Canadian Atlantic Fisheries Scientific Advisory Committee

Comité scientifique consultatif des pêches canadiennes dans l'Atlantique

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1985 Status Report on 4VWX Dogfish (*Squalus acanthias*)

by

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Les Documents de recherche sont publiés dans la langue officielle utilisée par les auteurs dans le manuscrit envoyé du secrétariat.

Abstract

No directed fishery exists for spiny dogfish on the Scotian Shelf, although dogfish have long been considered a nuisance by local fishermen. Catch-per-tow indices from recent RV surveys indicate an apparent increase in abundance since 1983. As a result dogfish are causing problems in the domestic fisheries in terms of time lost, removing dogfish from nets, searching for better fishing grounds, and damage to gear. Substantial drops in cod and haddock longline catch rates have been blamed on the high incidence of dogfish.

Résumé

La pêche de l'aiguillat commun n'existe pas en tant que telle sur le plateau Scotian, bien que ce poisson soit depuis longtemps considéré comme une espèce nuisible par les pêcheurs de la région. Les indices de prises par trait de chalut, obtenus à partir d'études effectuées par des navires de recherche, révèlent que l'abondance de l'aiguillat commun a augmenté depuis 1983. Cette abondance accrue crée des complications pour les pêcheurs canadiens : pertes de temps dues à l'enlèvement des aiguillats pris dans les filets et à la recherche de meilleurs endroits pour pratiquer la pêche, et dommages causés aux engins. On a attribué à l'incidence élevée de l'aiguillat commun les baisses substantielles dans les taux de capture de la morue et de l'aiglefin par suite de la pêche à la palangre.

Introduction

Fishermen have long been aware of the spiny dogfish Squalus acanthias. As the June 25th trip (Digby Weekly Courier 1915) of Eddie James shows, there have been other instances of dogfish outbursts; "During the ten days she has been out she has covered a good deal of ground but everywhere found the waters swarming with dogfish..."; and from the statutory declaration of Francis Boudreau, who served on several Lockeport vessels from 1935 until the 1950s, recalls that when dogfish struck on Browns Bank, groundfish vessels shifted position to other southwestern banks or Georges Bank in an attempt to avoid catching this undesirable species. Dogfish in the western Atlantic is chiefly important because of the damage it causes to gear and its interference with fishing operations. In the last couple of years this has been particularly true of the longline fishery in Division 4X where dogfish have been blamed for everything from reported substantial drops in the cod and haddock catch rate to the tying up of a large proportion of the inshore longline fleet. Dogfish have also caused problems in the offshore pollock and silver hake fisheries. In view of these recent events, it was decided to review the biology of this resource in order to seek explanations for these problems now being encountered in the fishery.

General Biology

The spiny dogfish Squalus acanthias appears to be an extremely long lived and slow growing species. Recent evidence (Nammack 1985) suggest that dogfish in the western Atlantic lives for approximately 40 years and reaches a maximum theoretical length of 100.5 cm for females and 92.49 for males (Figure 1). Dogfish in the Pacific have been calculated to live up to 95 years with lengths up to 124.3 cm (Ketchen 1975) and Pacific dogfish ages have recently been validated using oxytetracycline labelled, dorsal spines, at up to 70 years (McFarlan and Beamish 1985). This size and age difference suggest that the Pacific dogfish live longer and grow more slowly than those found in the western Atlantic. The reproductive capacity of this species in limited by late maturity, a long gestation period (2 years) and low fecundity. Litter size has been reported as 1-11 in the northwestern Atlantic by Jensen (1966) and 2-15 by Nammack et al. (1985) with fecundity appearing to increase with the size of the parent (Templeman 1944; Holden and Meadows 1964; Ketchen 1972; Gauld 1979 and Nammack et al. 1985).

Dogfish are distributed in the western North Atlantic from Florida to Newfoundland. They appear to be highly migratory (Figure 2) and in the northeastern United States undertake seasonal migrations spending the summer in the northern inshore extremes and winter in the southern offshore extremes (Colvocoresses and Musick 1980). Very little is known about the stock structure of dogfish even though it constitutes the largest unexploited fish resource in the western North Atlantic (Edwards 1968). Tagging and field observations of Templeman (1944), Bigelow and Schroeder (1953), Holland (1957), Jensen (1961; 1966), and Shafer (1970) agree that this species schools by size until it reaches sexual maturity and by size and sex after maturing. Templeman (1944) also proposed that some portion of the population might overwinter in water off the edge of the Shelf as far north as the Laurentian Channel. Holland (1957) found evidence of two separate stocks in the Pacific Coast dogfish and Holden (1965) reported three separate stocks in European waters. Tag returns of Templeman (1954), Jensen (1961; 1965), and Shafer (1970), did not indicate separate stocks. These data suggest that dogfish in the Northwest Atlantic probably comprise one stock with changes in its extensive seasonal migration patterns as the fish grow to maturity.

During a RV cruise (December 1984) directed at estimating pollock abundance, dogfish were observed in several areas (Figure 3). Modal lengths were found to be 68 cm for females and 71 cm for males. These fish are thought to be groups of immature fish that overwinter in pockets of deeper water, supporting the evidence of Templeman (1944) that dogfish may overwinter along the edge of the shelf.

Dogfish length-frequency distributions from the spring, fall, and summer surveys were looked at in an effort to elucidate the distribution of these fish as they follow their migratory route.

Although survey coverage was uneven, especially in the spring and fall in Divisions 4V and 4W, spring surveys agree with previous data that larger fish, predominantly female, appear to migrate northward earlier than smaller fish and seem to be restricted to the outer edge of the shelf and areas of deeper water. Survey data also indicate that dogfish present in Division 4X are consistantly and substantially smaller than elsewhere on the Scotian Shelf and that since 1978 females have shown a drop in modal length while that of males has remained relatively constant (Figure 4). Further analysis will be necessary in order to determine if this is due to an influx of small animals or a sex related change in growth rate. Modal lengths for dogfish present in Divisions 4V and 4W were larger than those found in Division 4X but no trends were discernable (Table 1).

Feeding

Studies by several researchers (Ford 1921; Templeman 1944; Bonham 1954; Holden 1966; Jones and Geen 1977; Nammack 1982; and Bowman and Eppi 1984) have shown that dogfish Squalus acanthias is an opportunistic feeder whose diet consists mainly of fishes, crustaceans, molluscs, and coelenterates. From these studies it has been estimated that teleosts comprise between 60-70% of the diet of dogfish over 60 cm. Although sandlance, mackeral, and herring were found to be the major prey items in these studies this may reflect availability of prey rather than preference, since the variability appears to be broadly related to the abundance trends of several major species (Bowman and Eppi 1984). Groundfish species would not be able to be ruled out as a prey item during times of high abundance.

