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Management Concerns for Atlantic halibut (Hippoglossus  
hippoglossus) in the Canadian North Atlantic

John D. Neilson  
Marine Fish Division  
Department of Fisheries and Oceans  
Biological Station  
St. Andrews, New Brunswick E0G 2X0  
Canada

W. R. Bowering  
Fisheries Research Branch  
Department of Fisheries and Oceans  
P.O. Box 5667  
St. John's, Newfoundland A1C 5X1

A. Fréchet  
Direction des Sciences Biologiques Maurice Lamontagne  
Pêches et Océans  
850 Route de la mer  
CP 1000  
Mont-Joli, Québec G5H 3Z4

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## ABSTRACT

Three questions related to the management of Atlantic halibut (Hippoglossus hippoglossus) are addressed:

1. On a biological basis, what should be the management unit(s) for Atlantic halibut on the Atlantic coast?
2. Can TAC advice be provided for these management units for the 1988 fishing season?
3. What is the biological impact of the different gear used in the halibut fishery ("circle" hooks, regular hooks and otter trawls)?

Largely on the basis of tagging information, it was concluded that Atlantic halibut on the Scotian Shelf and southern Newfoundland region (4VWX, 3Ps and 3NO) should be treated as a single management unit, with the Gulf of St. Lawrence (4RST) considered to be a second discrete management unit. Based on recent catch levels, precautionary TACs of 3200 and 300 t were recommended for the Scotian Shelf/southern Newfoundland and Gulf of St. Lawrence management units, respectively. Insufficient data were available to address the third question.

## RÉSUMÉ

Dans le présent article, on tente de répondre à trois questions concernant la gestion du flétan de l'Atlantique (Hippoglossus hippoglossus):

1. Du point de vue biologique, quelle devrait être l'unité de gestion (ou les unités de gestion) pour le flétan de l'Atlantique sur la côte de l'Atlantique?
2. Peut-on recommander un TPA pour ces unités de gestion pour la saison de pêche 1988?
3. Quelles sont les répercussions biologiques des différents engins utilisés pour la pêche au flétan (hameçon circulaire, hameçon ordinaire et chalut à panneaux)?

On a conclu, surtout à partir des informations provenant du marquage, que le plateau Scotian et le sud de la région de Terre-Neuve (4VWX, 3Ps et 3NO) devraient être traités comme une seule et même unité de gestion dans le cas du flétan de l'Atlantique, tandis que le golfe du Saint-Laurent (4RST) devrait être considéré comme une deuxième unité de gestion, distincte de la première. À partir des prises récentes, des TPA respectifs de 3200 et 300 t ont été recommandés pour l'unité de gestion du plateau Scotian/sud de Terre-Neuve et l'unité de gestion du golfe du Saint-Laurent. Enfin, les données dont on dispose à l'heure actuelle sont insuffisantes pour permettre de résoudre la troisième question.

## INTRODUCTION

Atlantic halibut (Hippoglossus hippoglossus) is the most highly valued (per unit of weight) groundfish species occurring on the Atlantic coast and, as such, has attracted considerable attention from both fishermen and researchers. However, the small landings in terms of weight compared with other groundfish species and the difficulties associated with obtaining commercial fishery samples has meant that there has been serious deficiencies in our understanding of the biology of this exploited species. Recent increases in both catch and value have prompted AGAC (Atlantic Groundfish Advisory Committee) to form an Atlantic halibut working group. The working group has referred three questions to CAFSAC for consideration:

1. What should, on a biological basis, be the management unit(s) for Atlantic halibut on the Atlantic coast?

2. Can CAFSAC advise on TAC for these management units for the 1988 fishing season?

3. What is the biological impact of the different gear used in the halibut fishery ("circle" hooks, regular hooks and otter trawls)?

Prior to a discussion of these questions, we felt it was appropriate to provide the most up-to-date statistics on nominal landings, aggregated by geographic area and gear type. Figure 1 shows trends in Atlantic halibut landings for NAFO divisions 4VWX (Scotian Shelf), 4RST (Gulf and St. Lawrence), 3P, 3NO (Grand Bank), and Subarea 2 + 3KL (northern Newfoundland and Labrador). These division groupings reflect the aggregations used by Bowering (1986). While 4VWX landings have declined over the past 2 yr (the 1984 value was the highest in the series), landings from the other regions have remained stable or increased. The catch for the region contributing the most to total Atlantic halibut landings, 4VWX, is further disaggregated in Table 1, which indicates that 4X historically contributes the largest fraction of halibut landings on the Scotian Shelf. The most recent (1986) Shelf landings have decreased since 1985. The catch by gear type for NAFO divisions 4RST, 4VWX, 3P, 3NO, and Subarea 2 + 3KL are provided in Tables 2-6, respectively. While longline gear is responsible for the bulk of Scotian Shelf and Gulf landings, trawl catches comprise almost as large a fraction of landings as do longline catches off Newfoundland. In the most northerly region, Subarea 2 + 3KL, the trawl catch is larger than the longline component.

### Question 1 - Stock Structure

No study of Northwest Atlantic halibut stock identification is yet available. However, the most complete data available that are relevant to a discussion of stock structure are the returns of tags from Canadian marking programs of Atlantic halibut. Stobo et al. (1987), in a review of Atlantic halibut tagging results, showed that halibut move extensively throughout much of the Canadian North Atlantic. Their conclusion was based on examination of 285 recaptures from releases of 1296 fish made on the Scotian Shelf and Grand Bank from 1958-73. Their view is consistent with Bowering's

(1986) conclusion and refutes the results of earlier marking studies (Martin and McCracken 1950; McCracken and Martin 1955; McCracken 1958; Wise and Jensen 1959; Jensen and Wise 1961; Kohler 1964) who indicated that the movements of halibut were generally limited, with most fish recaptured in the vicinity of the release sites. However, the movement of adult fish released on the Scotian Shelf and recaptured on the Grand Bank reported by Stobo et al. (1987) is consistent with the results of Jensen and Wise (1961), where recaptures from tagging done on Browns Bank showed considerable movement to the northeast, with four recaptures from the Grand Bank, one from Banquereau Bank and four from Sable Island area. The results of Stobo et al. (1987) indicated that the tendency of Atlantic halibut to move to the northeast is strongest in fish originating in the Sable Island Gully area, with fish originating further to the southwest showing less of a propensity to move in that direction. That observation appears consistent with McCracken's (1958) contention that halibut caught off southwest Nova Scotia originate from that area rather than to the east. However, even in the case of studies further to the south, such as those of Wise and Jensen (1959) and Jensen and Wise (1961), some recaptures were made to the northeast. For more detailed information on Canadian Atlantic halibut tagging studies, see Stobo et al. (1987).

