Prospects for a Sea Scallop Fishery on St. Pierre Bank in 1987

by

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Abstract

Size distributions of the sea scallop, Placopecten magellanicus on St. Pierre Bank were examined in relation to past and predicted meat yields and yield-per-recruit. Optimal ages of first exploitation would be considerably greater than the modal age (4.5 yr) available in 1987 for first exploitation. The meat-count regulation allows harvesting of small scallops only so long as there are scallops in the population of greater size. With fewer larger scallops remaining on the Bank for blending, management options to improve fishery yield are limited. Average age of first exploitation should be increased to more optimal levels. To ensure that no further growth overfishing occurs, it may be necessary to disallow the harvesting of sea scallops from St. Pierre Bank in 1987.

Résumé

Les distributions selon la taille des pétoncles géants, Placopecten magellanicus, sur le Banc de Saint-Pierre ont été examinées par rapport aux rendements passés et prévus en chair et au rendement par recrue. Les âges optimaux lors de la première exploitation seraient considérablement plus élevés que l'âge modal (4,5 ans) observé en 1987 lors de la première exploitation. Le règlement relatif sur la taille des chairs de pétoncles permet la pêche de petits pétoncles tant qu'il y a des pétoncles plus gros dans la population. Comme, sur le Banc de Saint-Pierre, il y a moins de gros pétoncles pour la préparation de mélanges, les options de gestion visant à améliorer le rendement de la pêche sont limitées. L'âge moyen lors de la première exploitation devrait être augmenté à des niveaux plus optimaux. Pour s'assurer qu'on ne pêche pas de trop petits pétoncles qui n'ont pas encore atteint l'âge optimal, il peut être nécessaire d'interdire, en 1987, la pêche de pétoncles géants sur le Banc de Saint-Pierre.

Introduction

The meat count for St. Pierre Bank (3Ps) during 1986 provisionally was set at 50/500 g (effective June 1986). From January 1 to June 1986 the meat count was 33/500 g. While protecting pre-recruit sea scallops (1982 year class), the strategy encouraged the exploitation of the Iceland scallop, an underutilized species also present in the area. As had been predicted, sea scallops began recruiting into the fishery in late summer. Components of the Maritimes' based offshore fleet quickly diverted effort into the preferred species (sea scallops). Some 153 t meats were removed in 287 vessel days. The presence in the catch of an inordinately large number of juvenile scallops prompted participants of industry into agreeing on a voluntary closure of the Bank in October 1986. At the same time Resource Management (Newfoundland Region) recommended that the meat count for the area should revert to 33/500 g, similar to the regulatory regime for Georges Bank. The area has not since been fished (to March 1987). While a 1987 management plan is yet to be developed for 3Ps, local Resource Management personnel have recommended that the meat count remain at 33/500 g (minutes OSAC meeting, December 9, 1986). This document examines past and present sea scallop size distributions on St. Pierre Bank in relation to yield-per-recruit (Y/R) and provides background material on the basis of which appropriate scientific advice may be generated for the stock for 1987.

History of production

This has been reviewed in some detail by Naidu et al. (1983). Production from St. Pierre Bank is more or less negatively correlated to fishery performance elsewhere on the Atlantic Seaboard, particularly Georges Bank. Although annual contributions to total offshore catches have been relatively small (Table 1), the fishery has taken on a new profile beginning in 1982. The dramatic decline in scallop removals from the primary fishing grounds (Georges Bank) had encouraged vessels, many for the first time, eastwards into 4VW and 3Ps. Vessels have now become familiar with the fishing grounds. Distribution of pre-recruits has been carefully charted by vessels operating in the area since 1982. Harvesting strategies may be expected to be more site-specific, with less time spent on locating scallop contagions. Precision of locational information allows more efficient harvesting of sea scallops as was apparent in 1986.

Research surveys

Systematic line surveys are conducted annually in each of two target areas in 3Ps to determine the spatial distribution and abundance of sea scallops on St. Pierre Bank. One-mile tows are completed along predetermined stations with a 12 ft New Bedford dredge. The same stations are occupied each year. Number of sets and sampling rates over the last five years are summarized (Table 2). Shell heights of all scallops sampled are recorded in 1 mm groups. The most recent survey was completed between February 28 and March 4, 1987.

Commercial sampling

Commercial landings were sampled at principal ports of discharge for individual meat-weight distributions. Weights to the nearest 0.1 gram were determined separately for muscle-on and muscle-off. Subsamples were used to obtain data on the relative weight contributions of the catch and quick fractions of the adductor muscle to facilitate transformations from muscle-off to muscle-on.