Approximate consumption estimates derived from mimimum stock biomass estimates and annual food intake (Bowman and Eppi 1984) suggest that spiny dogfish predation may be a significant source of mortality on commercially valuable species. Since large dogfish prey on the prerecruitment stages of fish it will be necessary to do more work on fish consumption by dogfish in order to determine the significance of this predation on the recruitment of more valuable species.

Trends in the Fishery

Most dogfish catches in recent years (1971-84) have been taken by the USSR and the USA. In the early 70s distant water foreign fleets, particularly those from the USSR took dogfish in their trawl fisheries. From 1971 to 1977 total reported nominal catches ranged between 200 t and 21,000 t (Table 2). Small incidental catches were taken by Canada, Japan, Poland, France, Germany, and Spain. Since 1977 USA catches occurred mostly in Division 5Y; they ranged from 700 t to 5,000 t, resulting from the development of a small European market and improved processing techniques. The market for dogfish products in Europe is fairly static at about 20,000 t so unless changes occur in either the catch or the consumption of dogfish, the market is likely to remain quite limited.

Landings by the USA in Division 5Y are predominantly from TC-3 side and stern trawlers and to a lesser extent TC-2 side trawlers and gill netters (Table 3). Canadian landings were insignficant throughout the 70s and have remained so, with very small catches taken by TC-1 longliners in Division 4X during the summer months. There have been essentially no Canadian catches of dogfish in Subarea 5. To date there have been no management measures in effect for dogfish in the Northwest Atlantic.

International Observer Program (IOP) data (1980-1984) were available for domestic offshore trawlers. These sources show the percent frequency of occurrence of dogfish in sets made, has increased since 1980 (Table 4). IOP data (1984) were also available for domestic inshore trawlers. The percent frequency of occurrence of dogfish in sets by month and unit area is given in Table 5; Figure 5. Table 6 shows the number of sets made in each area, how many contained dogfish and of those, the number that contained greater or less than 100 kg of dogfish per set. These data indicate that while dogfish occured in a large number of the sets made, 95% of them contain less than 100 kg. So it would appear that dogfish is more of a nuisance than a problem to most of the inshore draggers.

RV Catch Rates

As no commercial fishery exists for dogfish, catch rates (kg/tow) for 1970-1984 were calculated using data from the RV spring, summer, and fall surveys (Tables 7-9). Summer mean catch(kg)-per-tow from these surveys rose in recent years (1983-84) particularly in Division 4X. Divisions 4W and 4V remained consistantly lower although both show an increase in 1984. The USA spring survey results reflected very high abundance estimates in 1982 but have decreased rather dramatically in the last two years (Figure 6) although they are still much higher than the Canadian survey estimates. This high variability may be due to the structured schooling and migratory nature of the dogfish as well as the timing of the USA surveys. Another factor may be the possibility that the stock abundance in the Gulf of Maine is higher than on the Scotian shelf despite the northern migration route of the dogfish. Thus it is not apparent whether or not overall stock abundance is increasing or moving north as a result of environmental influences such as shifts in water temperature or availability of prey from one area to another. If the prey species such as mackerel also follows a migration route the dogfish may follow it, depending on the abundance of the prey species at the time (Waring, per. comm.).

Catch rates by strata were calculated (Tables 10-12) and distribution maps prepared (Figures 7-9). Spring distributions place dogfish predominantly in the deep water areas of Browns Bank, the Emerald Basin and Emerald-Western Bank. Abundance in the Bay of Fundy is low at this time. Summer and fall distributions show concentrations in the 4X area particularly the Bay of Fundy with a rather low incidence of dogfish elsewhere on the shelf.

Surveys also confirm a general co-occurrence of dogfish with haddock and cod (Mahon et al. 1984, Figure 110) in South and West Fundy, Yarmouth Plains and West Banks, and with pollock in the basins. So it can be understood how large increases in dogfish fish abundance could significantly affect the fishery in these areas.

Prognoses

This species is highly migratory, forms large schools and is thought to comprise one stock for Subareas 3-6. Localized increases in abundance could be due to behavioural and environmental changes rather than increases in biomass. Since the pattern of migration is thought in general to be a northward movement following the summer warming and a southward migration in connection with winter cooling, the time for the appearance of dogfish could vary considerably from year to year. Therefore temperature shifts, prey availability and timing of the surveys are some of the factors which cause the variability found in dogfish biomass estimates. Since the scientific knowledge of dogfish and its interactions with the environment are limited, plans are underway to look at the stock structure of the species using electrophoretic methods. Stomach contents will also be analyzed during the coming year.

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Statutory declaration of Francis Boudreau, retired fisherman, Shelburne, Nova Scotia, interviewed 17 May 1982, October 1982, and 21 November 1982.

Table 1. Median length-frequency for female dogfish in NAFO Divisions 4V, 4W, and 4X (1978-1983).

Division	Year	Spring	Summer	Fall
4V	1978	-	-	94
	1979	-	-	91
	1980	91	82	85
	1981	91	79	-
	1982	85	67	-
	1983	-	73	-
4W	1978	-	85	94
	1979	91	-	94
	1980	88	97	88
	1981	94	91	94
	1982	82	94	-
	1983	-	70	-
4X	1978	-	58	-
	1979	82	64	79
	1980	73	58	73
	1981	91	61	64
	1982	73	61	-
	1983	-	61	67

Table 2. Nominal landings[1] (t) of dogfish in Divs. 4VWX and Subarea 5.

Year	Canada		USA		Other		Total
	4VWX	5	4VWX	5	4VWX	5	4VWX+5
1970	-	-	-	-	-	-	-
1971	4	-	-	-	-	195	199
1972	3	-	-	-	-	369	372
1973	19	-	-	-	3,452	10,451	13,922
1974	6	-	-	2	6,882	12,224	19,114
1975	1	-	-	11	4,210	16,301	20,523
1976	2	-	-	434	2,856	12,359	15,651
1977	-	-	371	464	434	4,946	6,215
1978	7	-	-	742	11	442	1,202
1979	17	-	-	1,885	30	49	1,981
1980	22	2	-	2,785 (724)*	372	-	3,181
1981	5	-	-	4,357 (683)*	472 (24)*	204	5,038
1982	25	-	-	3,008	27	-	3,060
1983	-	-	-	4,753	-	-	4,753

1 Data obtained from NAFO Statistical Bulletins.

* (NS) dogfish

Table 3. Dogfish catches[1] by gear for the USA fishery.

Year	Gears									
	GNS	LLS	LHP	FPN	OTB1-2	OTB1-3	OTB2-2	OTB2-3	Misc	NK
1979	1053	16	1	1	1646	1225	42	22	16	146
1980	622	9	-	-	624	1054	47	1025	4	95
1981	554	-	-	-	716	2049	31	1675	-	6
1982	283	-	-	-	294	1041	9	1376	1	4

1 Data obtained from NAFO Statistical Bulletin.

Table 4. IOP data -- Percent frequency of occurence of dogfish in sets made by domestic offshore otter trawlers during 1980-84 in NAFO Division 4X. (- = no sets made).