Some other data are available which could assist in the determination of appropriate management units. We compared length-weight relationships from fish caught during research surveys of the Scotian Shelf to similar data for the southern Newfoundland region and the Gulf of St. Lawrence, also obtained from research surveys (Fig. 2). The regression described by Bowering (1986),  $\text{weight} = 0.0000086(\text{length})^{3.0755}$ , seemed to fit data from the Scotian Shelf equally well. However, in the case of Gulf of St. Lawrence fish, the largest fish diverged somewhat from the predicted fit. We also compared age-length relationships for male and female halibut from the Scotian Shelf and the southern Grand Banks. The equations produced by Bowering (1986) appeared to fit the Scotian Shelf data somewhat less well than was the case for the length-weight comparisons, with Scotian Shelf fish generally larger at a given age (Fig. 3). However, such differences may be attributable to variations in techniques for age determination, as different persons were involved, or to differences in survey timing (the Newfoundland data were from the spring, and the Scotian Shelf data were obtained during surveys conducted in the summer).

Bowering (1986) also compared growth rates for halibut caught during research surveys in the Newfoundland-Labrador region to those reported for the Scotian Shelf and the Gulf of St. Lawrence by McCracken (1958) and concluded that no differences were present (although such differences were not examined statistically). However, McCracken found differences in size composition (both in experimental catches and commercial landings), size at age (males only), length-weight and spawning time in Scotian Shelf population vs Gulf of St. Lawrence populations.

Commercial fishery length-frequency data from the Gulf of St. Lawrence, Newfoundland and the Scotian Shelf are presented in Fig. 4. For the Gulf of St. Lawrence, most of the commercial catch was less than 75 cm (all gears combined). A similar distribution was observed for the research length-frequency data from 1983-87 (Fig. 5). In the Newfoundland area, the samples from commercial otter trawl catches contained few fish less than 75 cm.

Survey results in Bowering (1986) showed a somewhat similar distribution although there were more smaller fish in the surveys. However, length compositions from the commercial otter trawlers on the Scotian Shelf during 1980-86 (Fig. 4) as well as research surveys from 1970-86 (Fig. 5), appear to be more similar to those of the Gulf of St. Lawrence. Although many of these length frequencies are the result of combining several years of data, the difference observed between the Scotian Shelf and the Newfoundland area are consistent with results of tagging studies presented in Stobo et al. (1987), where the size composition of the released fish on the Grand Bank was larger on the average than those of the Scotian Shelf.

In summary, the available data indicate that a separate stock occurs in the Gulf of St. Lawrence. However, evidence of stock discreteness is lacking for fish originating in the southern Newfoundland and Scotian Shelf areas. In the latter instance, the intermixing of the Newfoundland-Labrador and Scotian Shelf fish may be sufficient to necessitate joint management measures in the Scotia-Fundy and Newfoundland DFO regions. We conclude, largely on the basis of the tagging information, that Atlantic halibut on the Scotian Shelf and Newfoundland region should be treated as a single management unit.

#### Question 2 - TAC

Commercial sampling for Atlantic halibut in all regions has been inadequate. This situation is largely a result of the sporadic nature of the landings and the fact that fish are often landed with heads removed. Collection of data from the Observer Programs has also been intermittent and incomplete in coverage, as most of the landings are made by longliners, and observers are most often deployed on trawlers. However, in view of the increasing significance of the fishery, special attention will be given to increasing the numbers of biological samples obtained from the fishery. Within Scotia-Fundy region, plans are underway to place technicians aboard longliners to obtain samples while the vessels are at sea.

A CPUE series for 4VWX halibut fishery was prepared by Perley et al. (MS 1984) and updated for the purpose of this paper (Fig. 6, Table 7). The catch of halibut taken as main species caught (so-called "directed" catch) by longliners of all tonnage classes has increased substantially since 1982. However, the CPUE index has declined since 1981, despite the introduction of the circle hook, which increases the catchability of halibut to longline gear (see the section on biological impact of different gear next). Such a decline may be indicative of a declining stock.

Based largely on recent catch levels, a precautionary TAC of 3200 t for the 4VWX, 3Ps and 3NO, and 300 t for 4RST management units, is appropriate. In reaching this conclusion, we stress that the suggested TAC reflects neither  $F_{0.1}$  nor  $2/3EMSY$  levels, as those values are presently unknown. Further concerns which prompted us to recommend precautionary TAC's were the increased catching power of the recently introduced circle hooks compared with J hooks and the high value of halibut. We also noted the declining catch rates of halibut longliners and the fact that the fleet now mainly uses circle hooks, which should cause an increase in CPUE. A long time series of halibut landings was not employed to evaluate the level

of the precautionary TAC, as there were indications that reported landings in the 1960's and earlier contained a significant proportion of Greenland halibut identified generically as halibut.

### Question 3 - Biological impact of different gear

Until as recently as 3 or 4 yr ago, the traditional J-shaped hook was used by longliners. However, the popularity of the J-hook was supplanted by the newer circle hook to the extent that most halibut fishermen are now using the new design. The circle hook has the point offset and turned towards the shank, so that the probability of encircling a hard part of the fish's mouth is increased. An excerpt of a letter from Mr. Klaus Kjelstrup (President, O. Mustad & Son (USA)) to Mr. D. Robinson (Vice President, Corporate Development, Clearwater Fine Foods), dated April 9, 1987, describes the transition of popularity of the hook types: "The change to circle hooks for halibut fishing started in the Pacific about four years ago, where it caught on very quickly. On the Atlantic side, the change was a little slower and I would say right until three years ago, the old style J hook, Pattern No. 9401, size 12/0, was the dominant hook for halibut fishing in the Canadian Maritimes. Two years ago the ratio was very different when as far as we know more than 50% of halibut fishing had changed to circle hooks, Pattern No. 39965, size 16/0. Last year and certainly in 1987, close to 100% of halibut fishing must be done with circle hooks since our sales of the old style J hook is dried up completely in this market area."

