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Assessment of the scallop stock in scallop production Area 1, Bay of Fundy

by

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Abstract

Starting on 1 January 1997, the Bay of Fundy scallop fishery was divided into Scallop Production Areas (SPA's) for better management. This move was made in response to declining catches and concerns over the long term viability of the scallop fishery. SPA 1 is the largest SPA in the Bay of Fundy and is accessible, at least in part, to all bay of Fundy scallop license holders. This assessment examines previous and current survey data, Full Bay scallop logbook data, and port sampling data. Some of the data is preliminary as work is being done to bring the databases into line with the new boundaries.

Survey biomass estimates and commercial catch rates have declined from the historic peak in 1988/89, to the lowest levels in either time series. At the present level of effort the removals from the stock in the traditional Digby and Cape Spencer areas appear to be balanced by growth of the remains of the last recruitment pulse and a low level of recruitment. The population of large scallops is being fished down and there are no signs of a strong recruitment pulse in the next few years. The outlook is for a continuing decline in the scallop abundance in this area.

Résumé

Depuis le 1er janvier 1997, la zone de pêche du pétoncle de la baie de Fundy a été divisée en deux zones de production du pétoncle (ZPP) afin d'en améliorer la gestion. Cette mesure a été prise en réaction à la baisse des captures et aux inquiétudes quant à la viabilité à long terme de cette pêche. La ZPP 1 est la plus importante de la baie et accessible, du moins en partie, à tous les détenteurs de permis de pêche du pétoncle de la baie de Fundy. La présente évaluation porte sur les données recueillies au moment des relevés antérieurs et du relevé actuel, les données des registres de pêche pour toute la baie et les données des échantillonnages à quai. Certaines de ces données sont provisoires car l'on procède actuellement à faire correspondre les bases de données avec les nouvelles limites.

Les biomasses estimées par relevés et les taux des captures commerciales ont diminué, par rapport au maximum historique de 1988-1989, aux plus faibles valeurs des séries chronologiques. Au niveau d'effort de pêche actuel, les prélèvements effectués dans les aires de pêche traditionnelles de Digby et de Cape Spencer semblent être équilibrés par la croissance des individus qui restent de la dernière poussée de recrutement et par le faible recrutement actuel. La population de gros pétoncles est exploitée et rien n'indique une forte poussée du recrutement au cours des prochaines années. On prévoit un déclin continu de l'abondance du pétoncle dans cette région.

Introduction

Commercial scallop fishing in the Bay of Fundy was first reported by W.F. Ganong in 1889 (Ganong 1889), who reported that about 200 bushels originating from Maces Bay and L'Etang Harbour were sold annually in Saint John. In the 1920's, a commercial fishery started in Annapolis Basin N.S., where scallops had first been reported by Lescarbot in 1609. This fishery quickly moved out into the productive grounds off Digby, Nova Scotia. Scallop fishing regulations were first initiated in 1918 with licenses, a minimum size and closed seasons. These types of regulations are still in use for this fishery. Special regulations for specific areas within the Bay of Fundy date back to 1939 when a restriction on gear width was introduced specifically for Grand Manan waters. On the Nova Scotia side, a special zone was created off Digby in 1952, with a closed season from May 1 to September 30 to provide an area close to port for the winter fishery.

With declining catches and concerns over the long term viability of the fishery, the Bay of Fundy was divided into Scallop Production Areas (SPA's) for better management (Figure 1). These SPA's came into effect on January 1, 1997.

Scallop production Area 1 in the Bay of Fundy is a large area comprising several different fishing areas, and is accessible by three different scallop license categories (Table 1). Full Bay scallop licenses are able to fish scallops anywhere in the Bay of Fundy and are usually held by larger (>25.5 Gross Tons (G.T.)) vessels. Mid Bay license holders can fish for scallops on the northern side of the Mid Bay line (Figure 1), and Upper Bay license holders east of the Upper Bay line. These last two categories are typically held by smaller multi-purpose vessels that fish local waters. Landings for Area 1 in 1997 were 106.3 t for the Full Bay vessels, 12.6 t for the Mid Bay vessels and 10.6 t for the Upper Bay vessels.

Scallops are found in varying densities throughout most of Area 1, but the main concentrations are found on the Nova Scotia side outside Area 4, from Sandy Cove to Hampton (Figure 1), and out past the Mid Bay Line towards Cape Spencer New Brunswick. The productive area on the Nova Scotia side of the Mid Bay line is accessible only to the Full Bay License holders. The Cape Spencer bed, from the Mid Bay line extending towards Cape Spencer on the New Brunswick side, has been the second most productive area in recent times.

With the switch to Scallop Production Areas, and the recent requirement for the Mid Bay license holders to submit logs, there has been considerable effort required in revising existing databases and setting up some new ones. This is ongoing and, as a result, the numbers presented here will often not be an exact fit with the Area 1 boundaries, and should all be considered preliminary. For this analysis two

sections of Area 1 will be examined: the "2-16 mile" section from Sandy Cove to Hampton, excluding Area 4; and the section from 16 miles going towards Cape Spencer, New Brunswick.

Data Availability:

Research surveys

There have been annual surveys of the Digby portion of Area 1 since 1978 (Kenchington et al. 1995). The Cape Spencer grounds were first surveyed in 1987, (Chandler et al. 1989) during a survey of the Northern side and Upper Bay area. Robinson and Chandler (1990) and Robinson, Martin and Chandler (1992) conducted surveys covering the Cape Spencer area in 1989, 1990 and 1991. A grid survey of the Cape Spencer area was conducted in 1996 and 1997, in conjunction with the stratified random survey of the 2-16 mile Digby area. The Upper Bay area was surveyed in 1987 (Chandler et al., 1989) and in 1998 (Kenchington et al., 1998). The Upper Bay Surveys were not covered here.

Logbooks

Logbooks have been required for vessels >25 G.T. since 1973, and > 25.5 G.T. or > 14 m Length Over All (LOA) since 1979. These requirements covered most of the Full Bay license holders but few of the Mid Bay or Upper Bay licenses, although some of these vessels have submitted logbooks. The Mid Bay and Upper Bay license holders agreed to complete logbooks on a voluntary basis in 1996 and logbooks became mandatory in 1997. This database is in the process of being set up, and edited data was not available for this assessment. In the Full Bay Fleet, the percentage of active licenses that submitted logs has varied from 14 to 100%.

Port sampling

Port samples were collected regularly from the Full Bay Fleet landing in Nova Scotia, but there has been no port sampling coverage of the Mid Bay or Upper Bay Fleets in Area 1. Most of the available Full Bay samples came from the 2-16 mile Digby Area.

Methods

The survey analysis was divided into two separate areas. The first area was the area 2-16 miles off the Nova Scotia shore from Sandy Cove to Hampton, for which a time series of surveys exists. Annual surveys of this area have been conducted since 1978, but the station allocation scheme and area covered has changed during this period. For a full description of these changes see Kenchington et al. (1995). For this reason, only the 1991 to 1997 surveys, which are of a consistent area and with the most consistent design, will be used for this analysis. The survey area is now split between Scallop Production

Area 1 and Area 4, which extends out to 8 miles from Sandy Cove to Parkers Cove (Figure 1). The Area 1 survey is therefore broken down into two sections, the 8-16 mile area from Sandy Cove to Hampton, and a 2-8 mile area above Area 4 (Figure 2).

Tows of approximately 8 minutes duration were carried out at each randomly assigned station with a set of 4 Digby buckets (0.762 meters wide,76 mm rings with rubber washers), 2 lined and 2 unlined. The catch of scallops in the lined (38 mm diagonal mesh liner) were used to estimate the catch of scallops <80 mm shell height and the catch in the unlined buckets were used for scallops >=80 mm shell height. Catches were standardized to an 800 m tow with a 7 bucket drag (800 m * 5.334 m = 4,267.2 m^2).

A separate analysis was conducted for the Cape Spencer area, for which there is an irregular series of surveys covering different areas, and with differences in the way they have been conducted. Surveys tows were again standardized to an 800 m tow with 7 buckets. Catches that were recorded in round weight were converted to meat weights by dividing by the conversion factor of 8.33, which is the conversion factor used by Statistics Branch. Station assignments were on a grid in 1987, 1996 and 1997, and randomly assigned in 1989, 1990 and 1991. Since the area surveyed varied from year to year, biomass estimates were calculated both for the entire survey area and for a polygon that was surveyed in all 6 years. The abundance estimates within this polygon was used to examine trends in biomass. Biomass was estimated by contouring using delauny triangulation, which does not provide confidence intervals, and with an arithmetic mean estimate, for which confidence intervals can be calculated.

CPUE's for Area 1 were calculated from the Full Bay logs for the 1976 to 1995 period. Mid Bay and Upper bay logs for 1997 are currently being entered, but it will require a few years of data before any statements about trends could be made.

Port sampling data for the Full Bay fleet was broken down into three areas; <8 miles from shore above and below Area 4; 8-16 miles offshore from Sandy cove to Hampton; and the remainder of Area 1. To examine changes in the size distribution of the catch with time, the meat weight frequencies by month were plotted for 1996 and 1997.

Results

Traditional Area surveys

Based on the mean number of scallops per standard tow for the 10 strata in the survey, recruitment was low for the 1991-97 period (Tables 2 and 3). Patches of recruiting scallops were sometimes seen, such as in the Digby Gut area in 1994, and perhaps the areas around Gulliver's Head in 1997, but these appear to be localized patches. There has been a decline in commercial sized scallops

throughout the entire area, with the best catches coming from the area centering on Digby Gut (Table 3). The mean number per standard tow for all sizes for each stratum showed a decline through time over the survey area (Tables 4 and 5). The plots of mean numbers by year (Figure 3) show that there is a low level of recruitment which is not keeping up with the losses due to fishing and natural mortality. The scallop population in the area is declining.

Cape Spencer surveys

The contoured biomass estimates for the Cape Spencer area (Figures 4 to 9), and the simple and contoured estimates for the common polygon (Table 6) show a similar trend to the traditional Digby area. The large recruitment pulse that was seen throughout the Bay of Fundy is apparent in the 1989 survey, which has the highest biomass estimate in the series. Since that time the biomass in the area has declined as recruitment has not kept up with losses from the population. Histograms of the height frequencies from the 1997 survey (Figure 10) show low numbers of scallops in the survey areas. There is a small recruiting year class in the Cape Spencer area, but few scallops <80 mm in the Digby area.

CPUE for the Full Bay Fleet

The Class 1 catch and effort in Area 1 for the 1976 to 1995 period from Full Bay logbooks(Table 7), shows the large recruitment pulse that entered the fishery in 1988 and 1989. This pulse can be seen with the highest CPUE in the time series recorded in 1989. Since then, CPUE has declined to the lowest recorded in the time series in 1997.

Port Sampling

The 1997 data from the port samples for the Full Bay vessels in area 1 (Table 8), is broken down into three areas to match the breakdown of the surveys, <8 miles from shore above and below Area 4 (off Sandy Cove, Young Cove and Hampton); 8-16 miles off the Sandy Cove to Hampton area; and outside of these grounds. The meat weight distributions for the last two years, for the same areas, indicate that the fishery was relying on fairly large scallops (Figures 11, 12 and 13). Patches of recruiting scallops were occasionally found, as shown by modes of small scallops that appear for a single months samples, but these were quickly fished down. The minimum sizes in the samples given in Table 9 show that small scallops are still being taken in this fishery. This is especially true in the Cape Spencer area (Figure 13) where modes can be seen for meats less than 10 g. With large scallops in the catch and low numbers of recruiting smaller scallops, the fishermen have no problems meeting the meat count regulations.