Growth and yield-per-recruit

Estimates of size at age were obtained through back measurements of shell heights at age (Naidu et al. 1983). Adductor muscle (meat) weights at age were used to determine yield (kg) per 10,000 recruits for varying levels of F as in Thomson and Bell (1934) assuming knife-edge recruitment. Sea scallops were considered fully recruited at age 4^+ and Y/R calculated for values of F up to 2.0.

Results

Sea scallop shell height compositions (Fig. 1) and number of scallops per research vessel tow during 1983 to 1987 are shown in Table 3. Corresponding individual meat-weight frequencies of the commercial catch in each of those years are shown in Fig. 2. Detailed examination of relative contributions by numbers and weights at various meat count levels (Tables 4 and 5) show that in nearly every year individual scallop meats below the minimum critical weight made greater contributions by numbers and weights than did meats above it. (At a meat count of 33/500 g the minimum critical weight would be 15.1 g; at 50/500 g, the corresponding weight would be 10.0 g.) In 1985, however, undersized scallops made only small contributions to the sampled meat weight distributions. Overall trends in the meat count, again with the exception of 1985, indicated that the meat count for the Bank has varied between 45 and 55/500 g (Table 6). Relative contributions by numbers and weights below and above the minimum critical weight between 1982 and 1986 at 33/500 g (or 15.1 g) are summarized in Table 8. Counts recently (March 1987) obtained during a research vessel survey are in the range of 31 to 87 (Table 7). Mean shell height of the recently recruited cohort is 82.0 ± 5.0 mm (N = 329) with corresponding mean adductor muscle weight of 8.6 ± 1.7 g, equivalent to a meat count in the range of 48 to 73/500 g.

The results of the yield-per-recruit (Y/R) calculations are presented in Fig. 3. Maximum yield-per-recruit occurs at a mean age of first harvesting between eight to nine years for fishing mortality rates of 1.0 to 2.0.

Discussion

Commercial port samples taken between 1982 and 1986 have indicated that individual scallops below the minimum critical weight for the recommended meat

count (33/500 g or 15.1 g) nearly always made greater contributions (by numbers and weights) than did those above it (Table 8). The only exception was during 1985 fishing season when only 4% of sampled numbers were below the minimum critical weight and accounted for 3% of the total weight. Meat counts (adjusted) during those years did not exceed 50/500 g. The high count in 1984 resulted from vessels targetting for Iceland scallops predominantly in the 70-90 mm range with meat yield of 5 to 10 g respectively (Naidu 1985). Sea scallops in the 50-90 mm range were virtually absent from the Bank that year and consequently not available to the fleet. In every other year since 1982 it is apparent that the fleet looks for high sea scallop density patches of recent recruits in preference to lower densities of older cohorts. This has been the traditional fishing strategy of the Canadian fleet (Caddy 1975).

Interest in St. Pierre Bank in 1987 may be attributed to good sea scallop recruitment, to the precision of locational information on the distribution of scallop beds, particularly of the recently-recruited cohort and to TAC and EA-imposed limitations for Georges Bank. Exploratory effort likely would be minimal. A high fishing mortality on this cohort at age 4^+ would result in a relatively low Y/R with meat counts well above the proposed level (33/500 g). In effect the fishery will return to a situation similar to that prevailing in the early eighties. Initially, because of the presence of the accumulated biomass and the overall population structure (Naidu et al. 1983), it was possible to blend small scallops with larger ones to stay within the minimum landed meat count(s). Since it was the "blended" count that was being regulated, it permitted the harvesting of considerable number of small scallops. In more recent years the fishing strategy spread effort on densely populated recruits and on more sparsely populated contagions of older scallops so as to maintain non-violative counts. The potential to realize this has now been considerably diminished because numbers of larger-sized scallops ($\geq$ 100 mm) have been dramatically reduced over the last five years (Table 3).

A low meat count such as the one being proposed for 1987 at 33/500 g will result in increasing age at first capture. Significant increases in yield may be realized from a decrease in effort and an increase in size (age) at first capture. Allowing "aimed fishing" on the just-recruited scallops on St. Pierre Bank is to permit exploitation of the resource well before maximum yield-per-recruit is achieved and may not be compatible with maintaining the meat count below the recommended maximum at 33/500 g. Since natural mortality (M) on the Bank is 0.10 (Naidu and Cahill 1984), minimum age of 8.0 would result in the greatest yield-per-recruit over a wide range of fishing mortalities (F = 0.6 to 2.0). Only small gains (2-4%) are possible by further delaying harvest after age 8. The problem on St. Pierre Bank is compounded by the sporadic nature of recruitment in the area (Naidu and Anderson 1984) which makes blending of scallops of different sizes sometimes difficult. Sea scallop recruitment in this northern extremity of its distribution range will continue to be irregular with wide fluctuations in the strength of each recruitment pulse. Only by adopting stricter conservation measures, including increasing Y/R by delaying mean age of first capture of each pulse, can total yield from this fishery be improved.