In a recent study by the Fisheries Development Branch (Peeling and Rodgers 1984), a comparative study of the two hooks was made. The results are summarized below:

	<u>J hooks</u>	<u>Circle hooks</u>
Number of hook counted	3706	3706
Number of sets made	31	31
Number of days fished	8	8
Number of fish caught:		
Halibut	70	128
Cusk	186	180
Hake	116	421
Cod	26	19
Other	52	46
Totals	<u>450</u>	<u>794</u>

A similar investigation was conducted off Anticosti Island (Cliche 1986), which indicated that at all the stations fished, 21 halibut were caught on 19,552 J hooks whereas 48 halibut were taken on 19,968 circle hooks.

In addition to the increased catching power of the circle hook, fishermen also note that the quality of the landed fish was higher, as they feel no need to gaff fish (at least those under 20 kg) as they were hauled aboard, a necessity with the older design of hook.

The lack of commercial samples for this species mitigates against us being able to say much about the biological impact of the different gear types. However, some sampling of trawl fisheries was carried out by Observer programs in both Newfoundland and Scotia-Fundy regions. The length-frequency data from such samples is summarized in Fig. 4, along with the length of 50% maturity, when such a value is known. It appears that trawl fisheries take a significant proportion of immature fish. As previously noted, the average length of Scotian Shelf fish also appears to be considerably smaller than fish caught further north. This observation is born out by examination of the length-frequency composition of halibut caught during MFD trawl surveys (Fig. 5), with the modal length around 50 cm.

Unfortunately, we have little information on the size frequency of fish caught by longliners. However, one southwest Nova Scotia processor kindly allowed us to examine their records of amounts of halibut caught in various market categories. The vessels supplying the plant were two large longliners, generally operating in the southern Grand Banks area. As may be seen in Fig. 7, very few fish under 12 lb (gutted weight) are landed by these vessels, with the largest component of their catch falling into the 12-50 lb category. It seems likely that average size of fish caught by longliners was greater than those caught by trawlers, although the comparison can only be qualitative given the different types of data involved. If this is the case, longline catches are comprised of fewer immature animals. Better commercial sampling is required to substantiate this impression.

The Marine Fish Division (Scotia-Fundy) successfully conducted a research cruise in June of 1987 to specifically examine the question of whether small fish caught in either trawl or longline gear survive, in response to calls from industry for a minimum size limit. The results of this experiment will be available shortly. A survival rate will be calculated and incorporated into a modified Beverton and Holt yield analysis (the so-called Myrhe analysis used in support of a minimum size limit for Pacific halibut), hence providing an estimate of changes in fishery yield with a minimum size imposed.

#### ACKNOWLEDGMENTS

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Table 1. Total Atlantic halibut catch (t) for NAFO Division 4VWX for 1963-86.

Year	4V	4W	4X	Total	Canadian catch	Foreign catch
1963	214	479	840	1533	1453 (90) <sup>c</sup>	80 (10)
1964	332	358	861	1551	1461 (94)	90 (6)
1965	486	458	665	1609	1574 (98)	35 (2)
1966	532	313	331	1176	1030 (88)	146 (12)
1967	380	322	546	1248	1236 (99)	12 (1)
1968	250	363	604	1217	1175 (97)	42 (3)
1969	192	431	441	1064	1024 (96)	40 (4)
1970	115	349	366	830	818 (99)	12 (1)
1971	231	360	414	1005	946 (94)	59 (6)
1972	178	216	456	850	825 (97)	25 (3)
1973	147	226	401	774	765 (99)	9 (1)
1974	124	127	404	655	641 (98)	14 (2)
1975	114	159	376	649	638 (98)	11 (2)
1976	144	148	422	714	708 (99)	6 (1)
1977	88	177	448	713	705 (99)	8 (1)
1978	244	283	565	1092	1082 (99)	10 (1)
1979	230	358	636	1224	1224 (100)	-
1980	339	371	748	1458	1454 (100)	4 (0)
1981	250	379	766	1395	1389 (100)	6 (0)
1982	342	476	907	1725	1720 (100)	5 (0)
1983	419	546	864	1829	1828 (100)	1 (0)
1984 <sup>a</sup>	496	572	924	1992	1992 (100)	- (0)
1985 <sup>a</sup>	582	620	741	1943	1943	
1986 <sup>b</sup>	536	572	500	1608	1608	

<sup>a</sup>All countries except USA.

<sup>b</sup>Provisional (Maritime catches only).

<sup>c</sup>Percentage of total catch.

Table 2. Nominal catch (t) of Atlantic halibut by gear in NAFO Division 4RST by all countries, 1970-86.\*

Year	Side otter trawl	Stern otter trawl	Longline	Other	Total
1970	104	24	151	211	490
1971	93	10	172	164	439
1977	45	48	14	35	142
1978	22	36	15	62	135
1979	20	21	19	72	132
1980	31	80	11	80	202
1981	10	5	16	63	94
1982	23	18	16	33	90
1983	30	16	90	34	170
1984	18	82	51	25	176
1985	15	8	95	45	163
1986	15	18	147	93	273

\*1972-76 data were unavailable. 1986 data are preliminary

Table 3. Nominal catch (t) of Atlantic halibut by gear in NAFO Division 4VWX for all countries, 1972-86.