Discussion

All indicators of the stock status in Area 1 show the same trend. With low recruitment levels the population is being fished down. It has declined from the historic high of 1988 and appears to have leveled off at low numbers in the last 3 annual surveys. This level is below that seen in 1984-85 before the large recruitment pulse (Figure 14), but anecdotal evidence says it has been this low in the past. At present levels of effort, the removals from the stock in the traditional Digby and Cape Spencer areas, appear to be balanced by growth of the remains of the last recruitment pulse, and a low level of recruitment. The trend, and the density of scallops, is very similar for both the 8-16 mile band from Sandy Cove to Hampton (that has regularly been surveyed), and the selected polygon on the Cape Spencer bed that has an irregular series of surveys (Figure 15). The shell height frequencies from the surveys of the 8-16 mile band (Figure 16) indicate a decline in numbers of the scallops in the 80 to 120 mm shell height mode. There are also no signs of a strong recruiting year class in the next few years. In 1997 the Full Bay fleet only managed to land 106.3 t of a 240 t TAC, and the Mid and Upper Bay vessels landed 23.2 t of the 50 t they were allocated. Part of this was due to the fact that effort in Area 1 was lower in 1997 for a combination of reasons; there were fewer Full Bay vessels fishing; there was a two month closure for both the New Brunswick side of the Mid Bay line and the Upper Bay; and an opening of scallop fishing area 29 diverted effort from the Full Bay fleet for a month

Conclusion

The outlook for this stock is a slow decline at the current exploitation rate. Area 1 is the largest SPA in the Bay of Fundy and so there will probably continue to be small patches of recruiting scallops scattered throughout the area. Effort in this area will probably be higher in 1998 than it was in 1997, as more of the Full Bay fleet targets the area and there is not a 2 month closure in the New Brunswick and Upper Bay areas. Our main concern is about how low the population levels can go before the spawning stock biomass is so low that, even if environmental conditions are good, the spawning stock is not able to produce an adequate number of recruits to increase the population. At present we cannot predict where this critical level is, and so as the biomass drops to historically low levels, our concern increases.

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Table 1. Number of licenses issued and number of active vessels for each license type having access to Area 1.

	Mid-Bay*		Full Bay		Upper Bay	
Year	Licenses	Active	Licenses	Active	Licenses	Active
1978	n/a	n/a	88	n/a	n/a	n/a
1979	n/a	n/a	83	n/a	n/a	n/a
1980	135	n/a	90	n/a	n/a	n/a
1981	290	n/a	102	68	n/a	n/a
1982	278	n/a	104	66	n/a	n/a
1983	253	n/a	111	77	14	n/a
1984	262	n/a	104	82	14	n/a
1985	269	133	106	70	15	7
1986	238	127	98	67	13	10
1987	214	146	95	80	16	13
1988	211	130	99	91	16	15
1989	211	129	99	96	16	16
1990	210	145	99	94	16	16
1991	210	144	99	93	16	12
1992	206	143	98	90	16	12
1993	208	171	96	99	16	13
1994	209	178	96	92	16	10
1995	209	147	99	94	16	8
1996	208	149	99	96	16	1
1997	207	153	99	78	16	6

* Prior to 1987 these licenses were New Brunswick inshore licenses.

Table 2. Mean number of scallops <80 mm per standard tow by stratum and year for stratified random survey.

	Centreville	Gulliver's Head		Digby Gut	Delaps Cove		Young Cove		
		CV to GH	GH to DG		DG to DC		Parker's Cove		Hampton
1991	30.00	n/a	16.50	4.60	11.636	14.50	6.214	4.167	16.000	16.700
1992	10.83	n/a	13.67	6.75	31.750	68.17	15.500	41.750	13.750	16.833
1993	10.25	n/a	11.88	14.80	9.286	4.60	4.600	3.667	12.500	3.100
1994	n/a	17.00	17.88	27.12	111.929	31.88	16.750	6.500	7.333	3.125
1995	15.25	14.83	16.50	44.88	84.833	36.62	13.700	9.000	1.200	2.100
1996	15.12	7.50	22.00	19.17	23.125	24.88	12.083	12.500	7.600	8.300
1997	14.86	23.78	26.02	50.02	24.592	11.73	4.712	2.688	11.738	10.043

Table 3. Mean number of scallops >=80 mm per standard tow by stratum and year for stratified random survey.

	Centreville	Gulliver's Head		Digby Gut	Delaps Cove		Young Cove		
		CV to GH	GH to DG		DG to DC		Parker's Cove		Hampton
1991	339.17	n/a	234.6	217.80	228.32	142.67	154.86	187.00	139.50	172.70
1992	280.67	n/a	262.2	184.50	131.75	135.17	132.50	114.75	125.25	198.50
1993	173.38	n/a	230.1	156.00	163.50	116.20	67.40	84.67	63.20	116.70
1994	n/a	116.8	170.1	145.75	131.43	102.25	77.12	73.57	53.42	38.12
1995	132.12	140.3	146.4	65.12	97.56	58.50	56.90	40.17	18.90	36.70
1996	89.88	28.0	141.0	120.17	76.81	68.25	34.17	50.25	40.10	46.30
1997	60.35	115.8	137.3	113.30	112.48	51.78	23.26	32.56	22.95	26.17

Table 4. Mean number of scallops of all sizes per standard tow by stratum and year for stratified random survey.

	Centreville	Gulliver's Head		Digby Gut	Delaps Cove		Young Cove		
		CV to GH	GH to DG		DG to DC		Parker's Cove		Hampton
1991	369.17	n/a	251.1	222.4	239.95	157.17	161.07	191.17	155.50	189.40
1992	291.50	n/a	275.8	191.2	163.50	203.33	148.00	156.50	139.00	215.33
1993	183.62	n/a	242.0	170.8	172.79	120.80	72.00	88.33	75.70	119.80
1994	n/a	133.8	188.0	172.9	243.36	134.12	93.88	80.07	60.75	41.25
1995	147.38	155.2	162.9	110.0	182.39	95.12	70.60	49.17	20.10	38.80
1996	105.00	35.5	163.0	139.3	99.94	93.12	46.25	62.75	47.70	54.60
1997	75.21	139.6	163.3	163.3	137.07	63.52	27.98	35.25	34.69	36.21

Table 5. Stratified mean number of scallops per standard tow over all strata for 8-16 m part of Eastern Bay of Fundy.

	<80	SE	Lower	Upper	>=80	SE	Lower	Upper	Total	SE	Lower	Upper
1991	13.485	2.892	8.236	19.80	204.52	23.643	160.50	249.70	218.00	25.708	170.6	269.7
1992	24.016	6.447	12.260	36.03	172.36	16.781	141.40	203.30	196.37	21.981	158.2	235.6
1993	8.274	1.377	5.663	10.80	131.65	12.246	109.20	156.90	139.93	12.611	117.4	166.7
1994	32.026	7.925	17.550	48.58	100.46	8.955	82.77	117.78	132.48	12.816	108.8	159.6
1995	26.688	5.304	17.520	37.65	77.94	8.973	61.99	97.43	104.63	11.444	85.2	127.6
1996	15.692	2.221	14.170	20.92	70.76	7.271	57.13	85.58	86.45	7.932	71.4	102.1
1997	17.385	1.778	18.530	22.76	68.74	5.214	58.63	78.56	86.12	5.683	74.5	97.0

Stratified mean numbers with associated standard errors (Thompson, 1992). Bootstrap confidence limits for 95% CI's (1000 reps, BWR method, Smith 1997).

Table 6. Biomass estimates (kg meat weight) for a polygon of 391.5 square kilometers falling within the surveyed area in all 6 surveys conducted in the Cape Spencer area.

Year	Standard Biomass Estimate		Contoured Biomass Estimate
1987	346,507	± 63,255	383,693
1989	734,556	±211,146	567,300
1990	235,777	± 93,231	156,696
1991	262,127	±103,045	219,003
1996	89,342	± 27,812	67,580
1997	54,607	± 18,698	46,104

Table 7. Historic trends in Area 1 from Full Bay logbooks. Class 1 data is logbook records for which all catch effort and location information is complete. Matching of the database to the new SPA's is not complete so these numbers are preliminary.

Year	# Vessels	Total FB* Catch(t)	Logged Catch(t)	% Logged	Class 1 Catch	Class 1 Effort (h)	Average CPUE	n	Standard Deviation
80	33	179	92	52	92	2,989	33.5	490	15.2
81	39	215	69	32	69	2,205	33.5	343	18.9
82	34	167	85	51	82	2,671	32.7	434	16.0
83	57	283	201	71	174	9,312	20.2	1,342	9.1
84	59	297	230	78	214	14,297	17.3	1,918	11.6
85	55	326	239	73	220	16,865	14.1	1,913	6.9
86	34	266	68	26	63	5,396	12.5	663	5.8
87	19	561	45	8	44	2,656	24.2	342	30.3
88	14	756	81	11	64	2,241	34.5	305	25.3
89	20	1855	168	9	121	2,968	45.5	412	30.6
90	13	2089	266	13	218	8,127	29.2	871	16.0
91	19	710	151	21	95	4,873	20.7	498	15.2
92	49	961	730	76	541	26,257	22.3	2,608	13.3
93	56	602	296	49	176	13,098	14.0	1,146	5.6
94	61	232	152	66	73	6,268	11.9	599	4.9
95	63	373	219	59	131	15,284	8.8	1,302	3.0
96	61	186	110	59	67	8,587	7.9	843	3.5
97	79	106	113	106**	101	15,949	6.6	1,866	3.0

* 1980-1996 estimated by prorating total Full Bay landings by logbook data, accuracy varies with the number of vessels submitting logbooks. 1997 is the first year for which landings were recorded by the new SPA's by Statistics Branch.

** There are currently differences in the way the Statistics Branch and the Science Branch computer programs assign landings along the Area 1:Area 4 boundary. Statistics Branch show 22 tonnes caught in Area 4 in 1997 during the times it was closed, these landings most likely came from Area 1.

Table 8. Meat weight data for Port Samples from Full Bay vessels in Area 1 for 1997.

Year	Month	N	Mean	StDev	Min	Max	Count	Sum
Area 1 (< 8 miles Sandy Cove, Young Cove, & Hampton)								
96	3	109	22.45	8.68	4.9	37.5	22.3	2446.9
96	4	65	22.07	10.32	5.9	52.5	22.7	1434.5
96	9	35	16.95	3.86	8.0	25.4	29.5	593.3
97	2	446	19.53	7.08	5.3	38.9	25.6	8709.6
97	3	460	18.42	7.24	4.3	49.2	27.1	8471.7
97	4	38	22.09	6.64	9.4	35.4	22.6	839.3
97	5	216	16.04	5.84	4.0	38.4	31.2	3465.2
97	7	249	15.11	6.47	6.1	37.5	33.1	3762.8
97	8	86	23.92	10.41	7.6	44.4	20.9	2057
97	9	183	22.76	8.04	4.7	40.0	22.0	4164.9
97	10	88	25.03	5.95	15.9	38.8	20.0	2202.8
Area 1 (Outside Traditional Fishing grounds)								
96	2	284	16.51	7.49	5.1	36.8	30.3	4689.8
96	3	299	15.03	8.12	3.7	39.1	33.3	4494.0
96	4	523	14.17	8.15	3.1	40.4	35.3	7410.0
96	5	550	14.27	6.57	3.2	39.6	35.0	7850.5
96	6	198	20.00	9.47	2.0	51.0	25.0	3960.7
96	7	36	18.6	1.95	14.6	24.1	26.9	669.5
96	8	1152	11.19	5.16	4.0	31.0	44.7	12894.4
96	9	252	17.73	5.01	7.3	32.1	28.2	4467.7
96	10	154	15.41	4.72	5.2	26.8	32.4	2372.8
96	11	150	18.85	8.25	4.3	46.8	26.5	2827.7
96	12	476	9.53	2.13	4.8	19	52.5	4536.7
97	3	194	16.98	7.95	4.0	43.1	29.4	3293.2
97	4	448	15.91	5.22	3.2	34.9	31.4	7127.3
97	5	118	13.24	5.57	2.5	24.4	37.8	1562.1
97	6	119	18.10	2.27	12.9	25.4	27.6	2154.4

Table 8 continued. Meat weight data for Port Samples from Full Bay vessels in Area 1 for 1997.