Month	YEAR				
	1980	1981	1982	1983	1984
January	-	1	0.146	0.238	0.064
February	0.500	0.162	0.171	0	0.210
March	0	0.056	0	0.591	0.610
April	-	0.172	0.545	0	-
May	0	0.091	0.500	-	0
June	-	0	0.035	1	-
July	-	-	0	0.121	0.600
August	-	-	0.105	0	-
September	-	0	0.077	0.022	0
October	0	-	0.012	0	0.375
November	0.034	0.028	0.090	0.048	0.423
December	0.019	0.094	0.105	0.033	-
TOTAL	0.029	0.108	0.105	0.079	0.333

Table 5. IOP data -- Precent frequency of occurence of dogfish in sets made by domestic inshore otter trawlers during 1984 in NAFO Division 4X. (- = no sets made)

Month	AREA 4Xn	4Xo	4Xp	4Xq	4Xr	4Xs
May	.682	.077	-	.442	-	-
June	.886	.778	.771	1.0	-	-
July	-	-	-	.309	.493	-
August	-	-	-	.522	.333	.219
September	-	.615	.462	.177	.333	.250
October	-	-	-	.385	-	-

Table 6. IOP data -- Sets made by domestic inshore otter trawlers during 1984 in NAFO Division 4X.

Area	Sets Made	Sets With Dogfish	Sets With Dogfish < 100 kg	Sets With Dogfish >100 kg
4Xn	57	46	43	3
4Xo	62	18	13	5
4Xp	188	141	116	25
4Xq	278	97	77	20
4Xr	219	84	81	3
4Xs	36	8	8	0

Table 7. Geometric mean catch per standardized tow (kg per tow) of spiny dogfish caught on Canadian summer groundfish surveys in NAFO Division 4X (unadjusted for RV differences) for the period 1970-1984.

Year	SEASON Spring	Summer	Fall
1970	-	3.319	-
71	-	3.396	-
72	-	1.617	-
73	-	2.035	-
74	-	2.273	-
75	-	0.992	-
76	-	0.594	-
77	-	1.816	-
78	-	0.233	-
79	-	1.726	2.329
1980	1.304	1.396	1.554
81	-	1.378	0.616
82	1.494	1.670	-
83	-	5.797	2.086
84	-	7.040	-

Table 8. Geometric mean catch per standarized tow (kg per tow) of spiny dogfish caught on Canadian summer groundfish surveys in NAFO Division 4W (unadjusted for RV differences) for the period 1970-1984.

Year	SEASON Spring	Summer	Fall
1970	-	0.000	-
71	-	0.000	-
72	-	0.043	-
73	-	0.000	-
74	-	0.027	-
75	-	0.000	-
76	-	0.000	-
77	-	0.000	-
78	-	0.089	0.405
79	-	0.000	0.205
1980	1.007	0.138	0.184
81	-	0.113	0.077
82	0.303	0.164	-
83	-	0.077	0.017
84	-	0.331	-

Table 9. Geometric mean catch per standarized tow (kg per tow) of spiny dogfish caught on Canadian summer groundfish surveys in NAFO Division 4V (unadjusted for RV differences) for the period 1970-1984.

Year	SEASON Spring	Summer	Fall
1970	-	0.002	-
71	-	0.000	-
72	-	0.000	-
73	-	0.017	-
74	-	0.000	-
75	-	0.000	-
76	-	0.000	-
77	-	0.000	-
78	-	0.038	0.352
79	-	0.000	0.027
1980	0.027	0.000	0.007
81	-	0.022	0.000
82	0.049	0.000	-
83	-	0.022	0.000
84	-	0.199	-

Table 10. Geometric mean catch per standardized tow (kg per tow) of spiny dogfish caught on Canadian groundfish surveys in NAFO Division 4X (Strata 70-95).

Stratum	SEASON Spring (1979-1983)	Summer (1970-1983)	Fall (1978-1983)
70	0.442	0.344	0.000
71	20.615	0.583	1.070
72	1.534	0.191	0.256
73	0.442	0.049	0.000
74	0.000	0.233	0.000
75	0.000	0.107	0.000
76	0.000	0.191	0.089
77	0.000	0.184	0.414
78	4.759	0.000	0.100
80	0.279	1.165	3.760
81	11.088	0.992	0.977
82	46.965	0.863	2.565
83	10.197	0.639	4.453
84	1.474	6.054	2.722
85	0.823	10.197	3.475
90	0.000	1.435	2.350
91	0.000	2.504	2.380
92	0.119	2.921	2.164
93	0.000	3.060	11.800
94	0.000	6.816	7.660
95	0.000	6.321	16.450

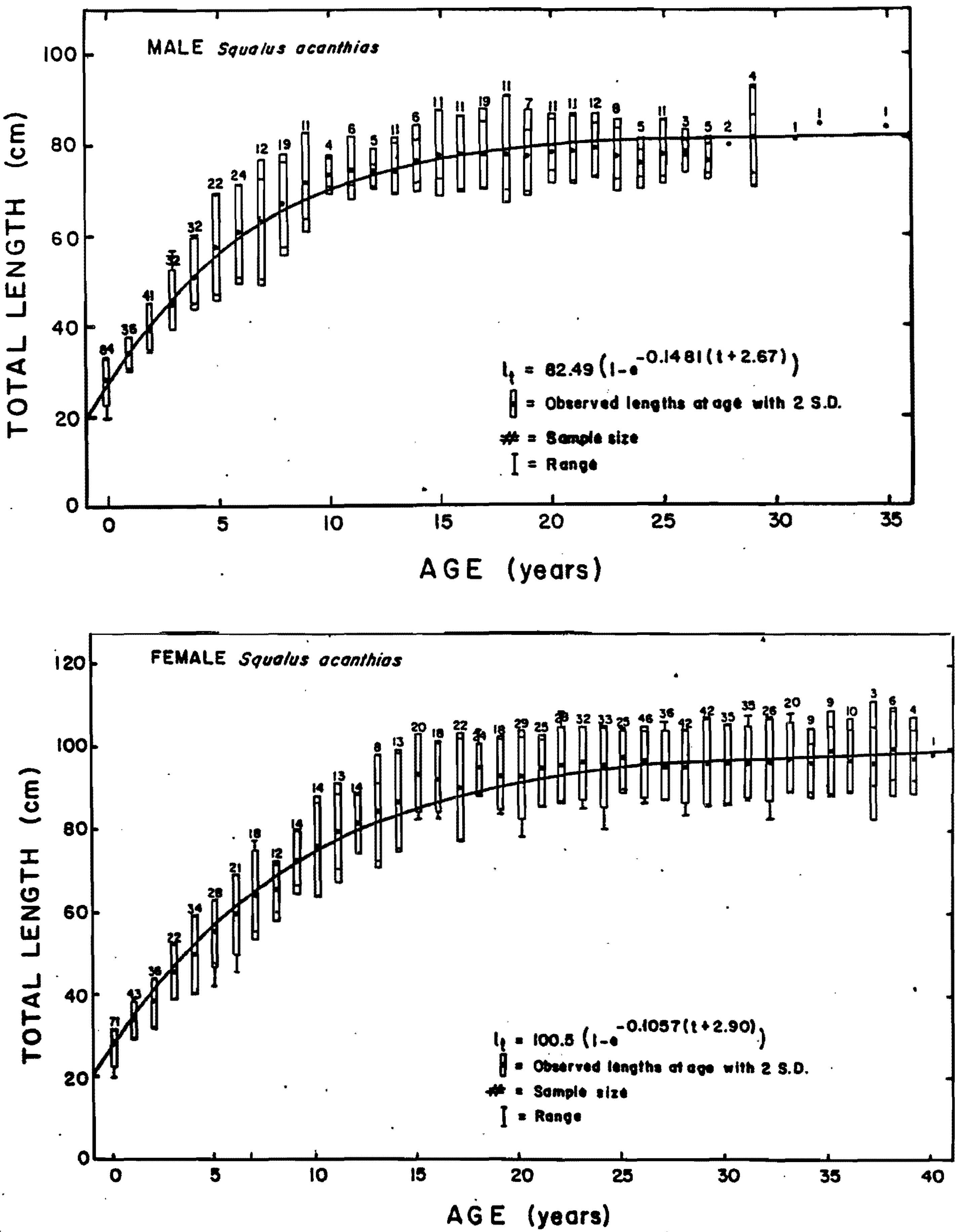
Table 11. Geometric mean catch per standardized tow (kg per tow) of spiny dogfish caught on Canadian groundfish surveys in NAFO Division 4W (Strata 53-66).