Year	Side otter trawl	Stern otter trawl	Longline	Danish and Scottish seine	Other <sup>a</sup>	Total
1972	60	89	639	1	61	850
1973	45	60	658	3	8	774
1974	12	54	555	1	33	655
1975	42	84	514	3	6	649
1976	74	79	544	1	16	714
1977	40	129	492	1	51	713
1978	56	265	689	5	77	1092
1979	70	219	824	5	106	1223
1980	81	312	1021	2	42	1458
1981	42	268	1049	2	34	1395
1982	61	270	1371	0	23	1725
1983	24	245	1471	0	89	1829
1984 <sup>a</sup>	1	181	1743	0	67	1992
1985 <sup>b</sup>	-	186	1707	5	45	1943
1986 <sup>b</sup>	3	143	1426	0	36	1608

<sup>a</sup>Includes NK and MISC gears.

<sup>b</sup>All countries except USA.

<sup>c</sup>Provisional (Maritime catches only).

Table 4. Nominal catch (t) of Atlantic halibut by gear in NAFO Division 3P.

Year	Side	Stern	LL	Others*	Total
1970	115	174	31		320
1971	31	62	69	33	195
1972	35	26	111		172
1973	47	85	59	2	193
1974	34	124	68	9	235
1975	34	91	46		171
1976	26	51	58		135
1977	64	308	30	1	403
1978	44	92	36	8	180
1979	40	116	23		179
1980	24	98	37		159
1981	18	102	35		155
1982	57	73	59		189
1983	20	41	80	37	178
1984 <sup>a</sup>	6	117	152	73	348
1985 <sup>a</sup>	-	170	160	87	417
1986 <sup>b</sup>	9	145	271	5	430

<sup>a</sup>All countries except U.S.A.

<sup>b</sup>Provisional (Maritimes only).

\*Includes NK and misc. gears.

Table 5. Nominal catch (t) of Atlantic halibut by gear in NAFO Division 3NO.

Year	Side	Stern	LL	Others*	Total
1970	72	81	226		379
1971	62	89	236	18	405
1972	24	234	100		358
1973	12	143	152		307
1974	1	156	90	40	287
1975		135	113	14	262
1976	8	156	94		258
1977	30	110	61	13	214
1978	26	99	46	9	180
1979	69	145	42	6	262
1980	25	74	45	6	150
1981	10	54	31	11	106
1982	25	271	24	31	351
1983		80	74	136	290
1984 <sup>a</sup>	1	199	485	57	742
1985 <sup>a</sup>		404	493	118	1015
1986 <sup>b</sup>		461	603	2	1066

<sup>a</sup>All countries except U.S.A.

<sup>b</sup>Provisional (Maritimes & Nfld.)

\*Includes NK and misc. gears.

Table 6. Nominal catch (t) of Atlantic halibut by gear in NAFO Division 2GHJ and 3KL.

Year	Side	Stern	LL	Others*	Total
1970	3	44		16	63
1971	4	44		16	64
1972	3	76		30	109
1973	3	176		26	205
1974	1	225	9	24	259
1975	1	89		32	122
1976	1	136		25	162
1977	-	85		62	147
1978	1	44		18	63
1979	-	60	3	35	98
1980	1	91	7	59	158
1981	4	64	6	39	113
1982		113	2	35	150
1983		100	6	13	119
1984		111	3	43	157
1985 <sup>a</sup>		50			50
1986 <sup>b</sup>		126	27	25	178

<sup>a</sup>All countries except U.S.A.

<sup>b</sup>Provisional (Maritimes & Nfld.)

\*Includes NK and misc. gears.

Table 7. Atlantic halibut CPUE (4VWX only). Only data from "directed" trips were used, all Tonnage Classes.

Year	Catch	Effort (1000's hooks)	CPUE
1968	223	3842	.058
1969	142	2129	.067
1970	131	2374	.055
1971	146	2277	.064
1972	199	3099	.064
1973	212	3653	.058
1974	172	3198	.054
1975	111	2082	.053
1976	110	1848	.060
1977	82	1477	.056
1978	68	1127	.060
1979	179	1991	.088
1980	176	2004	.092
1981	115	1253	.078
1982	220	2820	.075
1983	606	8040	.077
1984	800	11985	.067
1985	785	10252	.077
1986	691	11094	.062

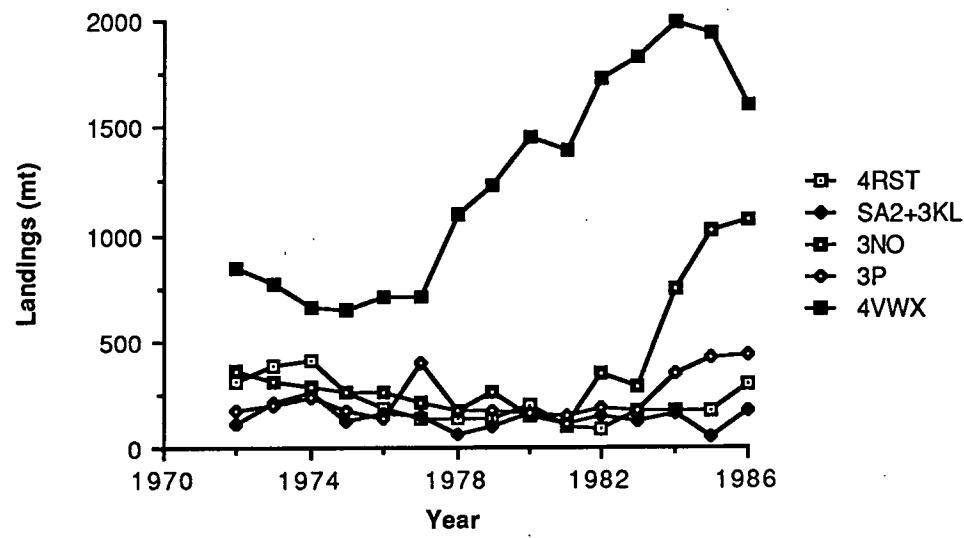


Figure 1. Landings of Atlantic halibut caught in various NAFO statistical areas. Groupings of areas reflect those employed in Bowering (1986).