Year	Month	N	Mean	StDev	Min	Max	Count	Sum
Area 1 (Traditional Fishing grounds 8-16 miles Sandy Cove - Hampton)								
96	1	93	11.76	6.42	5.4	36.4	42.5	1093.9
96	2	438	14.43	7.73	3.9	38.3	34.7	6321.4
96	3	348	17.72	8.89	3.6	43.5	28.2	6166.9
96	4	458	16.90	8.14	4.0	52.7	29.6	7741.0
96	5	103	14.37	7.23	3.6	31.2	34.8	1480.6
96	6	366	11.71	5.38	3.4	33.5	42.7	4287.2
96	7	246	13.65	5.78	4.6	30.6	36.6	3357.8
96	8	612	9.93	3.61	4.3	31.4	50.4	6075.7
96	9	37	16.53	4.1	8.9	24.7	30.2	611.6
96	11	328	7.72	2.55	5.0	23.2	64.8	2532.3
96	12	225	10.09	3.65	5.1	34.5	49.6	2270.7
97	2	351	19.73	4.99	5.8	35.1	25.3	6924.4
97	3	755	19.17	5.67	7.0	57.3	26.1	14474.1
97	4	648	17.18	3.61	3.0	30.6	29.1	11132.9
97	5	775	16.98	4.32	4.1	30.9	29.4	13162.5
97	6	473	18.35	3.77	8.7	31.1	27.2	8678.0
97	7	975	14.51	7.00	3.9	52.0	34.5	14144.7
97	8	511	14.40	6.57	6.4	41.8	34.7	7358.4
97	9	827	21.40	8.13	3.7	46.2	23.4	17698.9
97	10	198	22.72	4.38	16.2	37.4	22.0	4497.6
97	12	508	23.61	3.97	16.2	39.8	21.2	11992.8

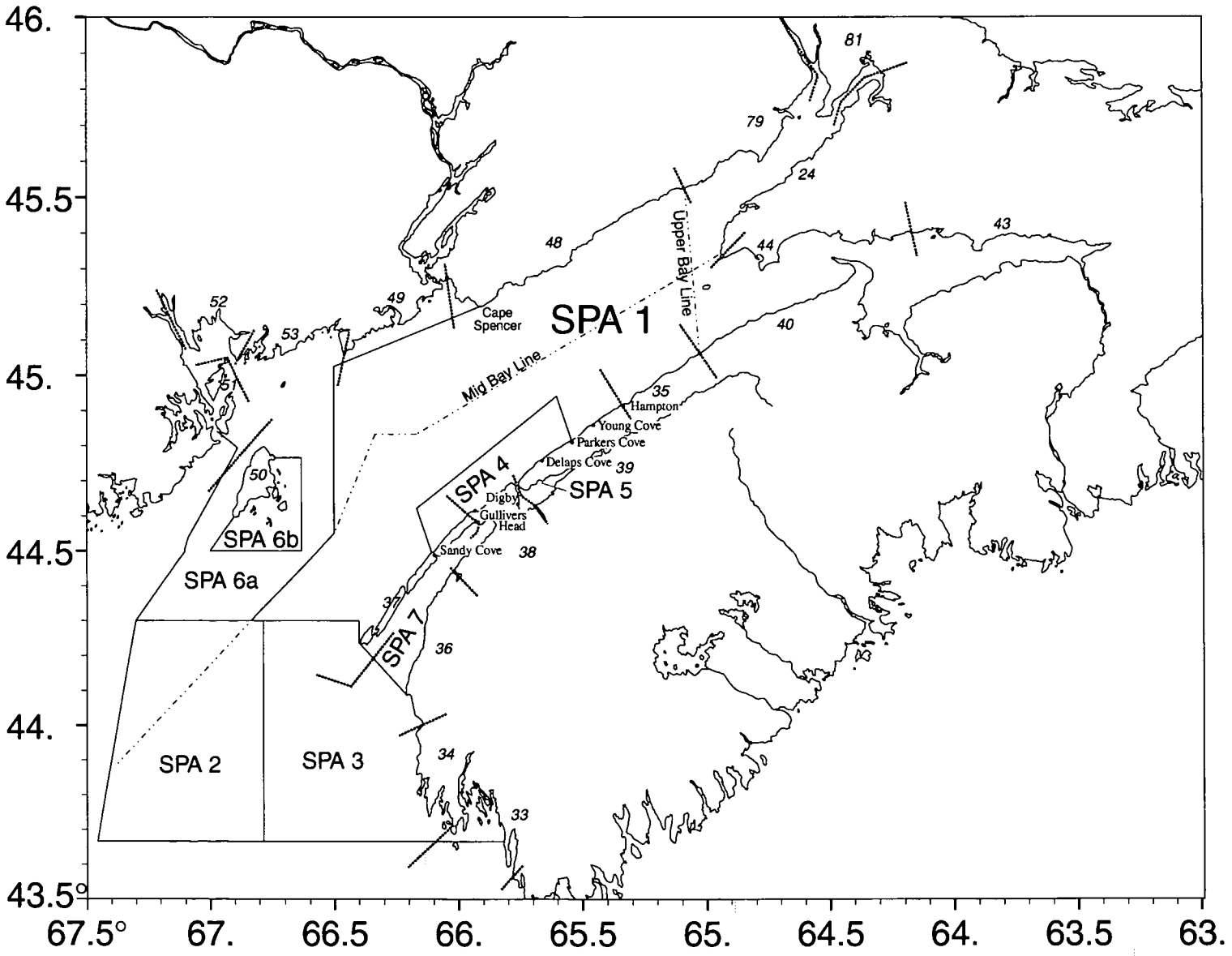


Figure 1. - Scallop Production Areas (SPA's), regulated lines and Statistical Districts in the Bay of Fundy.

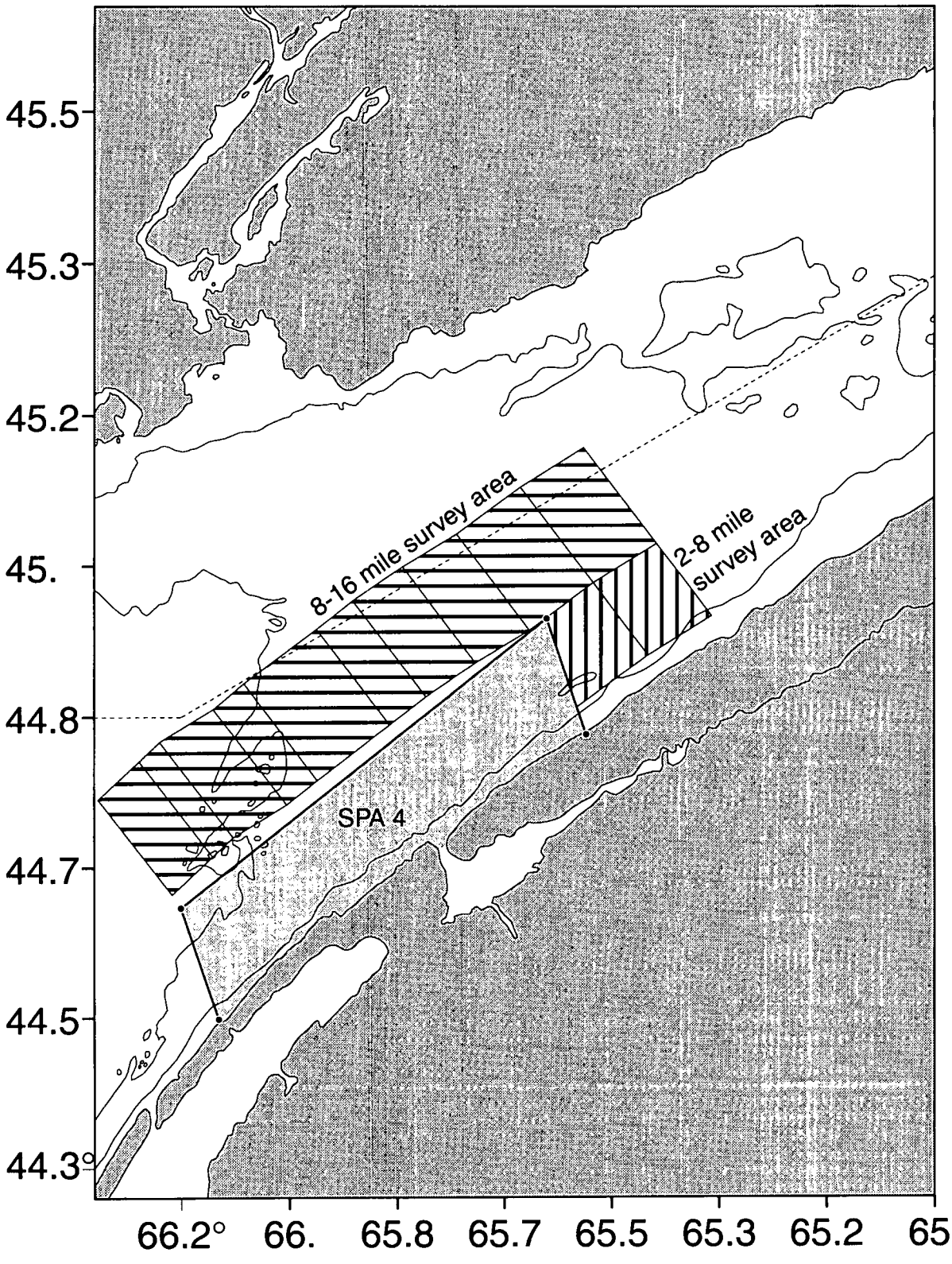
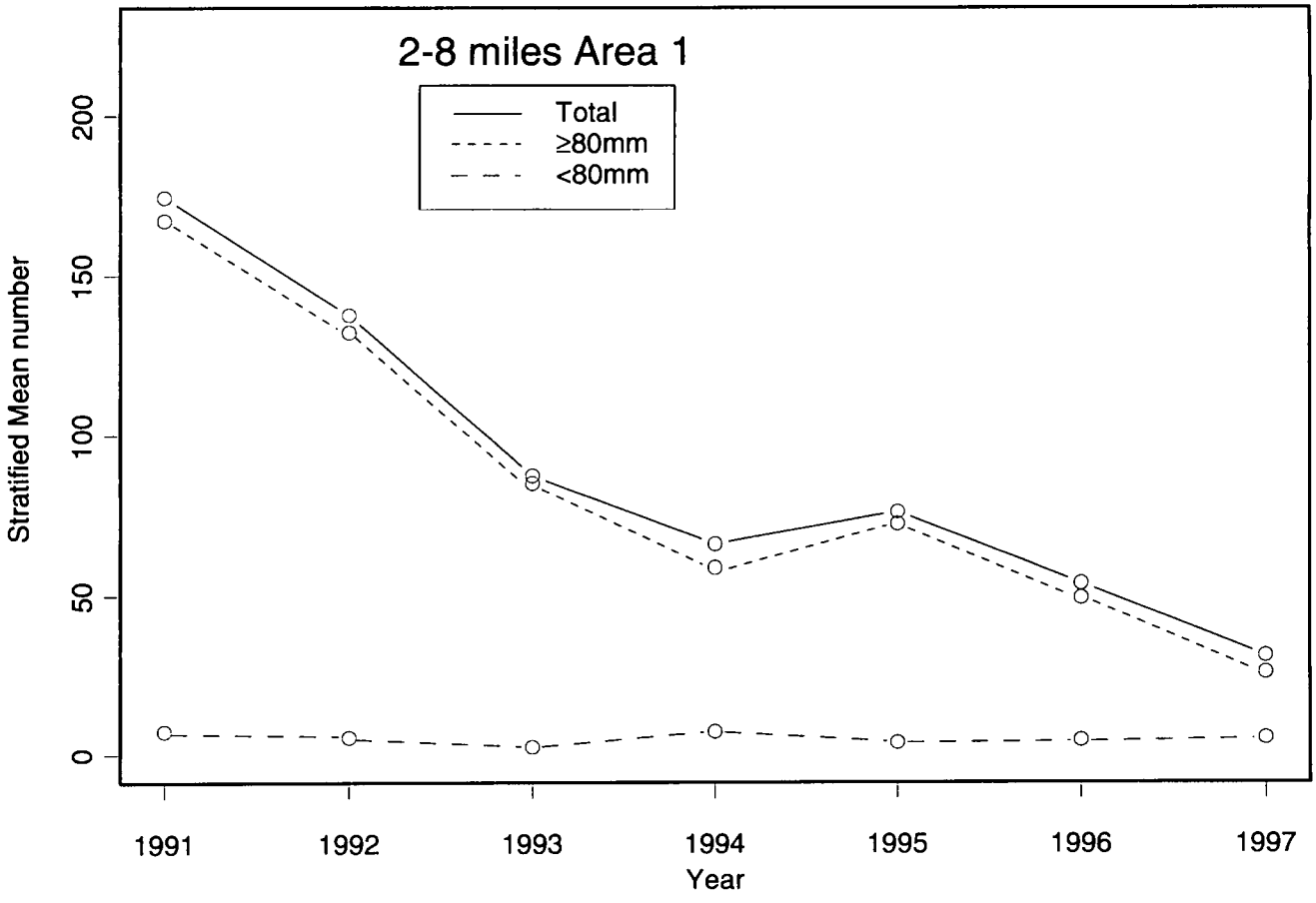