	SEASON		
Stratum	Spring (1979-1983)	Summer (1970-1983)	Fall (1978-1983)
53	1.199	0.027	0.000
54	0.205	0.017	0.000
55	0.000	0.000	0.043
56	0.000	0.000	0.060
57	0.000	0.000	0.000
58	0.000	0.027	0.170
59	0.000	0.000	0.049
60	1.007	0.226	0.797
61	2.956	0.241	1.474
62	1.396	0.107	0.054
63	0.000	0.000	0.000
64	0.113	0.017	0.000
65	21.698	0.107	0.562
66	5.312	0.000	0.205

Table 12. Geometric mean catch per standardized tow (kg per tow) of spiny dogfish caught on Canadian groundfish surveys in NAFO Division 4V (Strata 40-52).

	SEASON		
Stratum	Spring (1979-1983)	Summer (1970-1983)	Fall (1978-1983)
40	-	0.066	0.131
41	-	0.000	0.000
42	-	0.000	0.000
43	-	0.022	0.000
44	0.000	0.000	0.071
45	0.000	0.000	0.000
46	2.218	0.012	0.212
47	0.000	0.000	0.000
48	0.000	0.000	0.000
49	0.256	0.022	0.000
50	0.000	0.027	0.000
51	3.396	0.113	0.107
52	0.000	0.027	0.000

Figure 1. Von Bertalanffy growth curve for male and female spiny dogfish (Nammack *et al*. 1985).



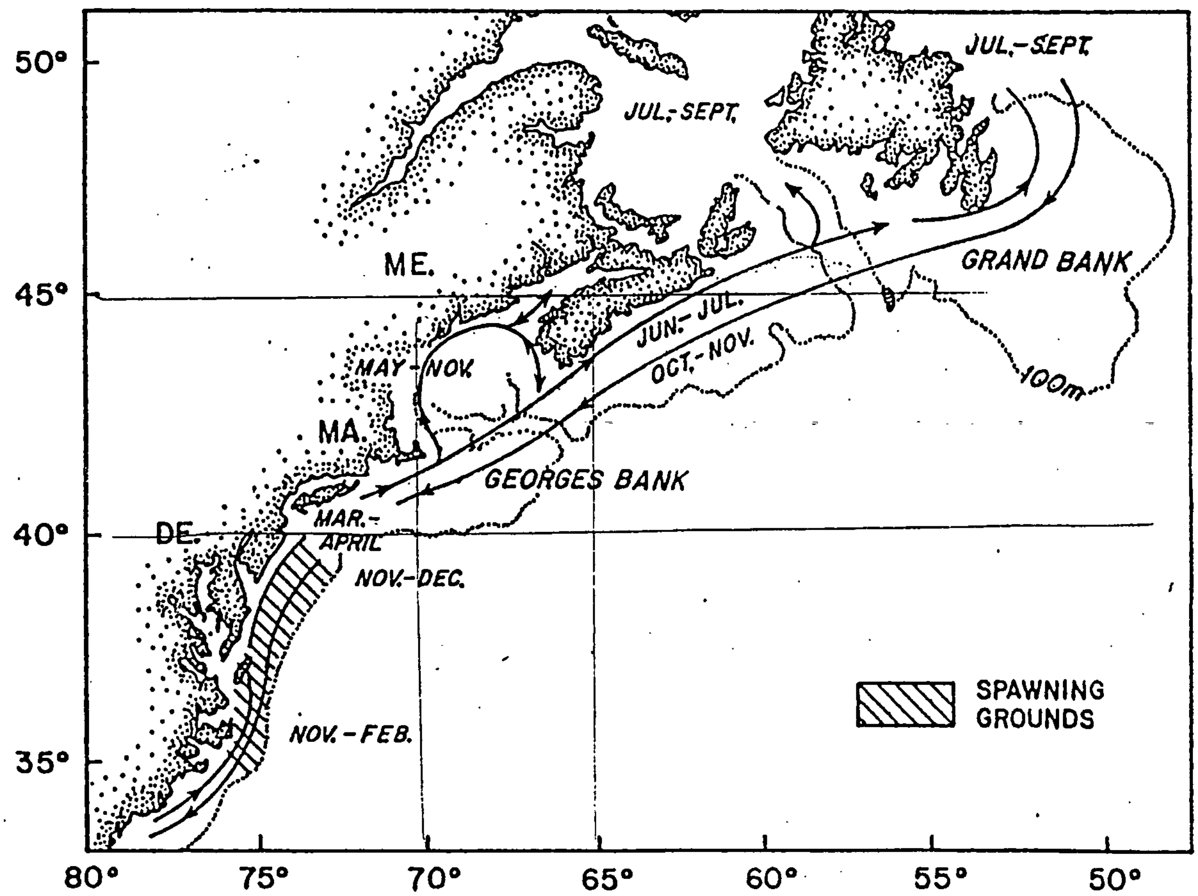


Figure 2. Spiny Dogfish Migrations

Figure 3. Distribution of dogfish from pollock cruise; December 1984.