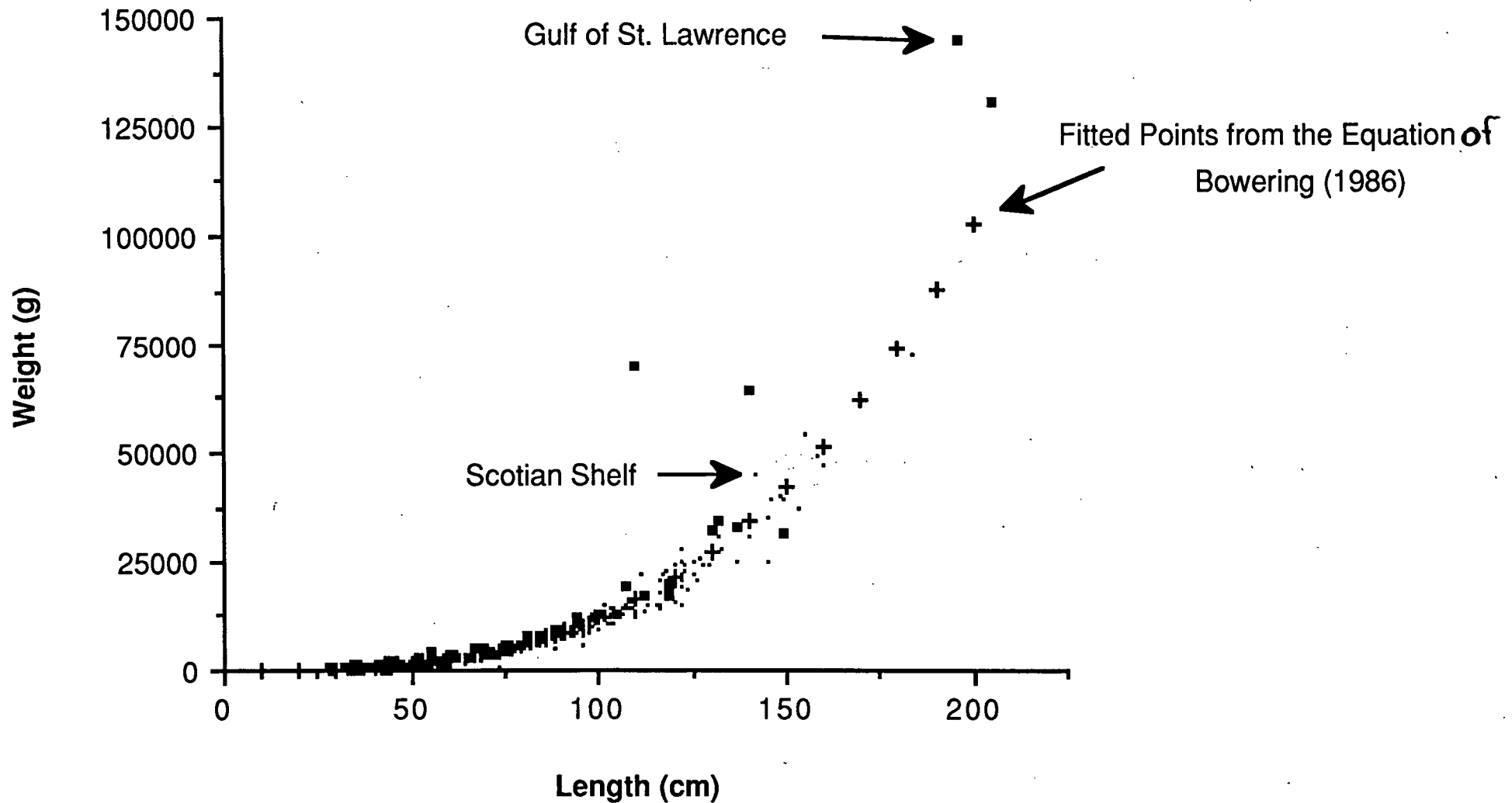


Figure 2. Scotian Shelf (n = 2051) and Quebec (n = 96) halibut weight (round) - length data, superimposed on length-weight equation of Bowering (1986) for southern Newfoundland. Data were obtained from research vessel surveys (Scotian Shelf, 1980-1985; Quebec, 1983-1987; and Newfoundland, 1972-1984).