Figure 2. - The 8-16 and 2-8 mile sections of Area 1 that have a series of annual surveys.



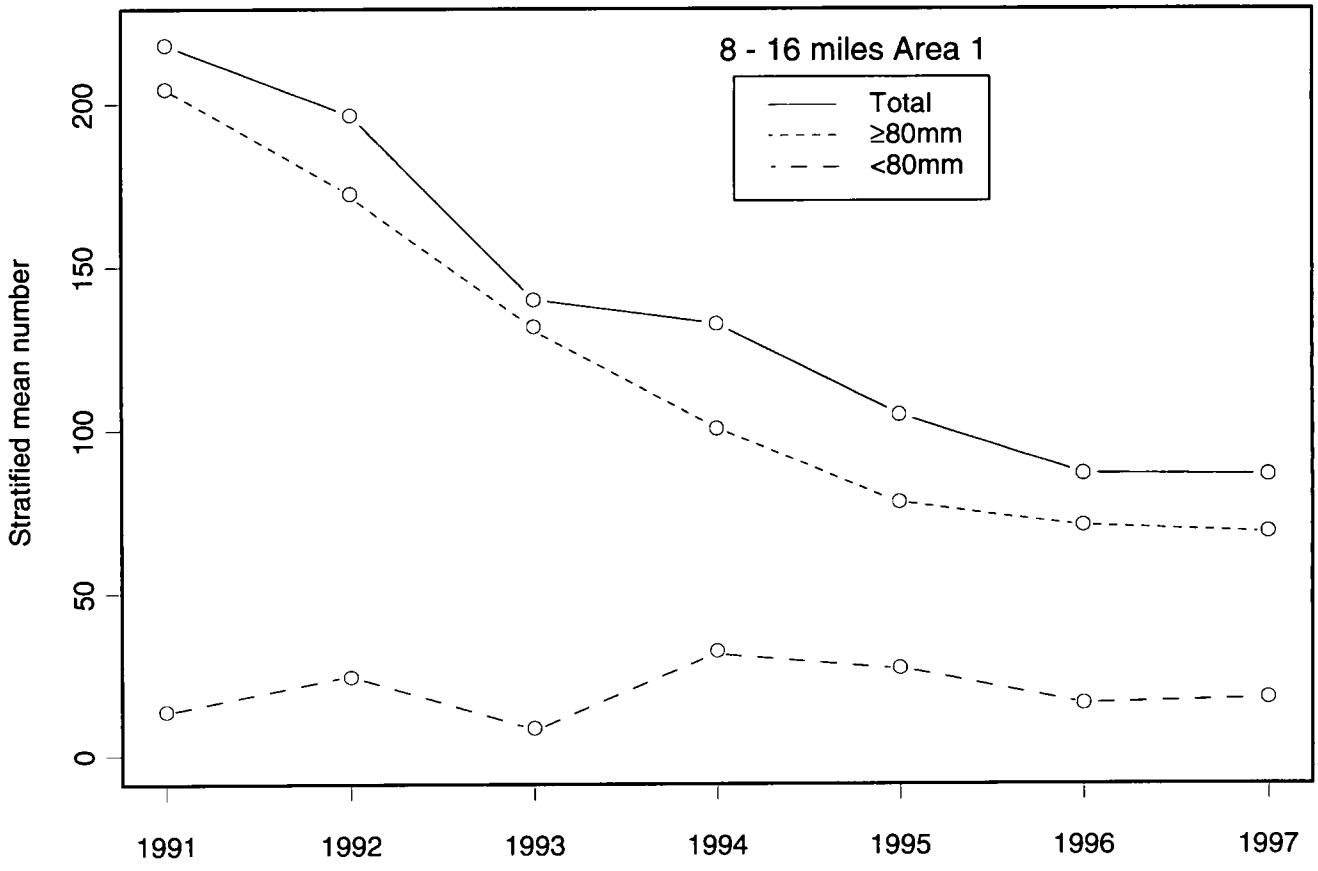


Figure 3. Trends in mean number of scallops per standard tow for the Digby 2-8 and 8-16 mile grounds of Area 1.

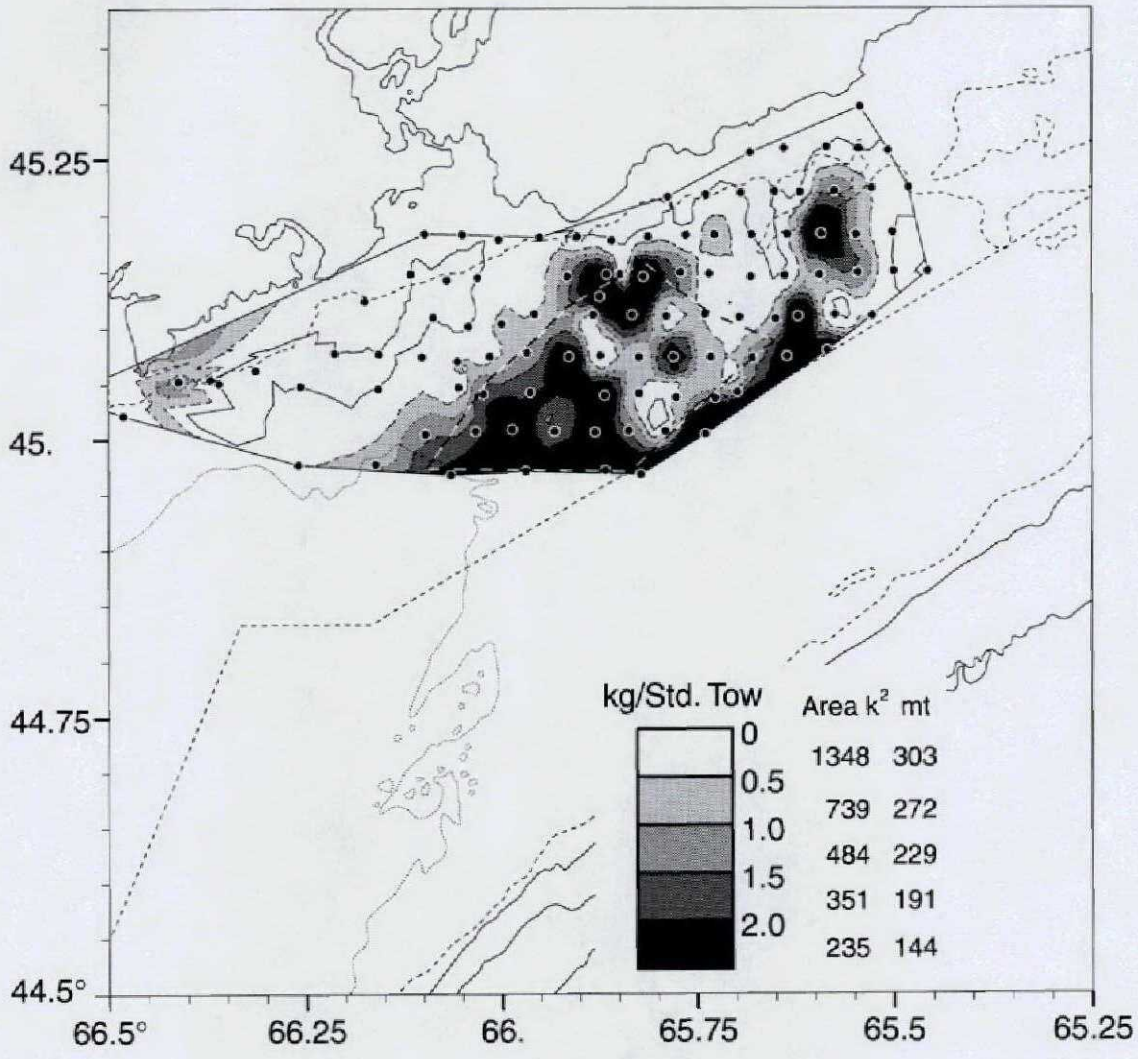


Figure 4.- Total meat weight for scallops >= 80mm per standard tow for the 1987 Cape Spencer survey. Dashed line shows polygon common to all six surveys that was used to examine trends.