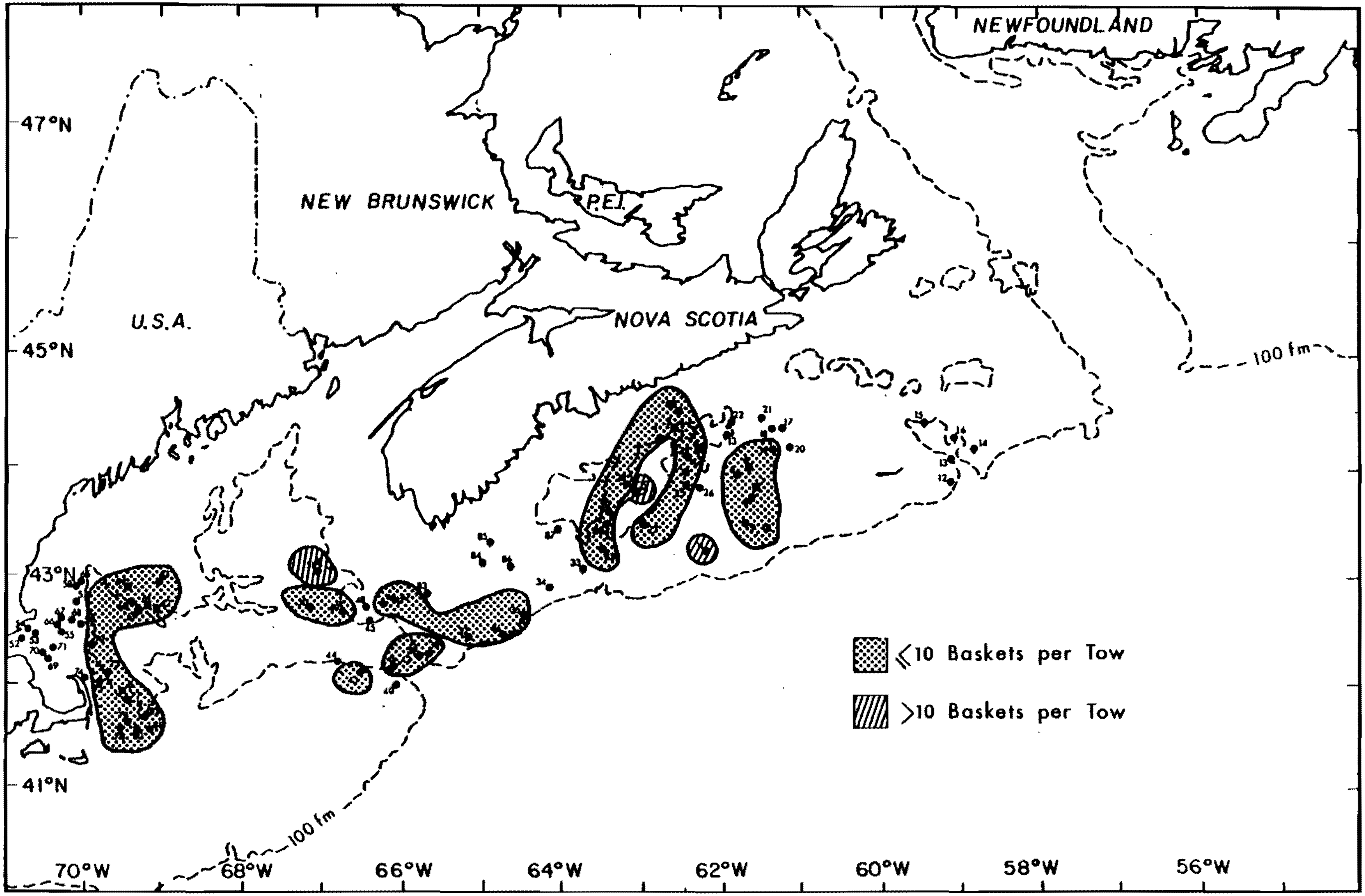
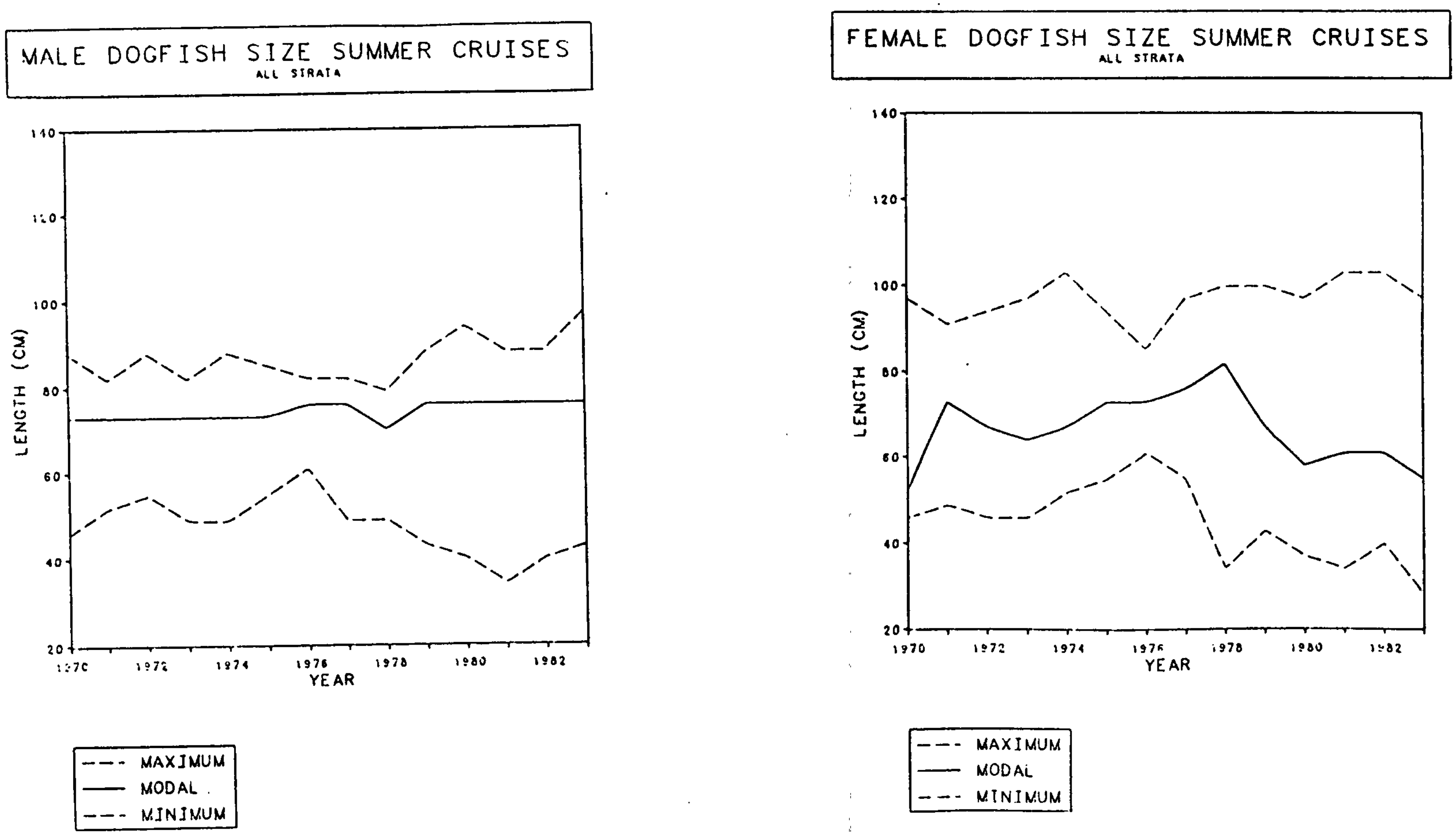


Figure 4. Trend in modal lengths (cm) for spiny dogfish collected on summer bottom trawl surveys (1970 - 1983).