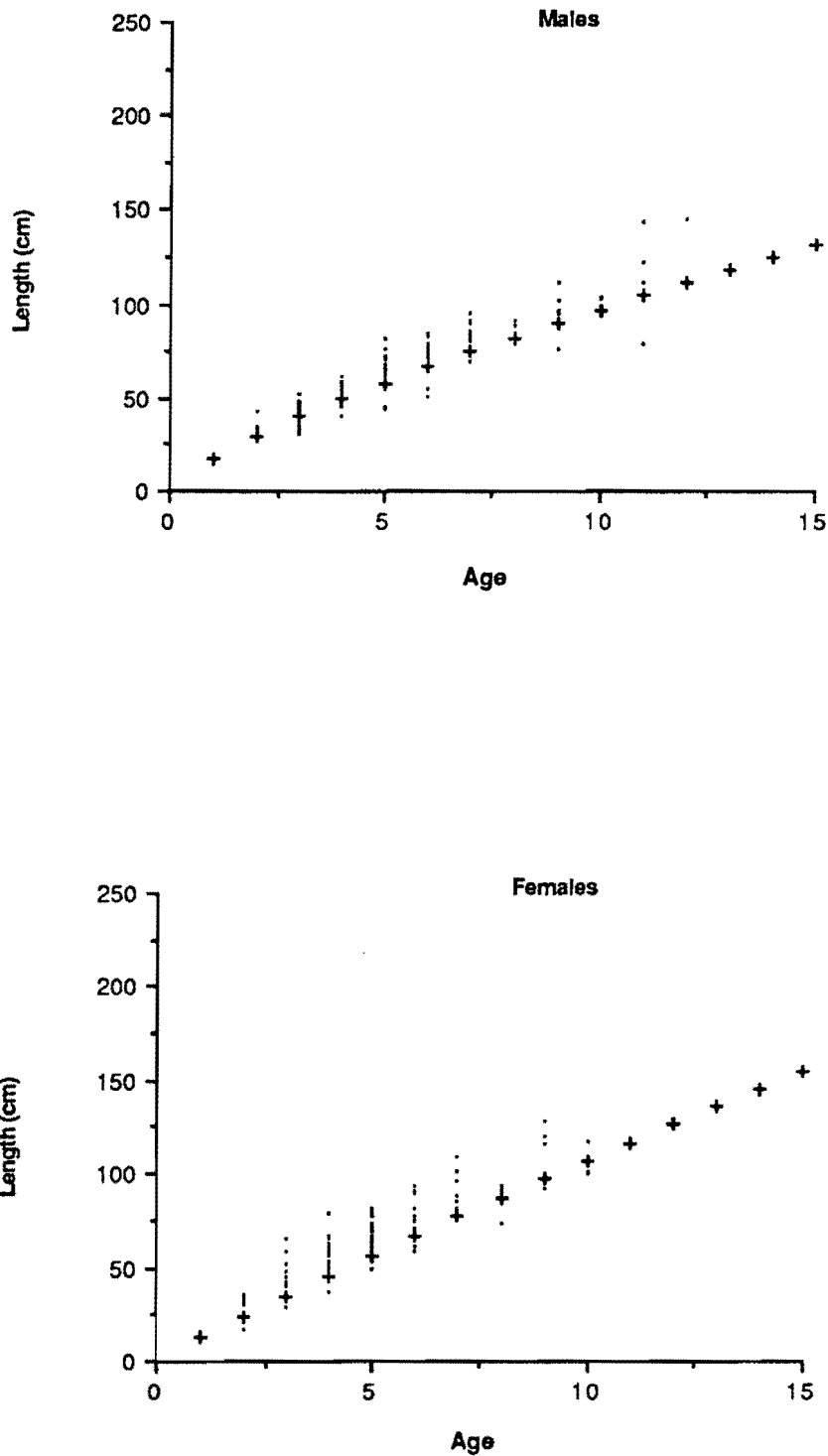


Figure 3. Scotian Shelf Atlantic halibut age-length data superimposed on southern Newfoundland age-length regressions (+) from Bowering (1986). Scotian Shelf n was 112 and 108 for males and females, respectively.

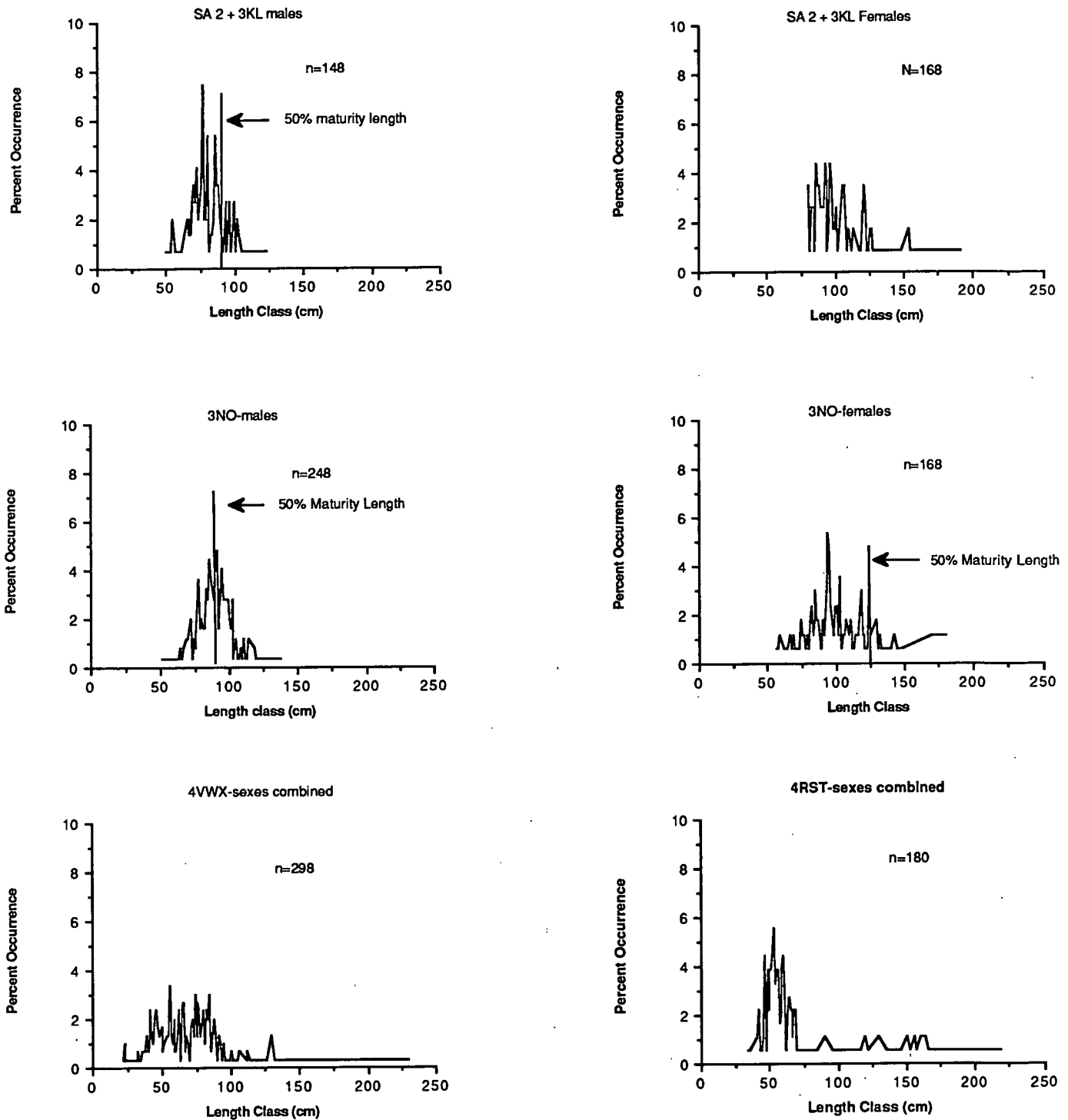


Figure 4. Length frequency composition of Atlantic halibut caught by commercial trawlers in SA2 + 3KL, 3NO, 4VWX and 4RST. Insufficient 3P data were available. Newfoundland and Quebec (4RST) are 1986 only, and Scotian Shelf are 1980-1986 combined. Source is Observer Program data.

