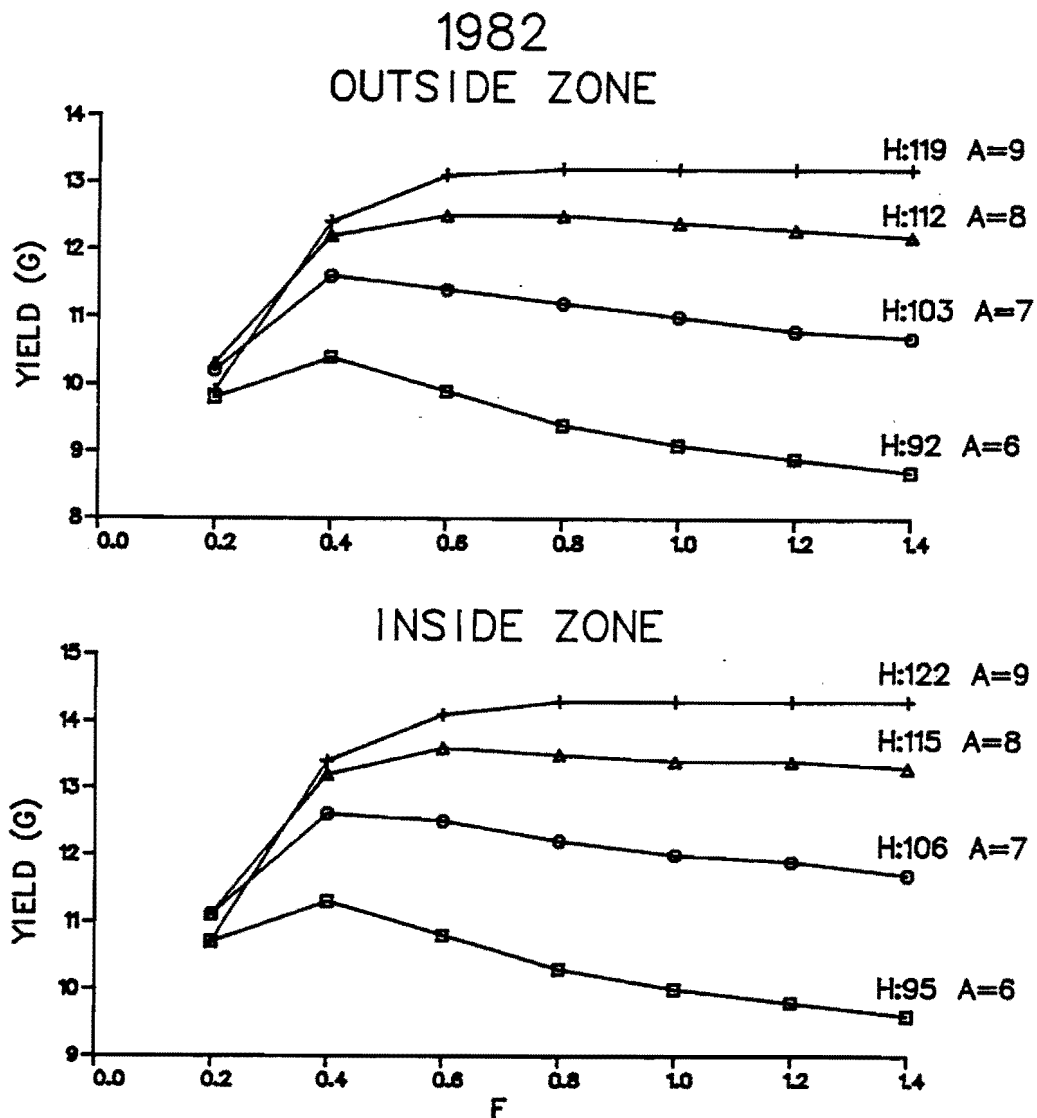


Figure 2.- Yield per recruit (Y) for different instantaneous fishing mortality rates (F) when age (A in years) (shell height: H in mm) is held constant for the two fishing zones in the Bay of Fundy using growth and meat yield data collected during the annual survey.