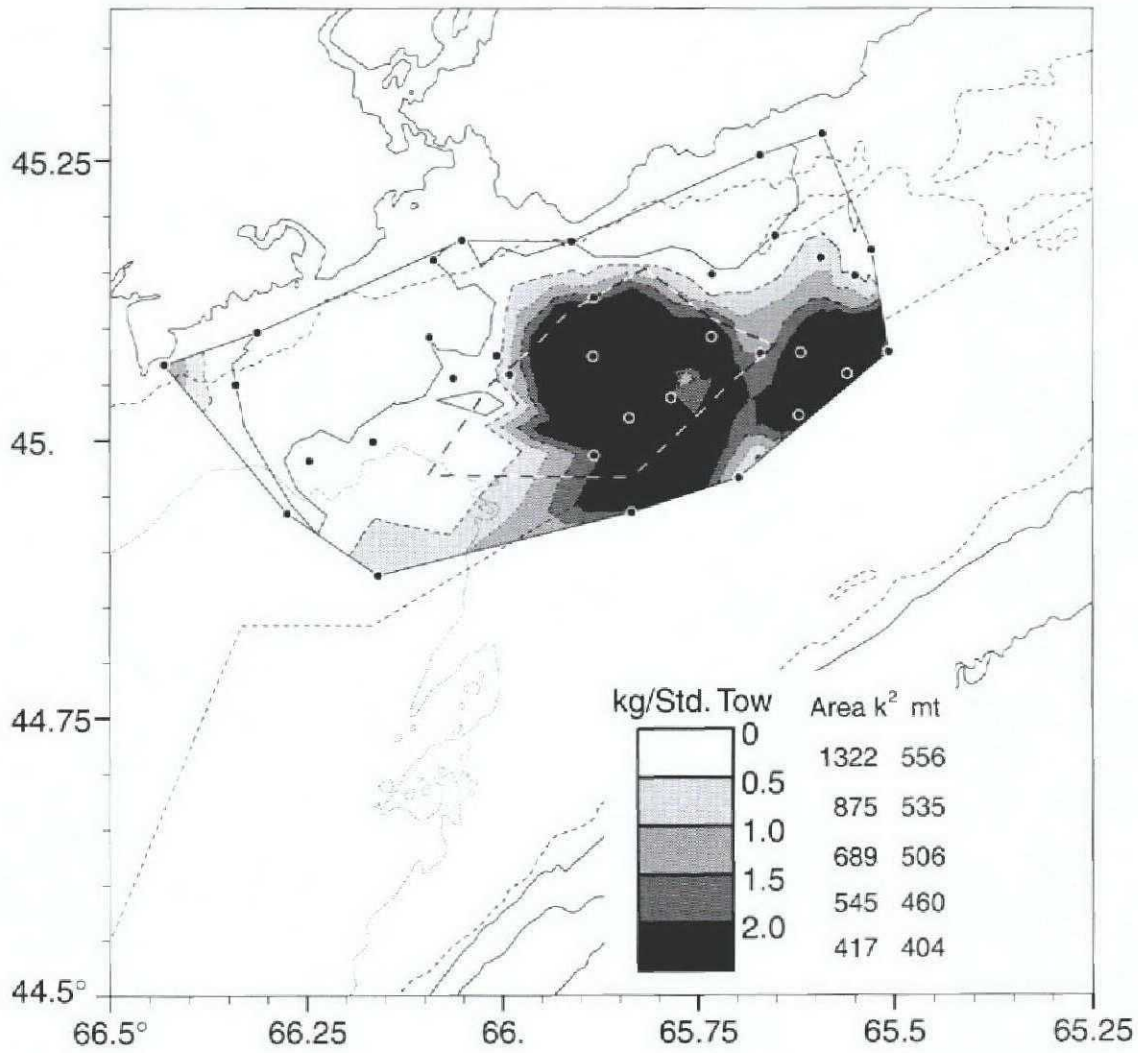


Figure 5.- Total meat weight for scallops >= 80mm per standard tow for the 1989 Cape Spencer survey. Dashed line shows polygon common to all six surveys that was used to examine trends.

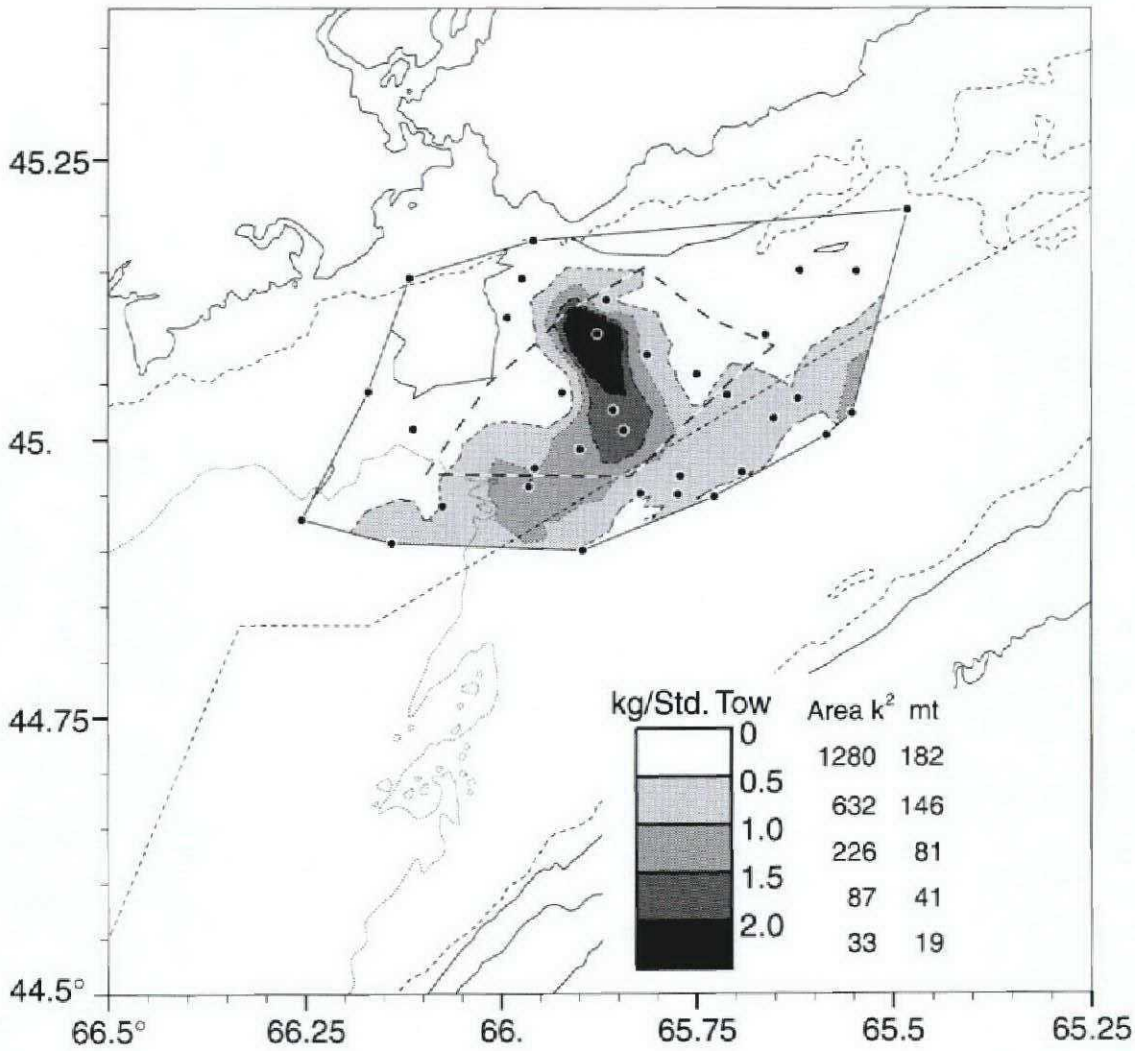


Figure 6.- Total meat weight for scallops >= 80mm per standard tow for the 1990 Cape Spencer survey. Dashed line shows polygon common to all six surveys that was used to examine trends.

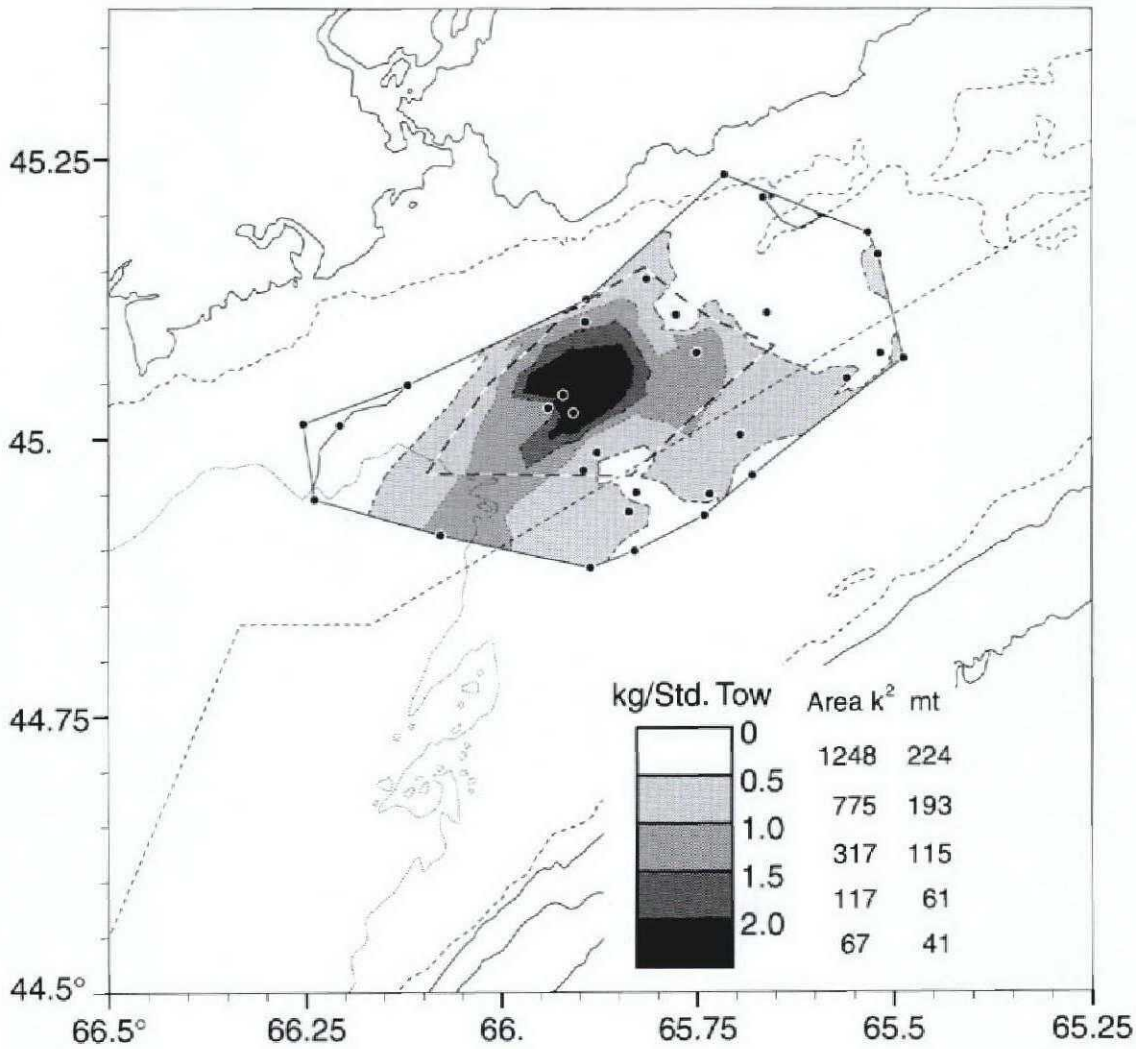


Figure 7.- Total meat weight for scallops >= 80mm per standard tow for the 1991 Cape Spencer survey. Dashed line shows polygon common to all six surveys that was used to examine trends.