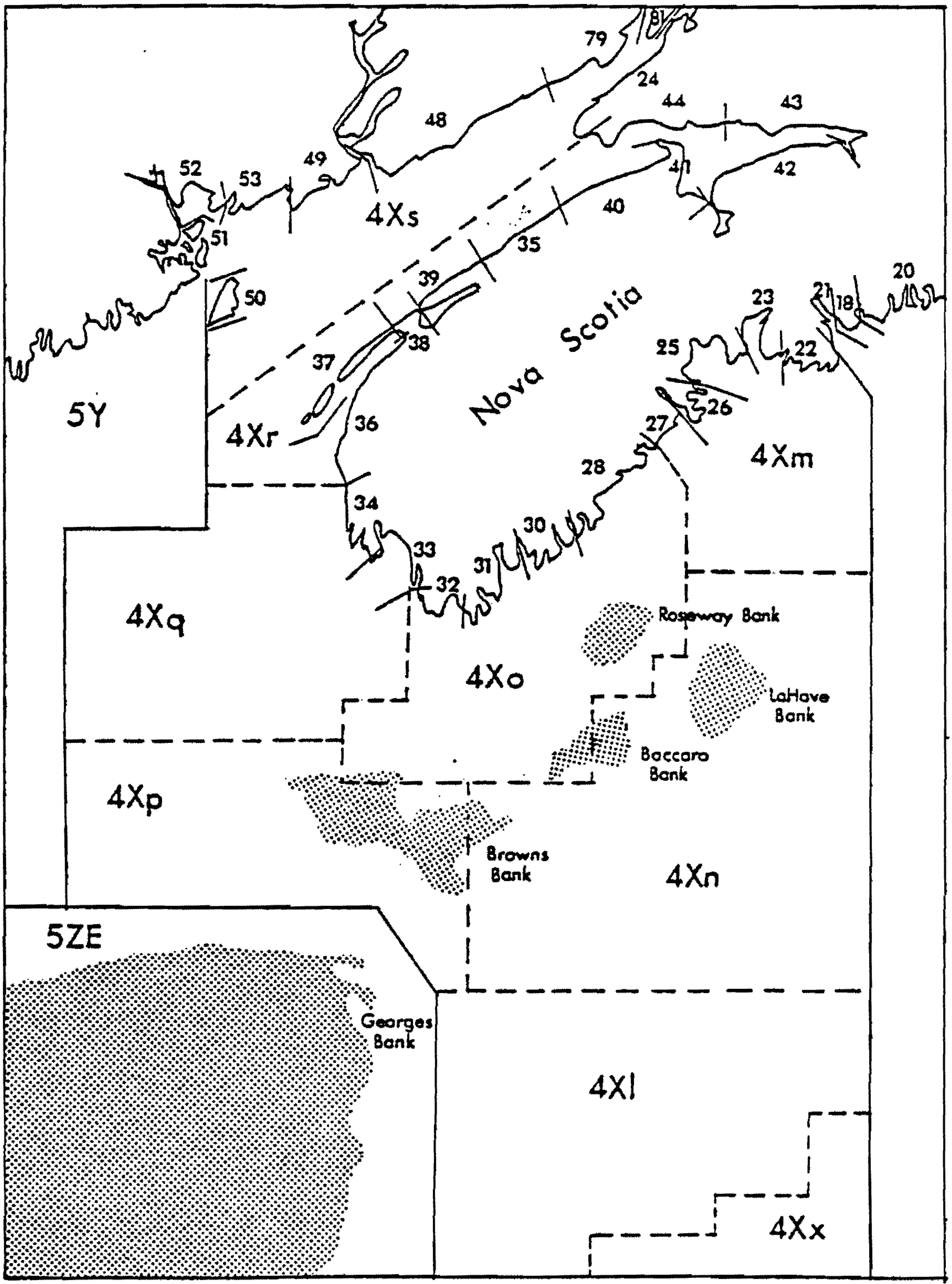
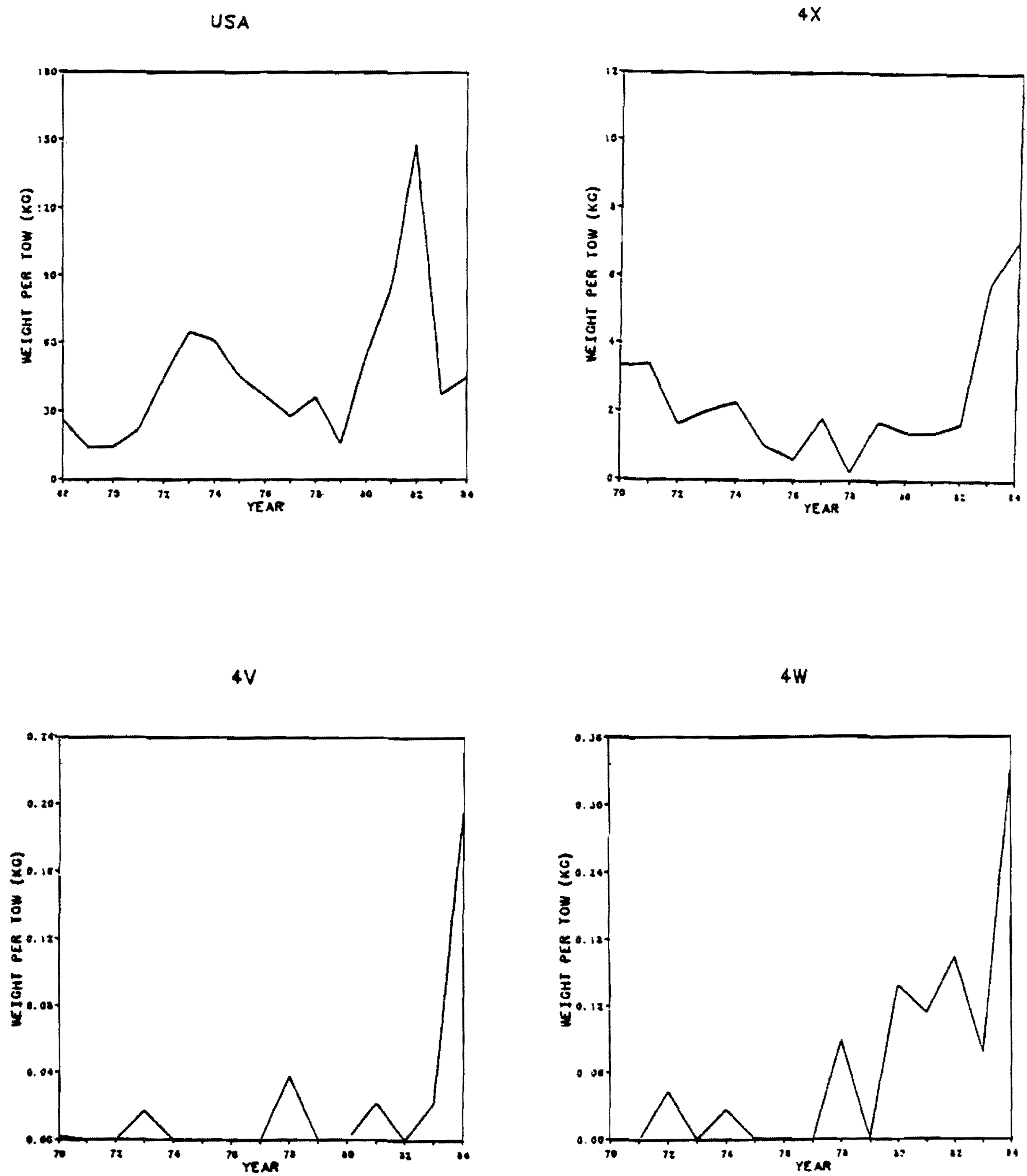