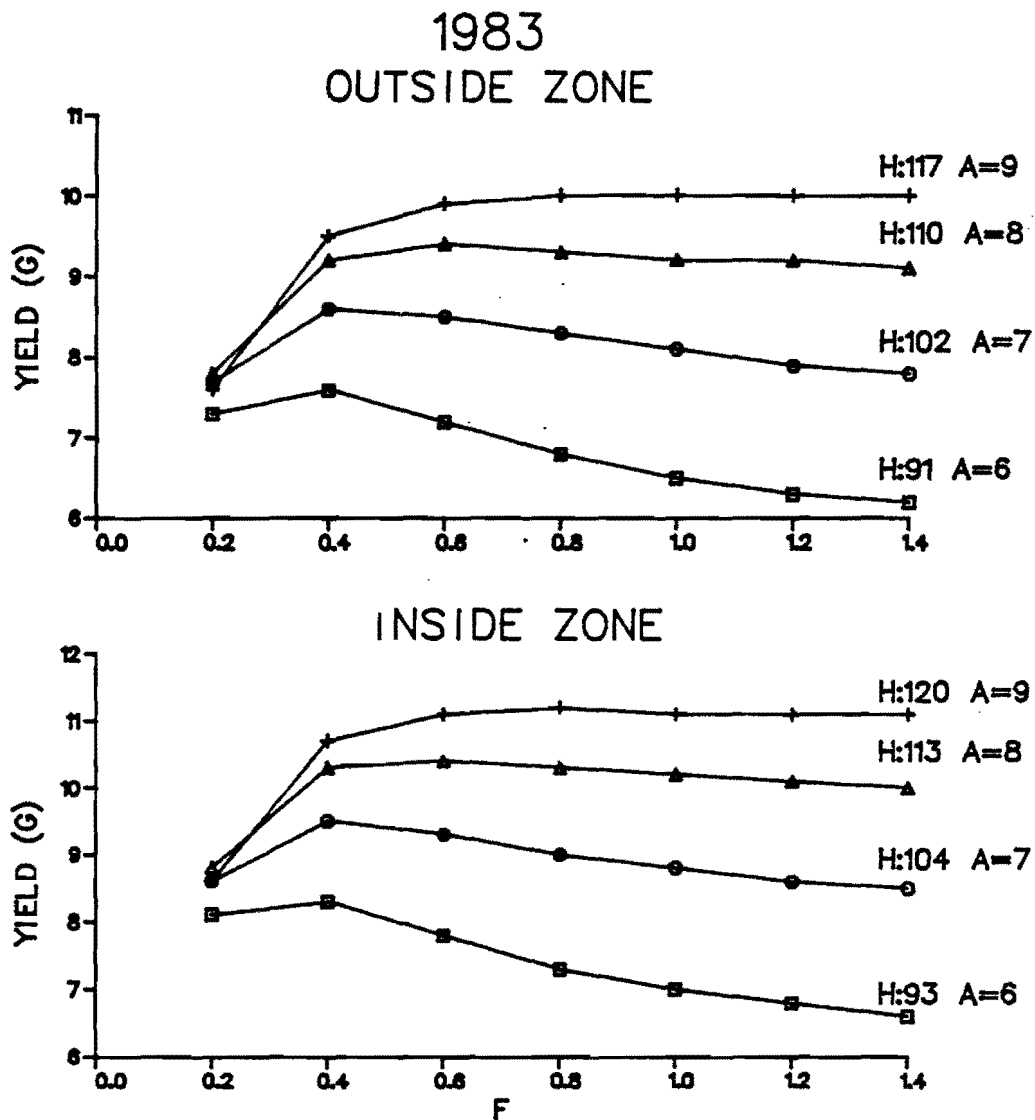


Figure 3.- Yield per recruit (Y) for different instantaneous fishing mortality rates (F) when age (A in years) (shell height: H in mm) is held constant for the two fishing zones in the Bay of Fundy using growth and meat yield data collected during the annual survey.