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Table 1. Canadian scallop landings (MT meat) from Georges and St. Pierre Bank.

Year	Georges Bank	St. Pierre Bank
1951	91	-
1952	91	-
1953	136	106
1954	91	143
1955	136	153
1956	317	107
1957	771	70
1958	1179	2
1959	1950	-
1960	3401	9
1961	4580	-
1962	5669	-
1963	5941	40
1964	5986	343
1965	4434	14
1966	4878	-
1967	5019	164
1968	4822	9
1969	4318	83
1970	4097	127
1971	3908	27
1972	4161	29
1973	4223	36
1974	6137	-
1975	7414	-
1976	9726	-
1977	13089	-
1978	12189	23
1979	9207	1
1980	5221	35
1981	8013	-
1982	4306	717
1983	2839	594
1984	1945	413
1985	3812	53
1986	4671	153

Table 2. Catch and sampling rates for sea scallops on St. Pierre Bank, 1983-87.

Year	Catch		Sampled	
	Weight (kg)	Numbers	Weight (kg)	Numbers
1983	1,613.3	10,011	1,464.8	8,614
1984	2,422.5	13,948	2,285.5	12,691
1985	4,120.9	39,021	3,720.5	28,679
1986	3,091.0	30,346	2,642.0	21,547
1987	518.0	8,394	253.0	3,421

Table 3. Number of sea scallops/research vessel tow (1983-87).

Year	No. sets	Size class (mm)			Total No.
		0-50	51-100	≥101	
March 1987	24	-	266	19	6842
April 1986	270	2	46	33	21804
Sept. 1985	195	12	61	51	24353
Sept. 1984	215	8	13	37	12356
Sept. 1983	145	-	34	26	8617
Jan. 1983	115	-	54	6	6894

Table 4. Individual scallop meat-weight frequency distributions (by numbers) at four meat count levels from St. Pierre Bank fishery, 1982-86. Figures in parentheses are percentages (not adjusted for loss in yield associated with manual shucking, see Naidu 1985).

Year	No. of samples	Meat condition	N	Meat count/lb								Meat count/500g	
				30		35		40		45		45	
				≤15.1g	≥15.2g	≤12.9g	≥13.0g	≤11.4g	≥11.5g	≤10.1g	≥10.2g	≤11.1g	≥11.2g
1982	4	Muscle on	2,246	2,129 (95)	117 (5)	1,912 (85)	334 (15)	1,622 (72)	624 (28)	1,383 (62)	863 (38)	1,567 (70)	679 (30)
		Muscle off	2,232	2,093 (94)	139 (6)	2,009 (90)	223 (10)	1,850 (83)	382 (17)	1,609 (72)	623 (28)	1,805 (81)	427 (19)
		Adj. combined	4,231	3,948 (93)	283 (7)	3,613 (85)	618 (15)	3,169 (75)	1,062 (25)	2,709 (64)	1,522 (36)	3,054 (72)	1,177 (28)
		As landed	3,643	3,489 (96)	154 (4)	3,229 (89)	414 (11)	2,855 (78)	788 (22)	2,495 (68)	1,148 (32)	2,779 (76)	864 (24)
1983	5	Muscle on	1,877	1,612 (86)	265 (14)	1,396 (74)	481 (26)	1,180 (63)	697 (37)	953 (51)	924 (49)	1,118 (60)	759 (40)
		Muscle off	2,522	2,290 (91)	232 (9)	2,080 (82)	442 (18)	1,840 (73)	682 (27)	1,597 (63)	925 (37)	1,786 (71)	736 (29)
		Adj. combined	4,399	3,818 (87)	581 (13)	3,340 (76)	1,059 (24)	2,885 (66)	1,514 (34)	2,352 (53)	2,047 (47)	2,759 (63)	1,640 (37)
		As landed	4,399	3,902 (89)	497 (11)	3,476 (79)	923 (21)	3,020 (69)	1,379 (31)	2,550 (58)	1,849 (42)	2,904 (66)	1,495 (34)
1984	6	Muscle on	6,085	5,569 (92)	516 (8)	5,196 (85)	889 (15)	4,811 (79)	1,274 (21)	4,358 (72)	1,727 (28)	4,721 (78)	1,364 (22)
		Muscle off	3,283	2,875 (88)	408 (12)	2,653 (81)	630 (19)	2,463 (75)	820 (25)	2,300 (70)	983 (30)	2,430 (74)	853 (26)
		Adj. combined	9,368	8,325 (89)	1,043 (11)	7,722 (82)	1,646 (18)	7,165 (76)	2,203 (24)	6,482 (69)	2,886 (31)	7,028 (75)	2,340 (25)
		As landed	9,368	8,444 (90)	924 (10)	7,849 (84)	1,519 (16)	7,274 (78)	2,094 (22)	6,658 (71)	2,710 (29)	7,151 (76)	2,217 (24)

Table 4 (Cont'd.)