Figure 5.

Canadian fisheries statistical unit areas in NAFO Division 4X.

Figure 6. Biomass kg/tow of dogfish from USA spring bottom trawl surveys 1968-1984 (Waring pers. com.).

Biomass kg/tow of dogfish in Divisions 4X, 4V, and 4W from Canadian summer groundfish surveys.



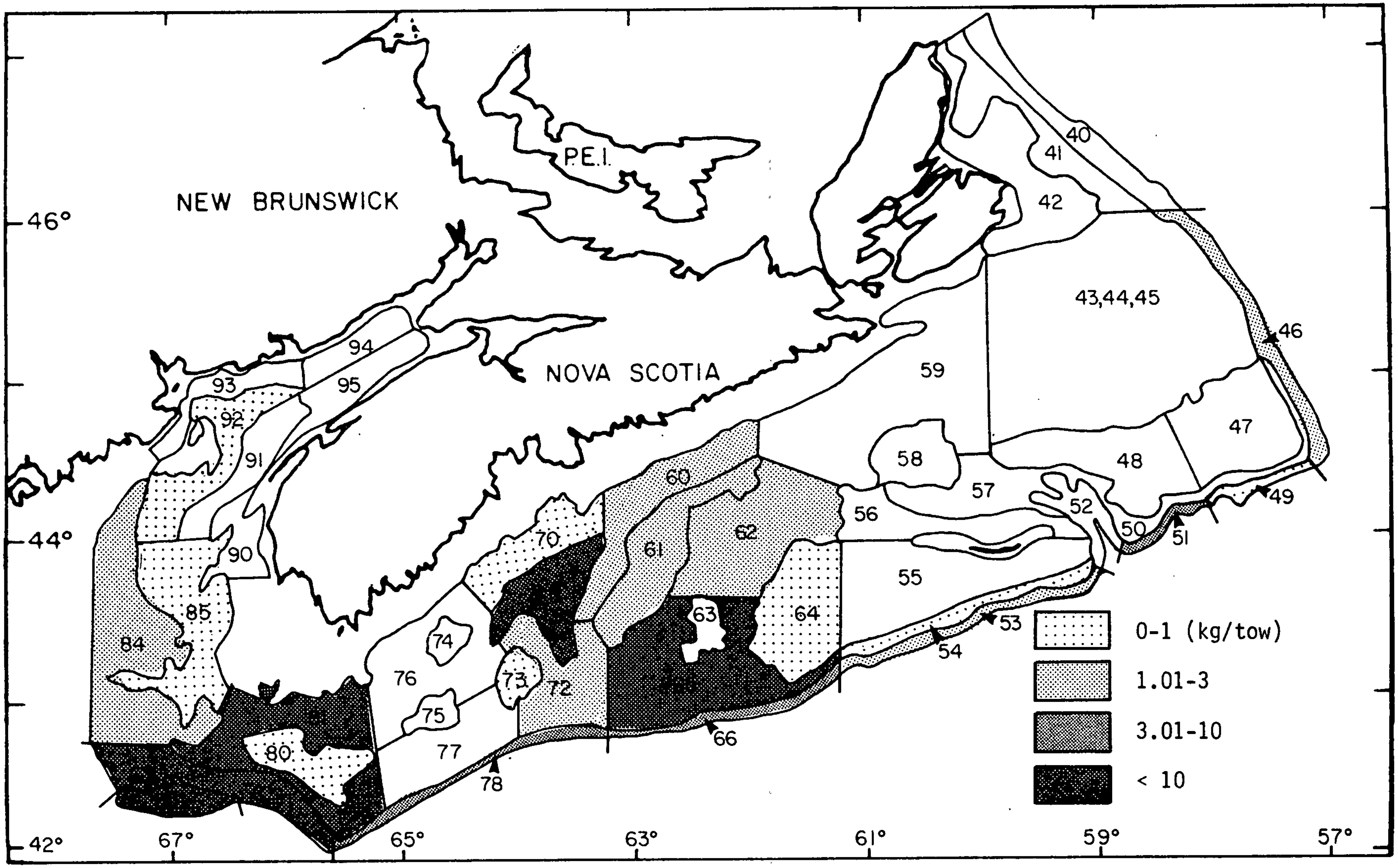


Figure 7. Spring dogfish RV surveys (1979 - 1983).