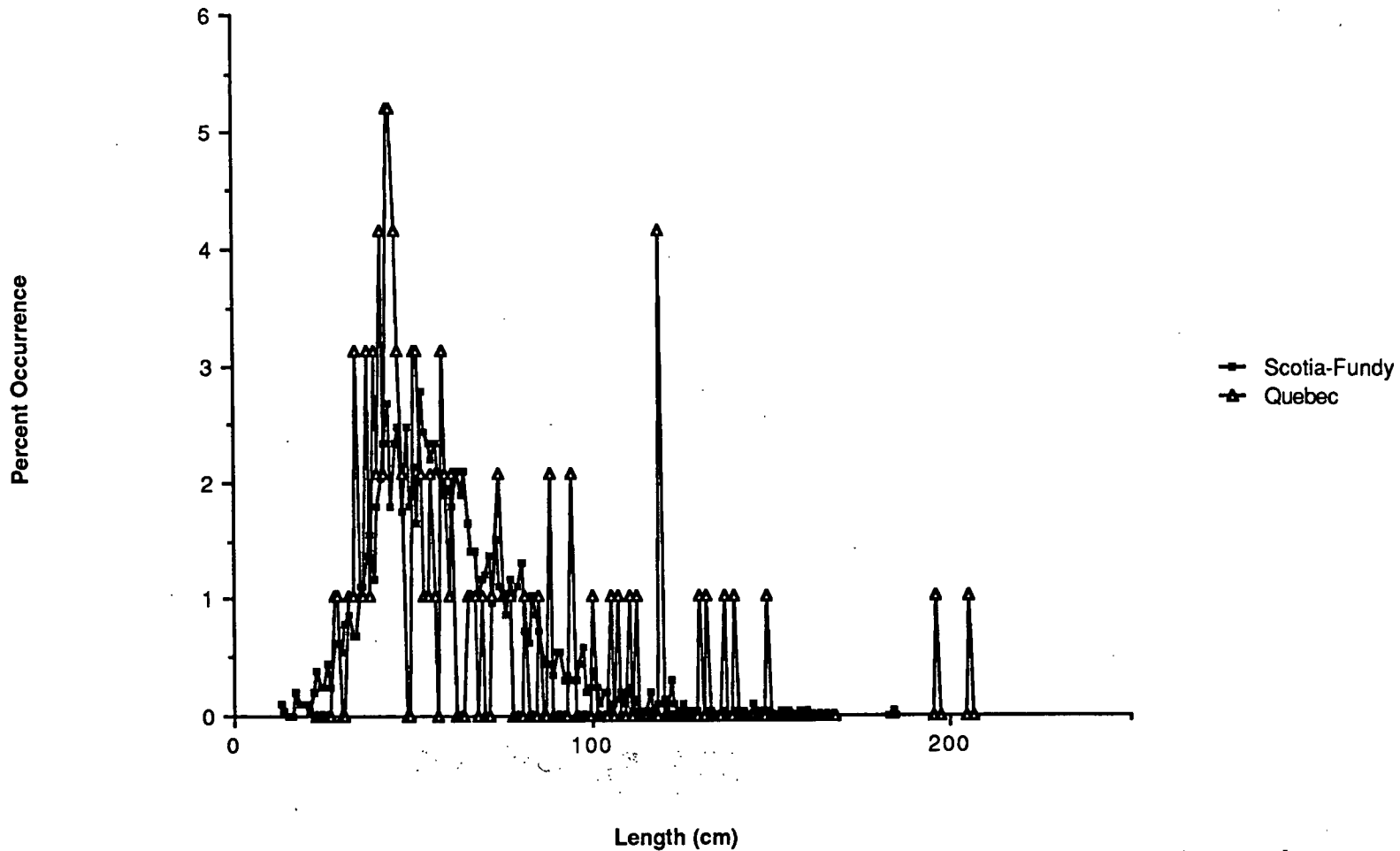


Figure 5. Length-frequency composition of Atlantic halibut caught during research vessel surveys in the Gulf of St. Lawrence (Quebec, 1983-1987) and the Scotian Shelf (Scotia-Fundy, 1980-1985). N is 2051 and 180 for Scotia-Fundy and Quebec, respectively.