Year	No. of samples	Meat condition	N	Meat count/lb								Meat count/500g	
				30		35		40		45		45	
				≤15.1g	≥15.2g	≤12.9g	≥13.0g	≤11.4g	≥11.5g	≤10.1g	≥10.2g	≤11.1g	≥11.2g
1985	2	Muscle on	397	11	386	2	395	2	395	1	396	1	396
				(3)	(97)	(1)	(99)	(1)	(99)	(0)	(100)	(1)	(99)
		Muscle off	958	49	909	20	938	4	954	1	957	2	956
				(5)	(95)	(2)	(98)	(0)	(100)	(0)	(100)	(0)	(100)
		Adj. combined	1,355	42	1,313	14	1,341	3	1,352	1	1,354	2	1,353
				(3)	(97)	(1)	(99)	(0)	(100)	(0)	(100)	(0)	(100)
		As landed	1,355	60	1,295	22	1,333	6	1,349	2	1,353	3	1,352
				(4)	(96)	(2)	(98)	(0)	(100)	(0)	(100)	(0)	(100)
1986	4	Muscle on	1,884	1,328	556	1,257	627	1,180	704	1,107	777	1,158	726
				(70)	(30)	(67)	(33)	(63)	(37)	(59)	(41)	(61)	(39)
		Muscle off	3,514	3,010	504	2,940	574	2,855	659	2,771	743	2,838	676
				(86)	(14)	(84)	(16)	(81)	(19)	(79)	(21)	(81)	(19)
		Adj. combined	5,398	4,304	1,094	4,135	1,263	3,969	1,429	3,805	1,593	3,930	1,468
				(80)	(20)	(77)	(23)	(74)	(26)	(70)	(30)	(73)	(27)
		As landed	5,398	4,338	1,060	4,197	1,201	4,035	1,363	3,878	1,520	3,996	1,042
				(80)	(20)	(78)	(22)	(75)	(25)	(72)	(28)	(74)	(26)

Table 5. Individual scallop meat weight frequency distributions (by weights) at four meat count levels for St. Pierre Bank fishery, 1982-86. Figures in parentheses are percentages (not adjusted for loss in yield associated with manual shucking, see Naidu 1985).