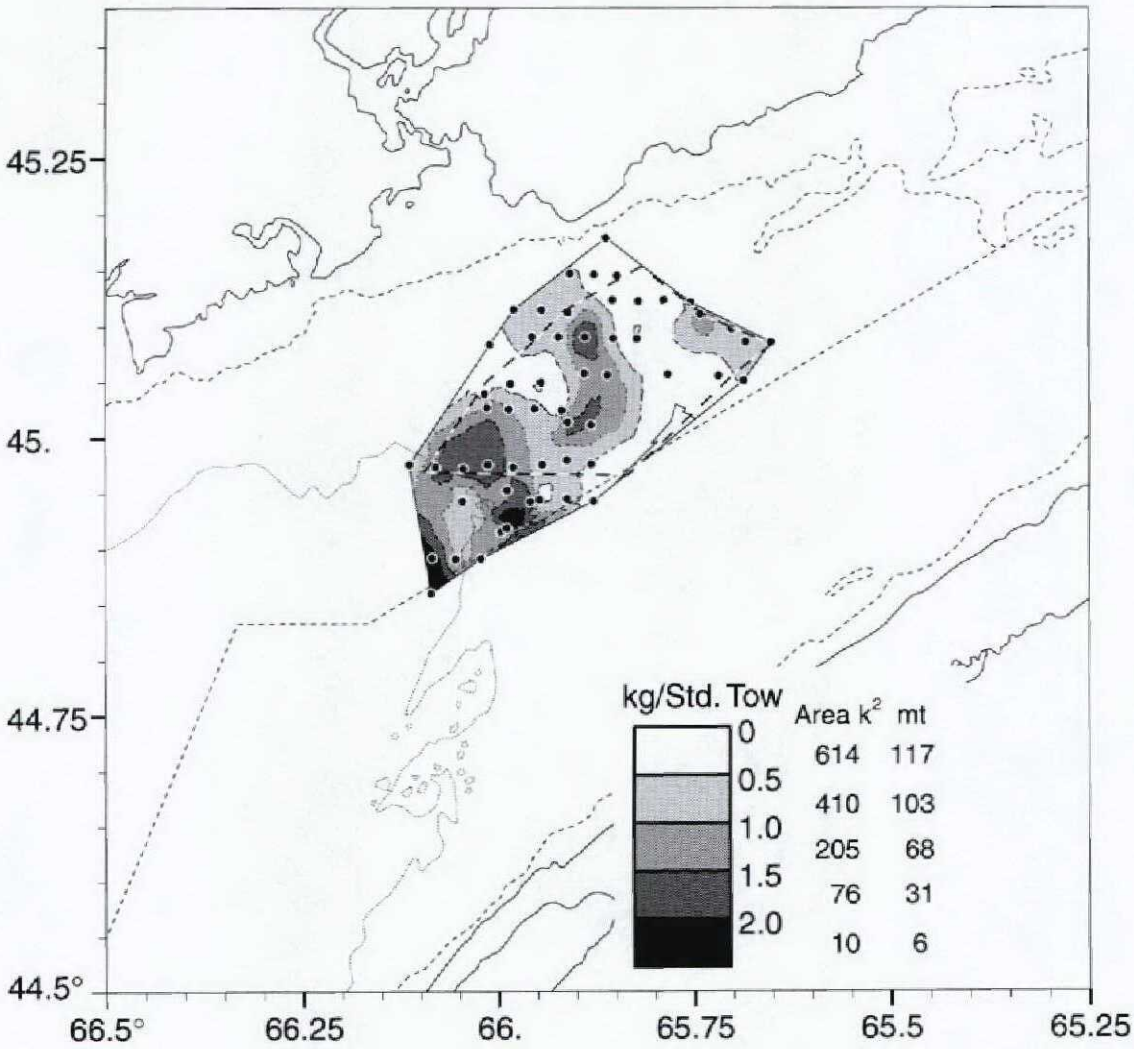


Figure 8.- Total meat weight for scallops >= 80mm per standard tow for the 1996 Cape Spencer survey. Dashed line shows polygon common to all six surveys that was used to examine trends.

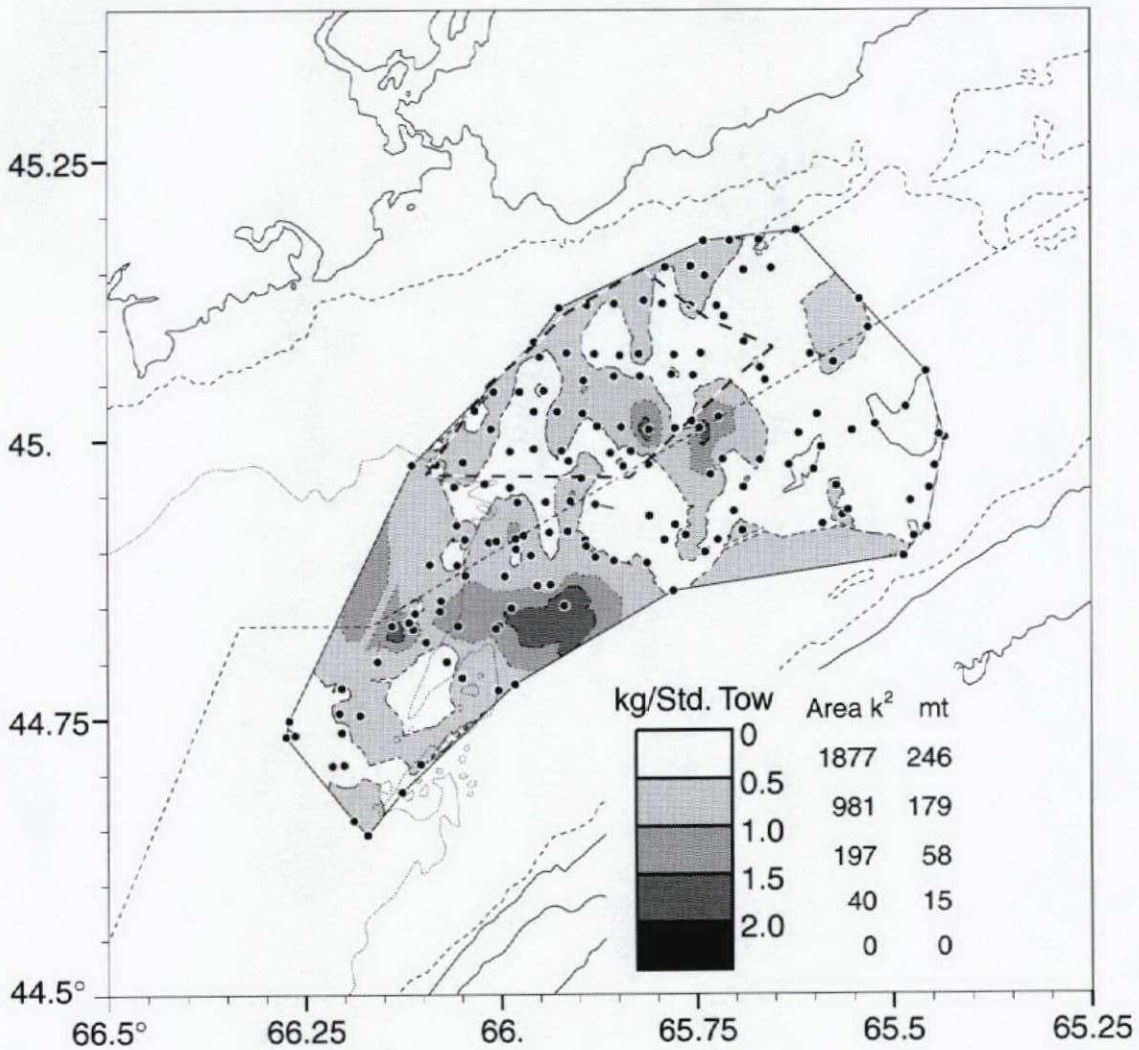
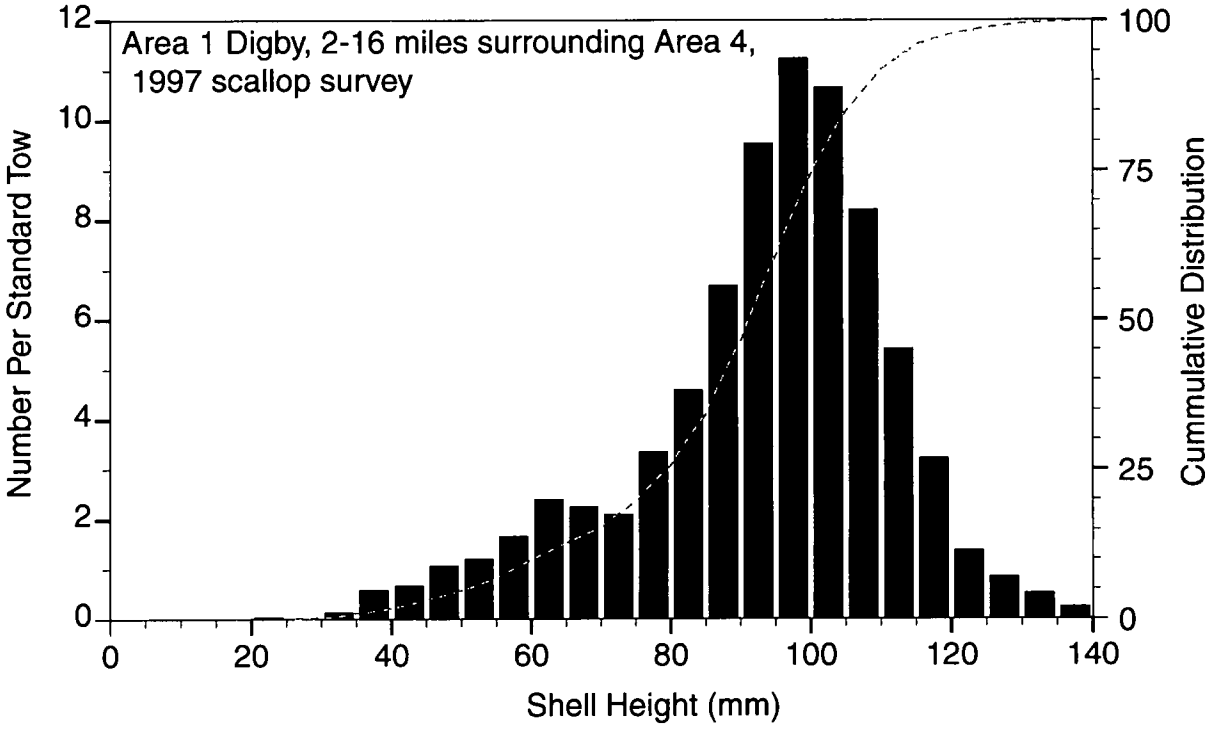


Figure 9.- Total meat weight for scallops >= 80mm per standard tow for the 1997 Cape Spencer survey. Dashed line shows polygon common to all six surveys that was used to examine trends.