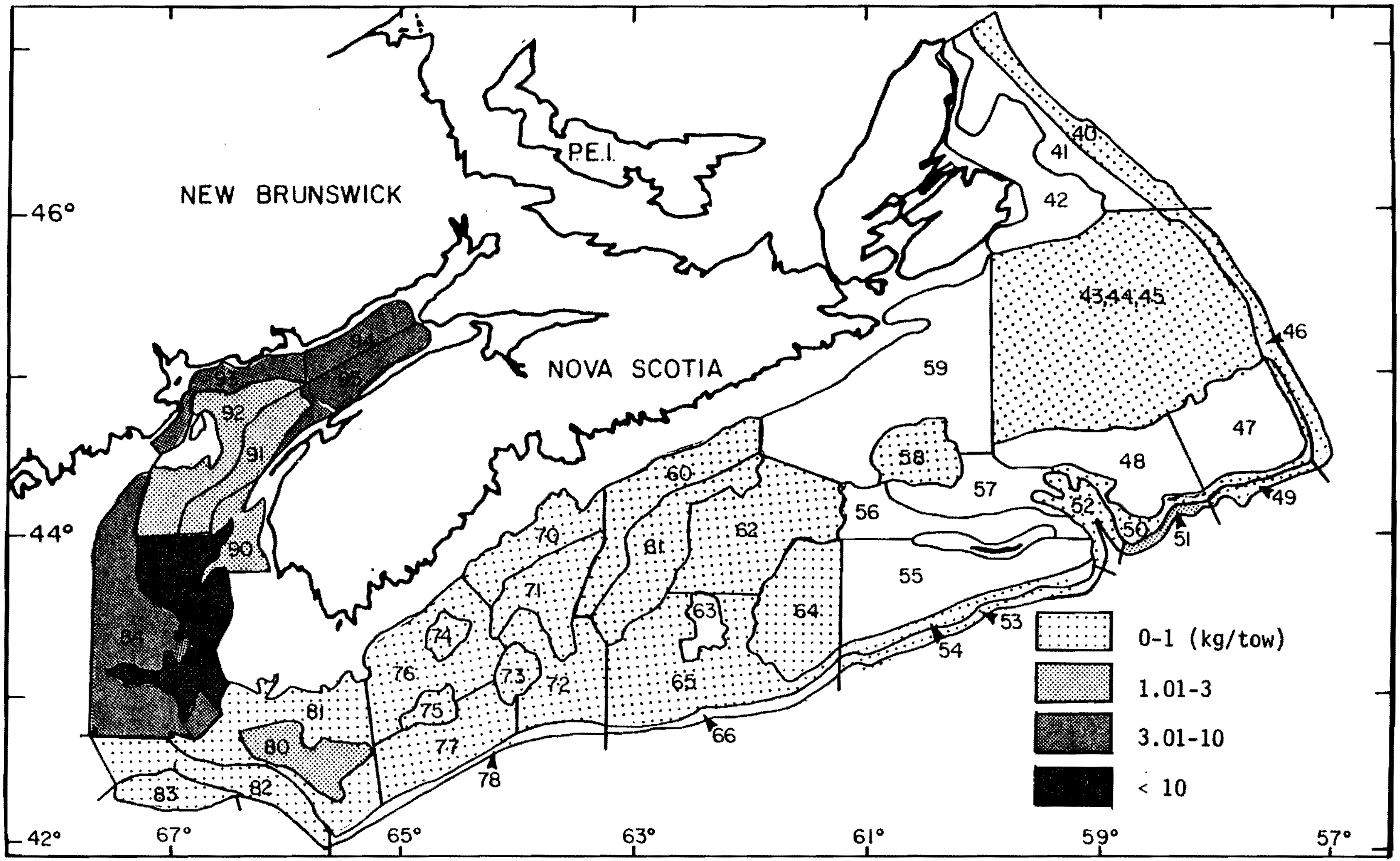


Figure 8. Summer dogfish RV survey data (1970 - 1983).

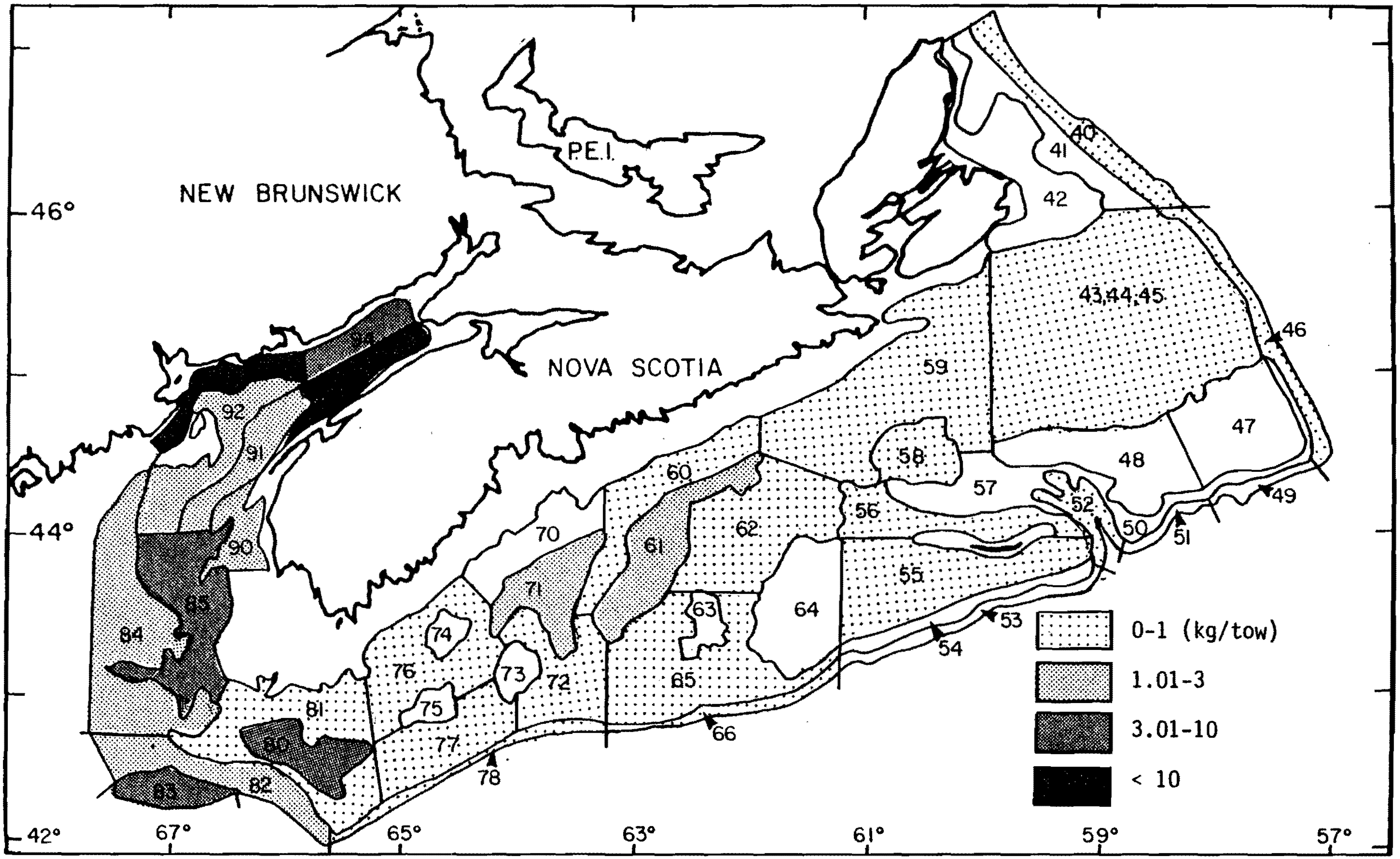


Figure 9. Fall dogfish RV survey data (1979 - 1983).