Year	No. of samples	Meat condition	N	Sample wt. (g)	Meat count/lb								Meat count/500g	
					30		35		40		45		45	
					≤15.1g	≥15.2g	≤12.9g	≥13.0g	≤11.4g	≥11.5g	≤10.1g	≥10.2g	≤11.1g	≥11.2g
1982	4	Muscle on	2,246	22,109.7	19,378.1 (88)	2,731.6 (12)	16,344.2 (74)	5,765.5 (26)	12,813.6 (58)	9,296.1 (42)	10,237.8 (46)	11,871.9 (54)	12,193.2 (55)	9,916.5 (45)
		Muscle off	2,232	20,492.4	17,175.1 (84)	3,317.3 (16)	16,019.1 (78)	4,473.3 (22)	14,087.6 (69)	6,404.8 (31)	11,498.2 (56)	8,994.2 (44)	13,579.7 (66)	6,912.7 (34)
		Adj. combined	4,231	41,855.7	35,124.5 (84)	6,731.2 (16)	30,456.0 (73)	11,399.7 (27)	25,050.3 (60)	16,805.4 (40)	20,080.6 (48)	21,775.1 (52)	23,751.7 (57)	18,104.0 (43)
		As landed	3,643	33,375.3	29,869.1 (89)	3,506.2 (11)	26,248.9 (79)	7,126.4 (21)	21,693.9 (65)	11,681.4 (35)	17,820.4 (53)	15,554.9 (47)	20,836.4 (62)	12,538.9 (38)
1983	5	Muscle on	1,877	20,537.9	15,133.6 (74)	5,404.3 (26)	12,114.1 (59)	8,423.8 (41)	9,487.7 (46)	11,050.2 (54)	7,028.3 (34)	13,509.6 (66)	8,785.3 (43)	11,752.6 (57)
		Muscle off	2,522	24,469.7	19,900.5 (81)	4,569.2 (19)	16,968.7 (69)	7,501.0 (31)	14,051.1 (57)	10,418.6 (43)	11,437.0 (47)	13,032.7 (53)	13,441.5 (55)	11,028.2 (45)
		Adj. combined	4,399	46,968.4	35,325.5 (75)	11,642.9 (25)	28,655.6 (61)	18,312.8 (39)	23,106.9 (49)	23,861.5 (51)	17,355.2 (37)	29,613.2 (63)	21,681.9 (46)	25,286.5 (54)
		As landed	4,399	45,007.6	35,034.1 (78)	9,973.5 (22)	29,082.8 (65)	15,924.8 (35)	23,538.8 (52)	21,468.8 (48)	18,465.3 (41)	26,542.3 (59)	22,225.8 (49)	22,780.8 (51)
1984	6	Muscle on	6,085	55,319.3	43,775.4 (79)	11,543.9 (21)	38,576.9 (70)	16,742.4 (30)	33,893.1 (61)	21,426.2 (39)	29,013.6 (52)	26,305.7 (48)	32,877.0 (59)	22,442.3 (41)
		Muscle off	3,283	30,714.5	21,735.7 (71)	8,978.8 (29)	18,625.4 (61)	12,089.1 (39)	16,312.2 (53)	14,402.3 (47)	14,560.9 (47)	16,153.6 (53)	15,938.9 (52)	14,775.6 (48)
		Adj. combined	9,368	88,858.4	65,616.4 (74)	23,242.0 (26)	57,189.7 (64)	31,668.7 (36)	50,399.1 (57)	38,459.3 (43)	43,042.5 (48)	45,815.9 (52)	48,851.8 (55)	40,006.6 (45)
		As landed	9,368	86,033.8	65,511.1 (76)	20,522.7 (24)	57,202.3 (66)	28,831.5 (34)	50,205.3 (58)	35,828.5 (42)	43,574.5 (51)	42,459.3 (49)	48,815.9 (57)	37,217.9 (43)

Table 5 (Cont'd.)

Year	No. of samples	Meat condition	N	Sample wt. (g)	Meat count/lb								Meat count/500g	
					30		35		40		45		45	
					≤15.1g	≥15.2g	≤12.9g	≥13.0g	≤11.4g	≥11.5g	≤10.1g	≥10.2g	≤11.1g	≥11.2g
1985	2	Muscle on	397	9,044.1	147.3 (2)	8,896.8 (98)	20.3 (-)	9,023.8 (100)	20.3 (-)	9,023.8 (100)	9.0 (-)	9,035.1 (100)	9.0 (-)	9,035.1 (100)
		Muscle off	958	20,457.3	648.2 (3)	19,809.1 (97)	236.8 (1)	20,220.5 (99)	42.8 (-)	20,414.5 (100)	9.6 (-)	20,447.7 (100)	20.4 (-)	20,436.9 (100)
		Adj. combined	1,355	31,096.1	560.8 (2)	30,535.3 (98)	167.1 (1)	30,929.0 (99)	30.6 (-)	31,065.5 (100)	9.0 (-)	31,087.1 (100)	19.3 (-)	31,076.8 (100)
		As landed	1,355	29,501.4	795.5 (3)	28,705.9 (97)	257.1 (1)	29,244.3 (99)	63.1 (-)	29,438.3 (100)	18.6 (-)	29,482.8 (100)	29.4 (-)	29,472.0 (100)
1986	4	Muscle on	1,884	25,275.2	10,725.1 (42)	14,550.1 (58)	9,733.9 (39)	15,541.3 (61)	8,793.0 (35)	16,482.2 (65)	8,000.1 (32)	17,275.1 (68)	8,544.0 (34)	16,731.2 (66)
		Muscle off	3,514	32,994.7	21,245.4 (64)	11,749.3 (36)	20,269.4 (61)	12,725.3 (39)	19,233.6 (58)	13,761.1 (42)	18,325.6 (56)	14,669.1 (44)	19,041.8 (58)	13,952.9 (42)
		Adj. combined	5,398	61,116.0	33,401.1 (55)	27,714.9 (45)	31,049.0 (51)	30,067.0 (49)	29,030.4 (48)	32,085.6 (52)	27,262.9 (45)	33,853.1 (55)	28,588.6 (47)	32,527.4 (53)
		As landed	5,398	58,269.9	31,970.5 (55)	26,299.4 (45)	30,003.3 (51)	28,266.6 (49)	28,026.6 (48)	30,243.3 (52)	26,325.7 (45)	31,944.2 (55)	27,585.8 (47)	30,684.1 (53)

Table 6. Commercial meat counts for St. Pierre Bank, 1982-86. Sampled weights are adjusted upward to include portions of adductor muscles not recovered during commercial shucking (Naidu 1985).