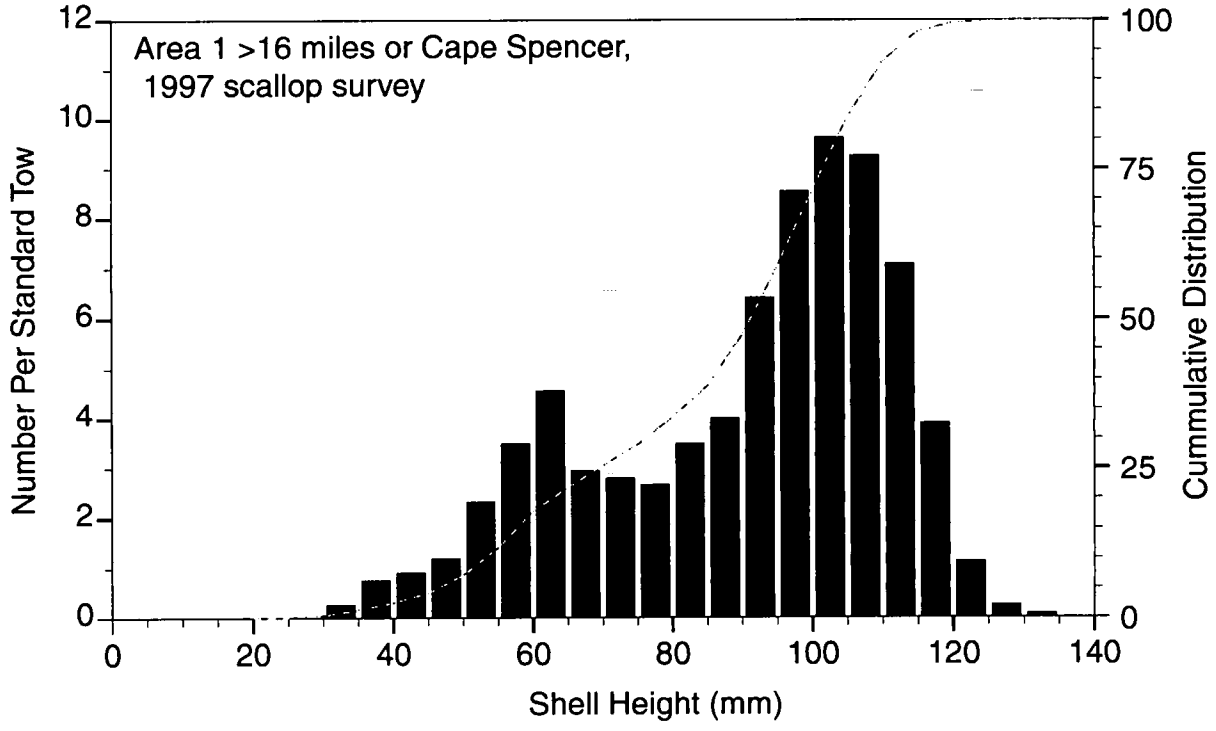


Figure 10. - Shell height frequencies for the traditional Digby and Cape Spencer Areas, 1997 survey data

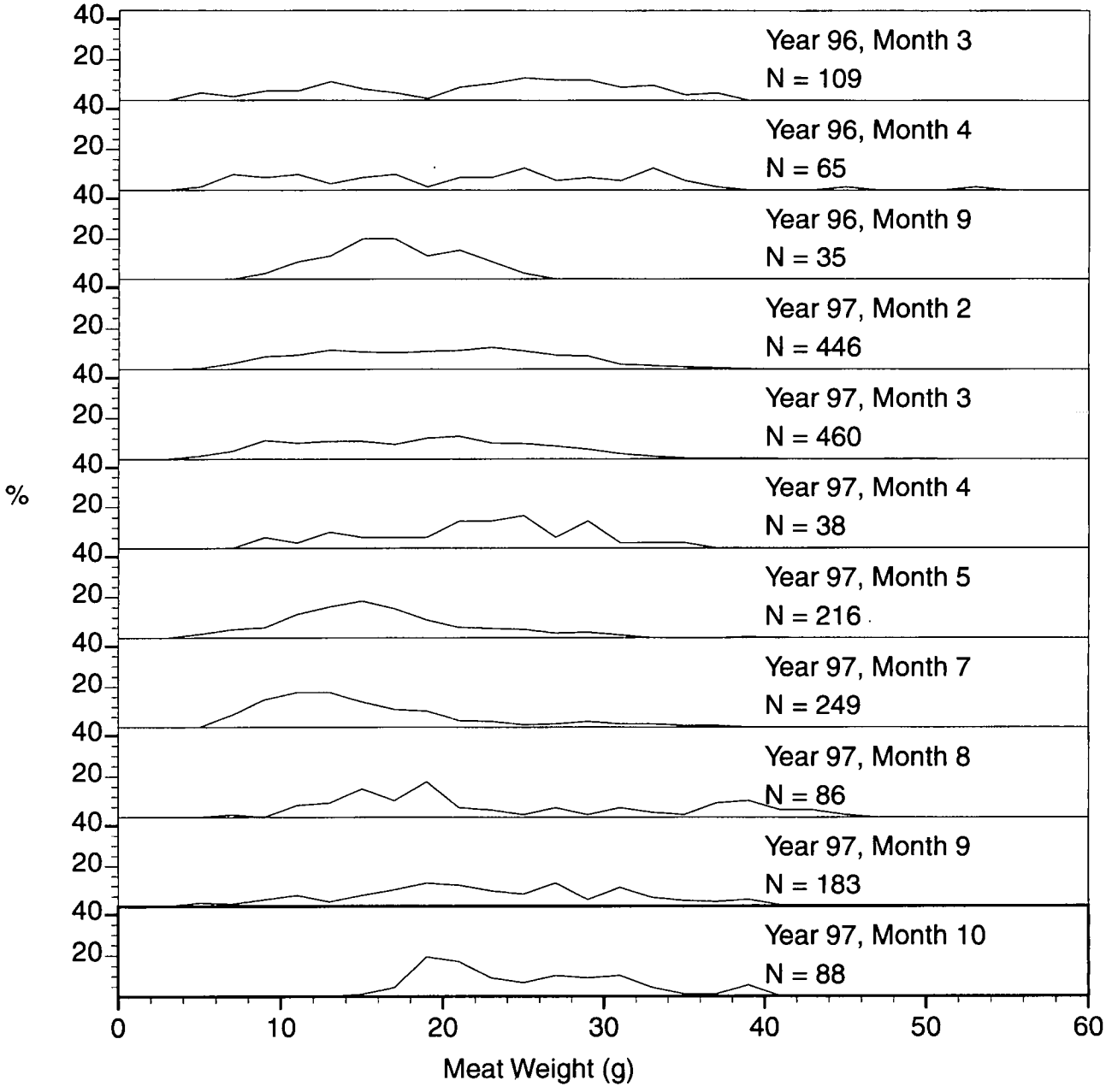


Figure 11. Meat weight distribution for port samples from vessels fishing in Area 1 in the Digby grounds < 8 miles from shore above and below Area 4 (Off Sandy Cove, Young Cove and Hampton).

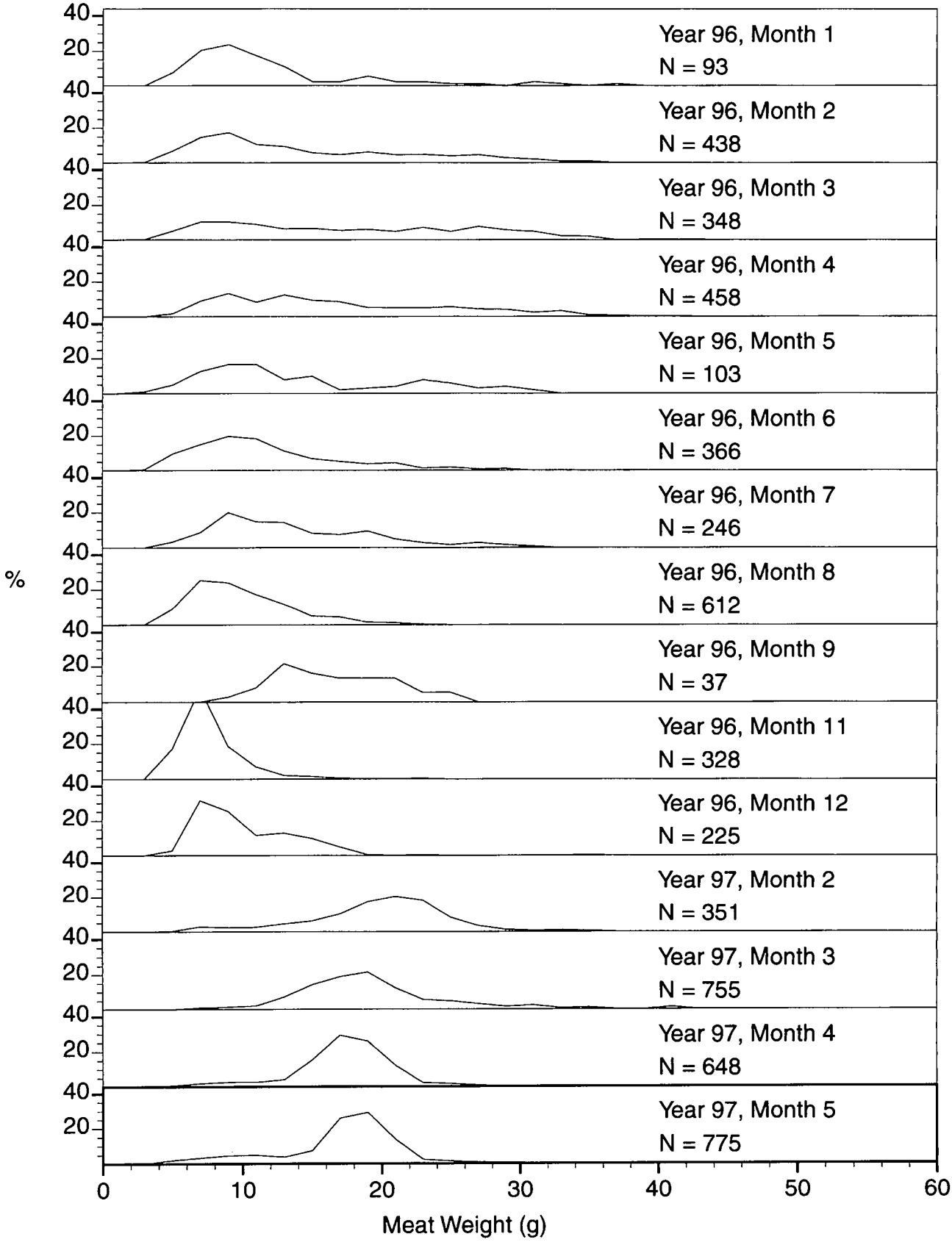


Figure 12a. Meat weight distribution for port samples for vessels fishing in the Digby outer area (8-16 miles offshore from Sandy Cove to Hampton).