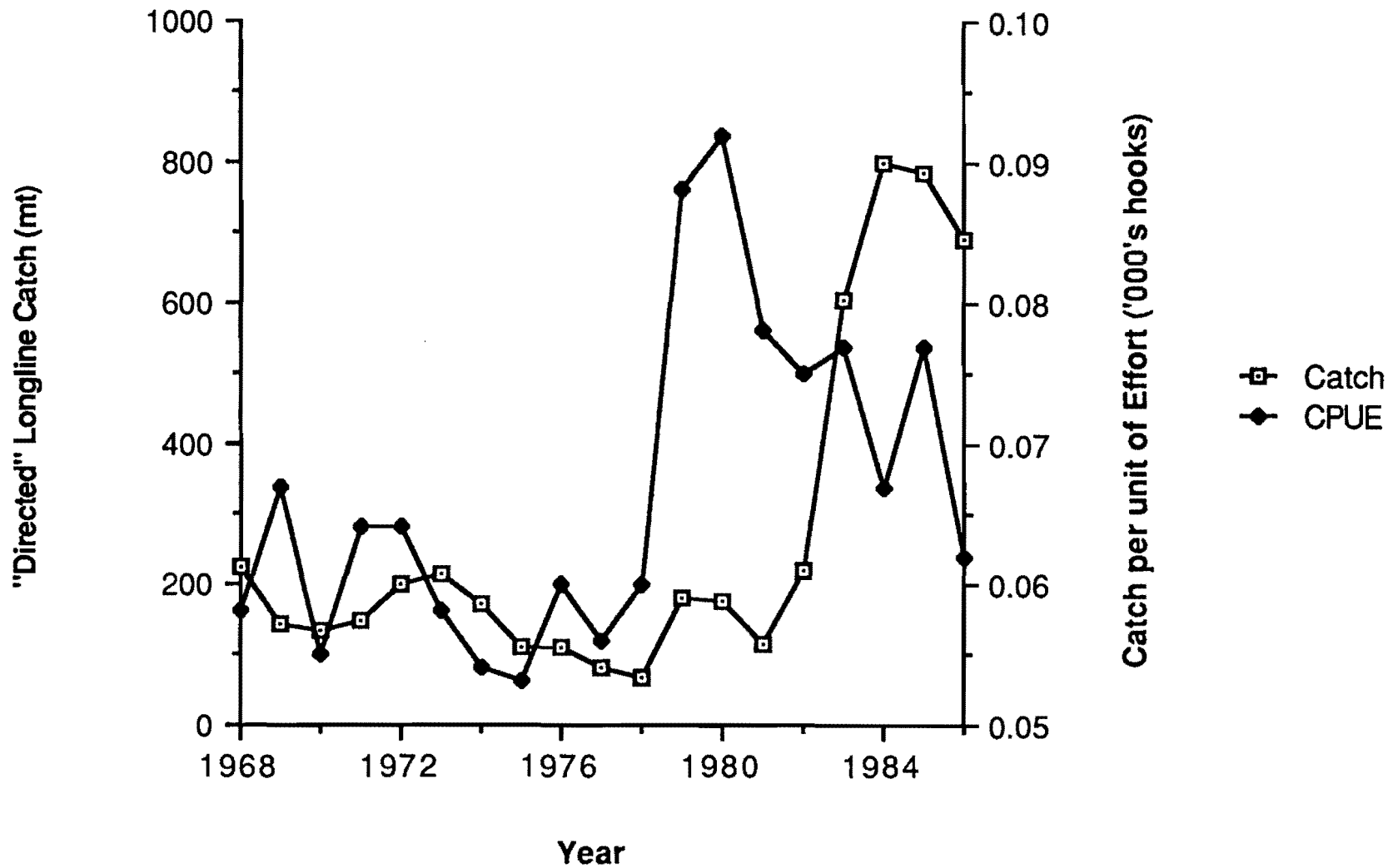


Figure 6. Scotian Shelf longline CPUE for Atlantic halibut ("directed" trips only, all tonnage classes) and directed catch.

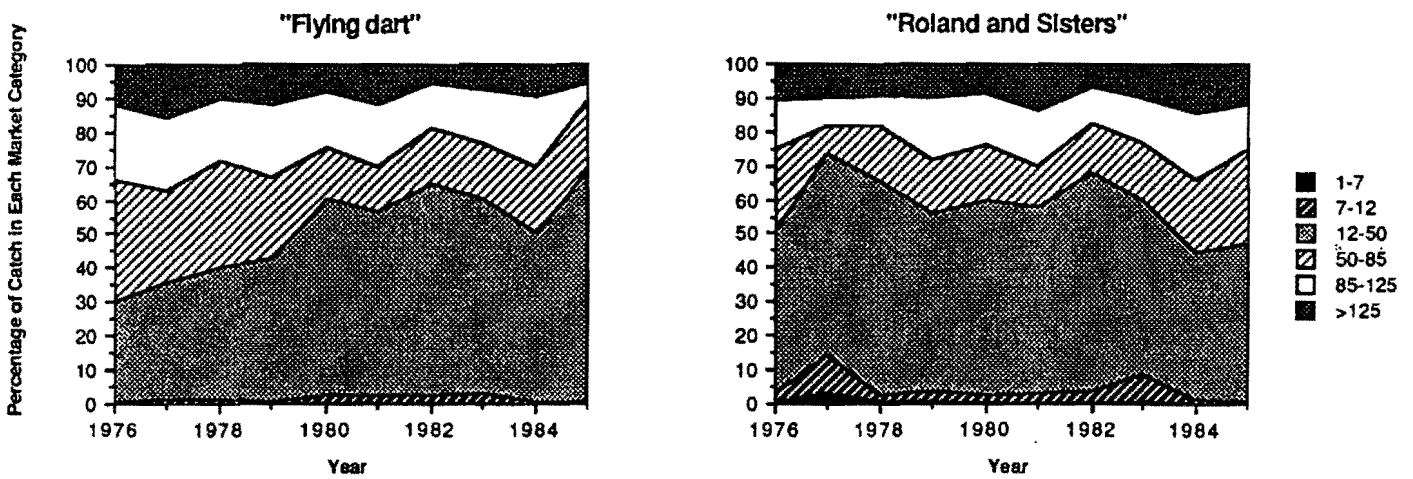
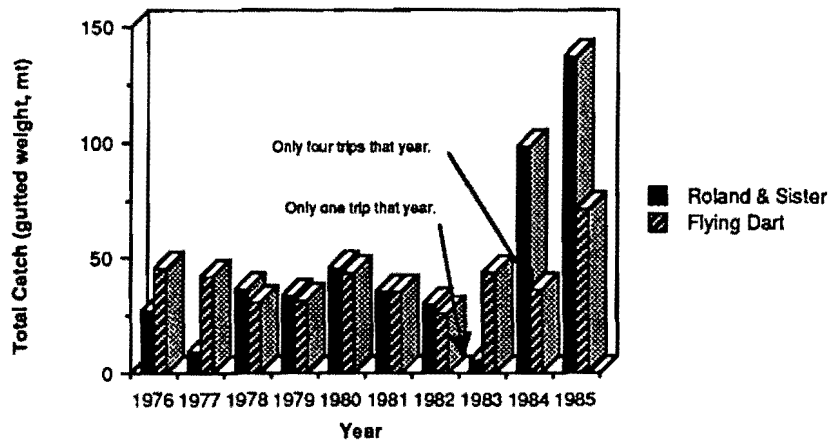


Figure 7. Catch of two southwest Nova Scotia longliners, broken down by market category (1976 to 1985). Vessels generally fished on southern Grand Banks.