Year	Sample wt. (g)	No. meats in sample	Meat wt. (g)		Meat count/ 500 g	
			Commercial	Anatomical	Commercial	Anatomical
1982	33,375.3	3643	9.2	10.2	54.6	49.2
1983	45,007.6	4399	10.2	11.4	48.9	44.0
1984	86,033.8	9368	9.2	10.2	54.4	49.1
1985	29,501.4	1355	21.8	24.2	23.0	20.7
1986	58,269.9	5398	10.8	12.0	46.3	41.7
1987	(SEE TABLE 7)					

Table 7. Meat counts/500 g for St. Pierre Bank (research vessel data, March 1987). Commercial weights are adjusted downward to allow for loss in yield resulting from manual shucking (Naidu 1985).

Set	% 100 mm	Total no. meats	Aggregate meat weight (g)	Meat wt. (g)		Meat count/ 500 g	
				Commercial	Anatomical	Commercial	Anatomical
18	27	119	1931.8	14.5	16.2	34.6	30.8
6	0	329	2924.3	7.9	8.9	63.2	56.2
22	2	408	2337.1	5.1	5.7	98.0	87.3
8	2	272	2563.2	8.4	9.4	59.6	53.1
Totals		1128	9756.4	7.7	8.7	64.9	57.8

Table 8. Summary of port-sampled scallop numbers below minimum critical weight (15.1 g) and corresponding weight contributions for St. Pierre Bank, 1982-86.

Year	Numbers (%) below minimum critical weight	Corresponding contribution to weight
1982	96	89
1983	89	78
1984	90	76
1985	4	3
1986	80	55

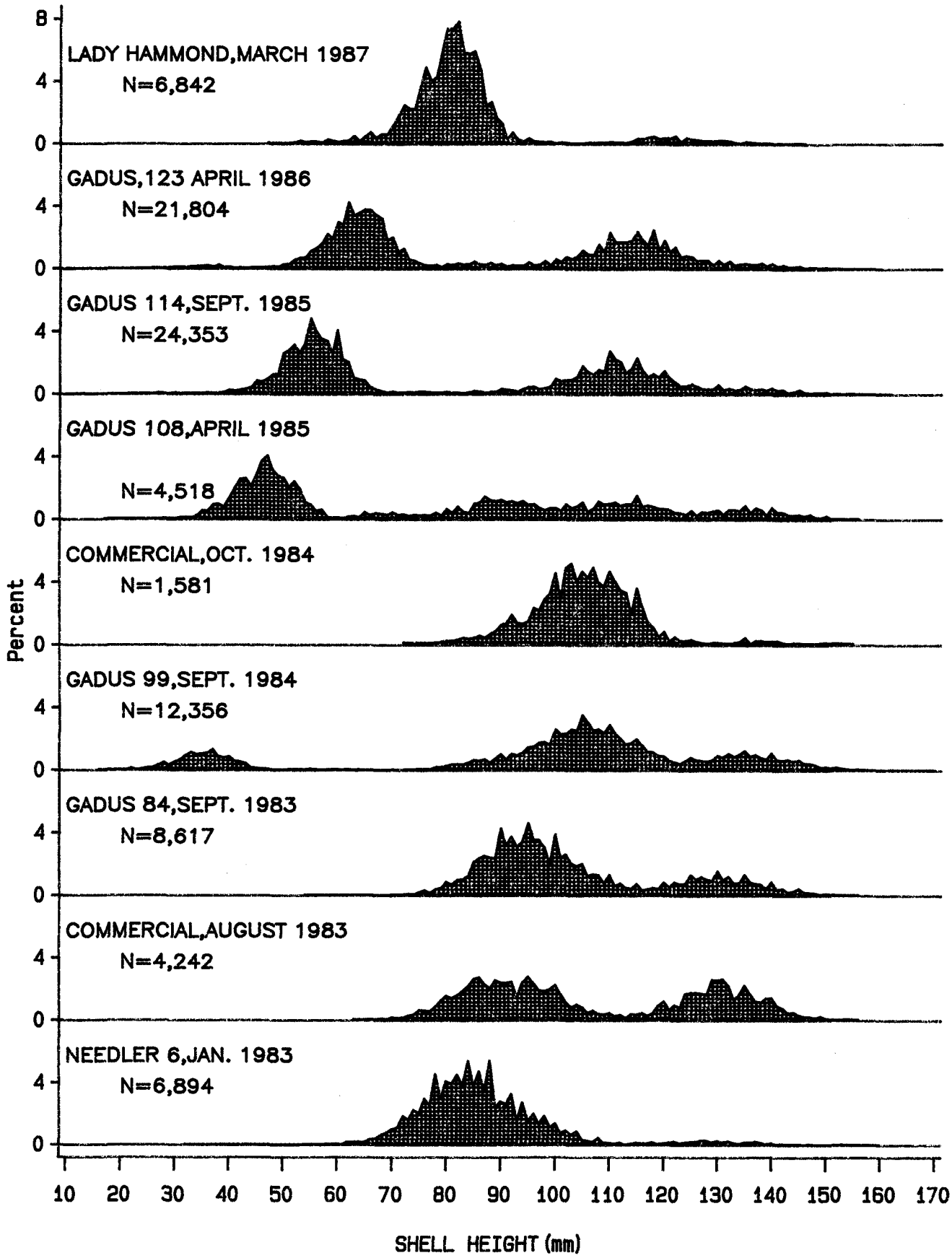

Fig. 1. Sea scallop shell-height distributions on St. Pierre Bank (1982-87).

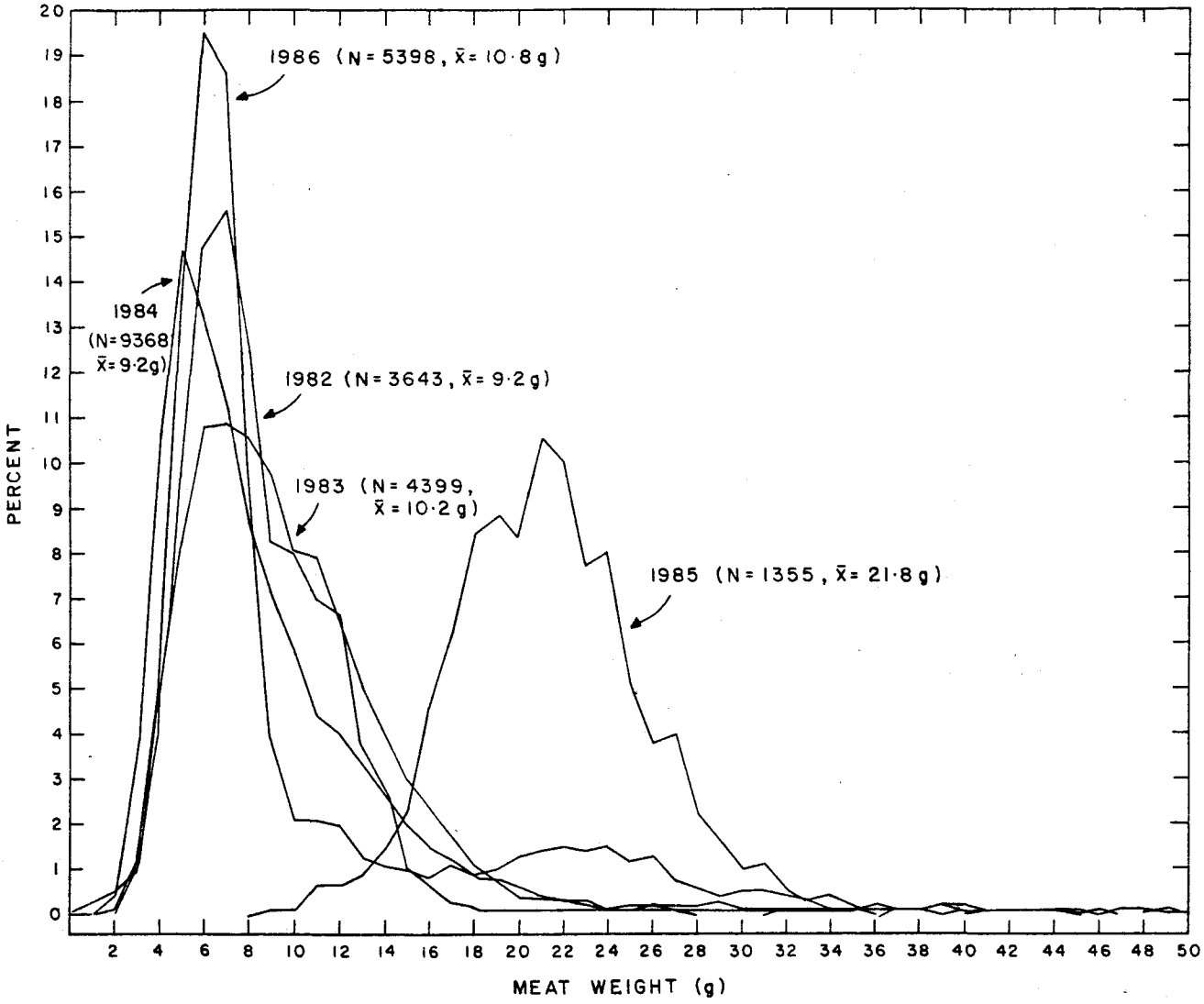

Fig. 2. Meat weight (as landed, g) frequencies for scallop landings from St. Pierre Bank, 1982-86.

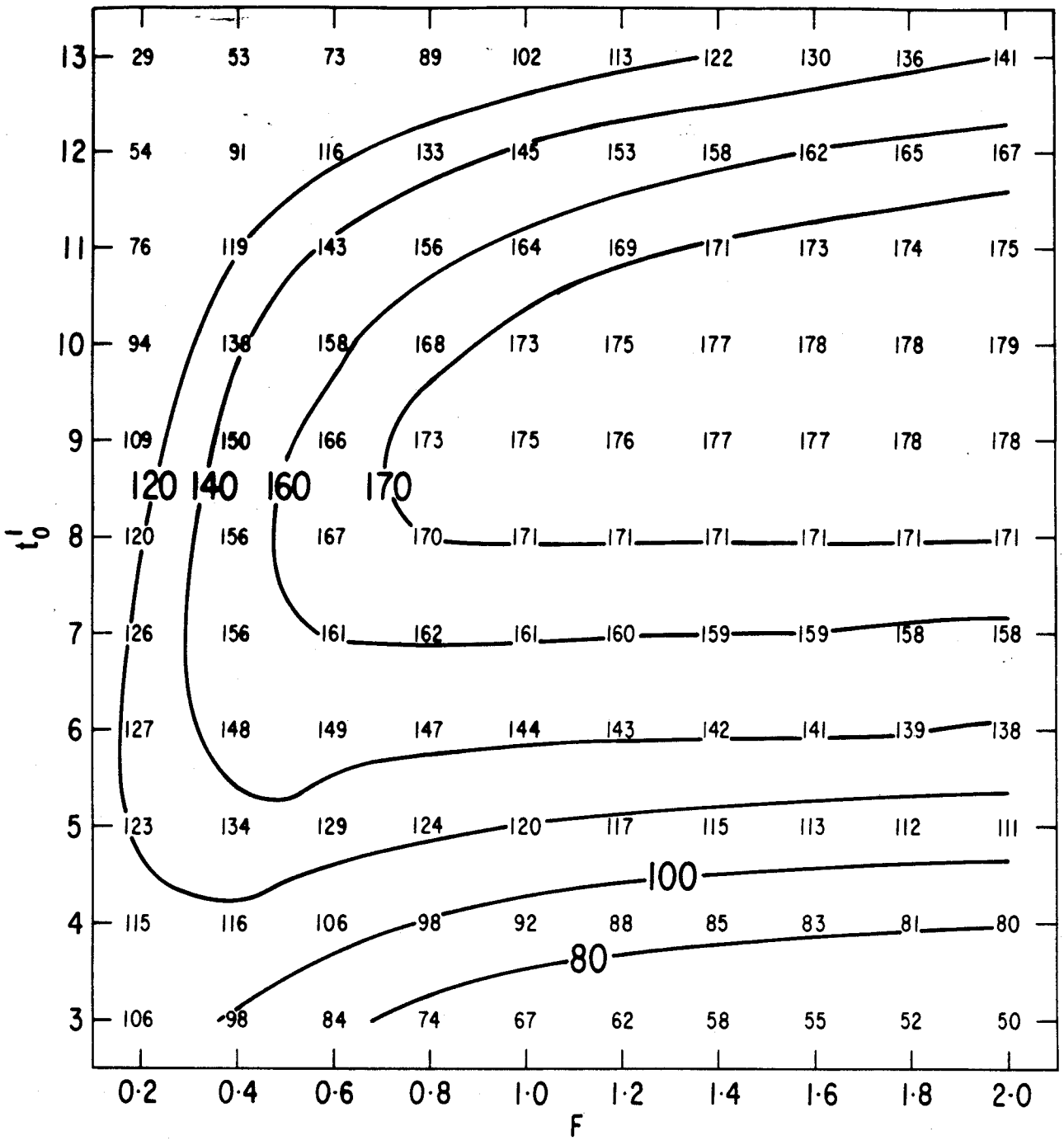

Fig. 3. Yields and yield isopleths (kg/100,000 recruits) for sea scallops from St. Pierre Bank. t_0' = age (year) of first capture, F = fishing mortality.