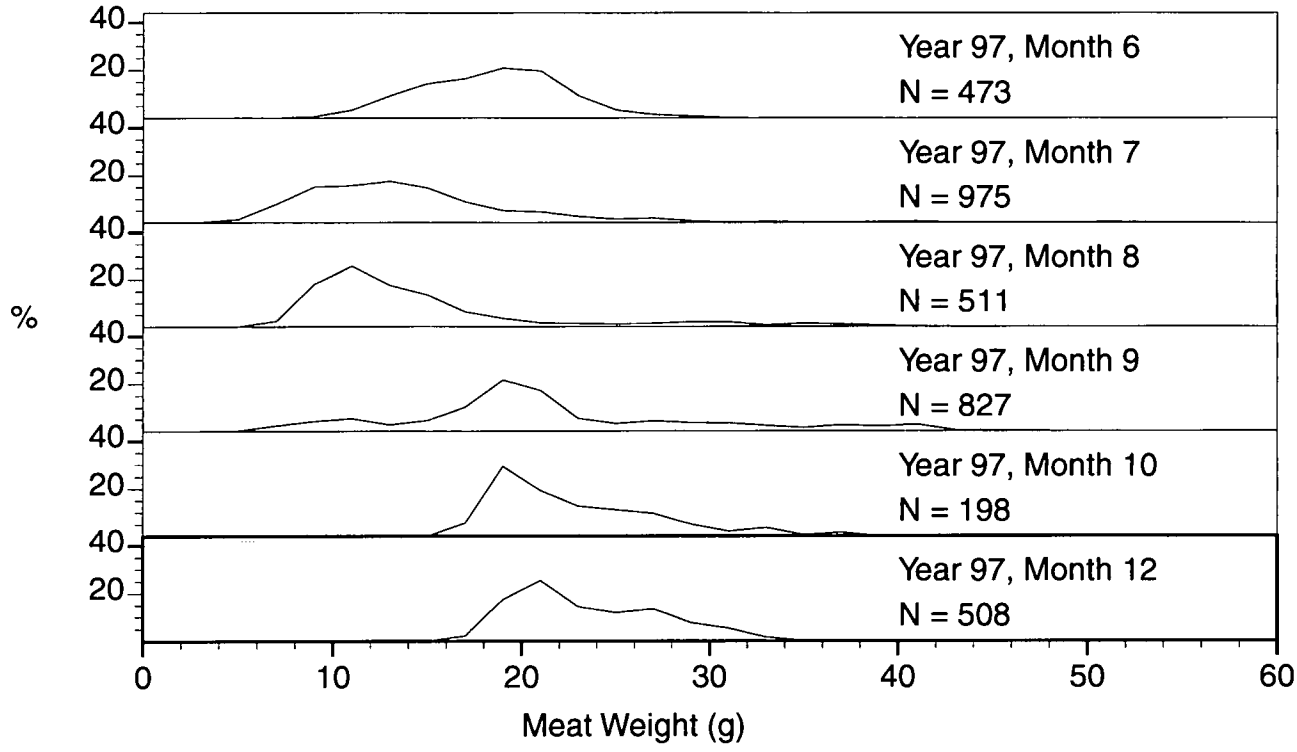


Figure 12b. Meat weight distribution for port samples for vessels fishing in the Digby outer area (8-16 miles offshore from Sandy Cove to Hampton).

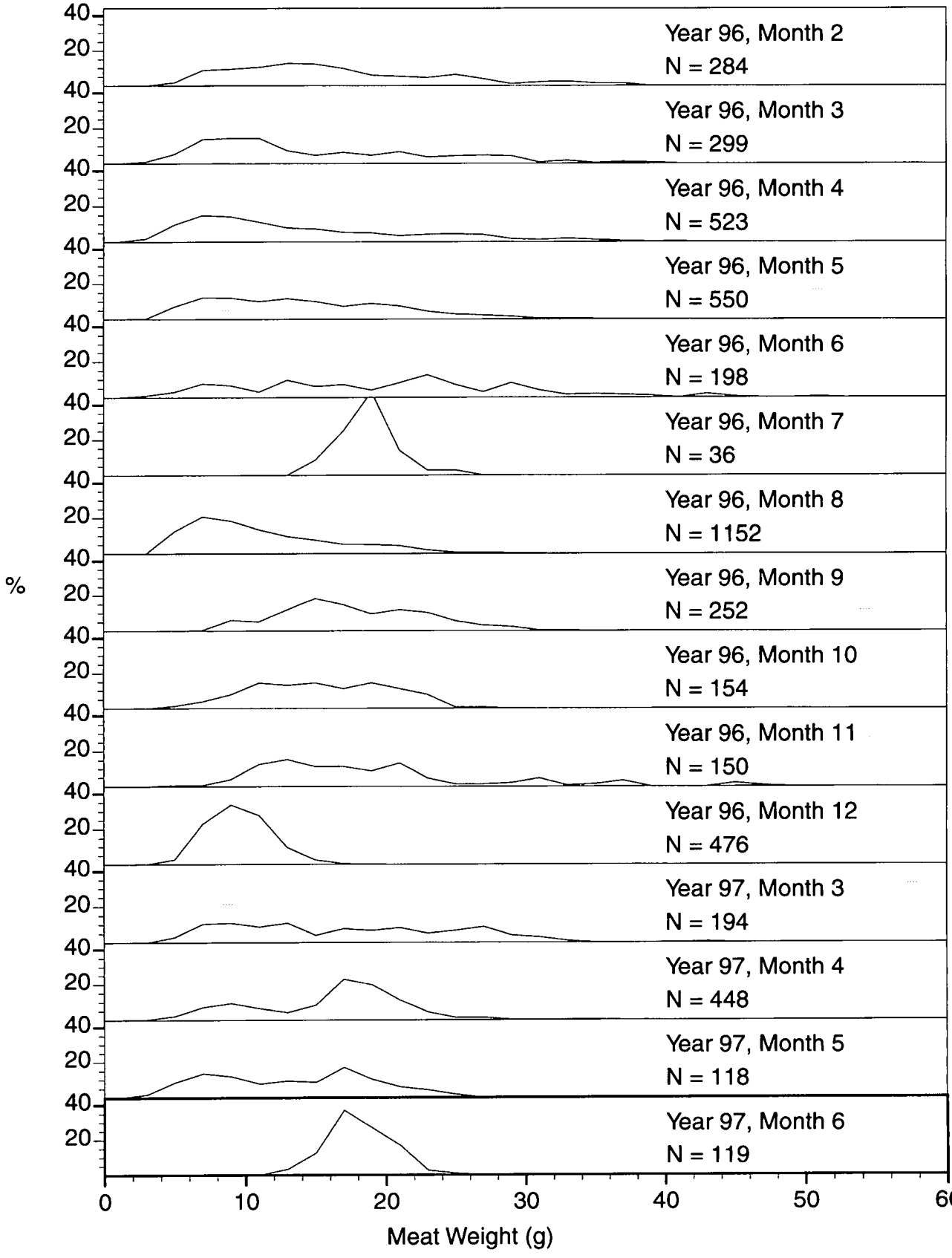


Figure 13. Meat weight distribution for port samples from vessels fishing in Area 1 outside the area <16 miles offshore from Sandy Cove to Hampton.

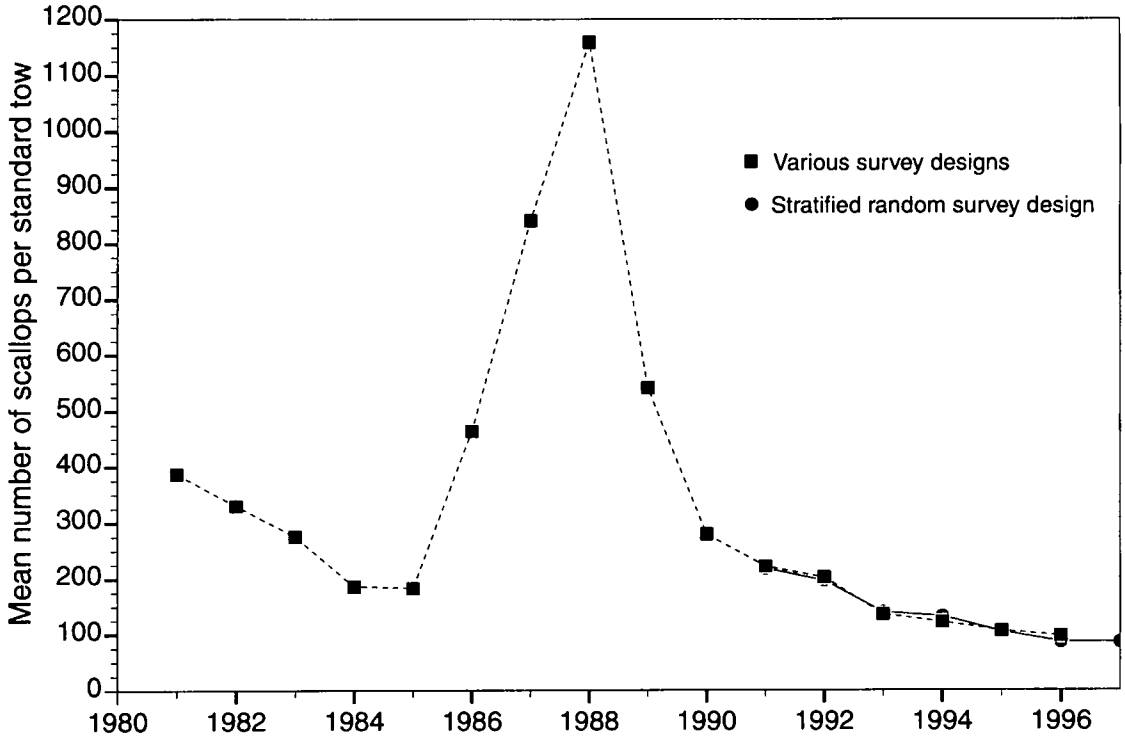


Figure 14. Survey estimates of scallop densities for the 8-16 mile area from Sandy Cove to Hampton.

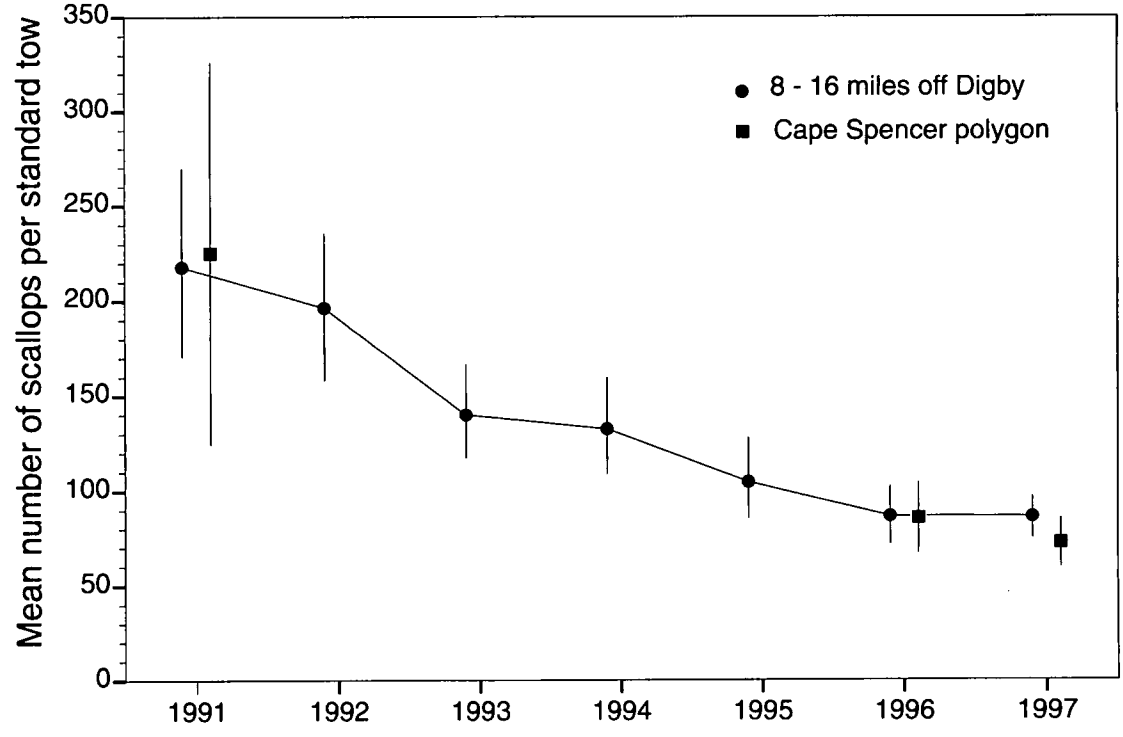


Figure 15. Comparison of survey estimates of scallop densities for the 8-16 mile area off Nova Scotia and the Cape Spencer Area.

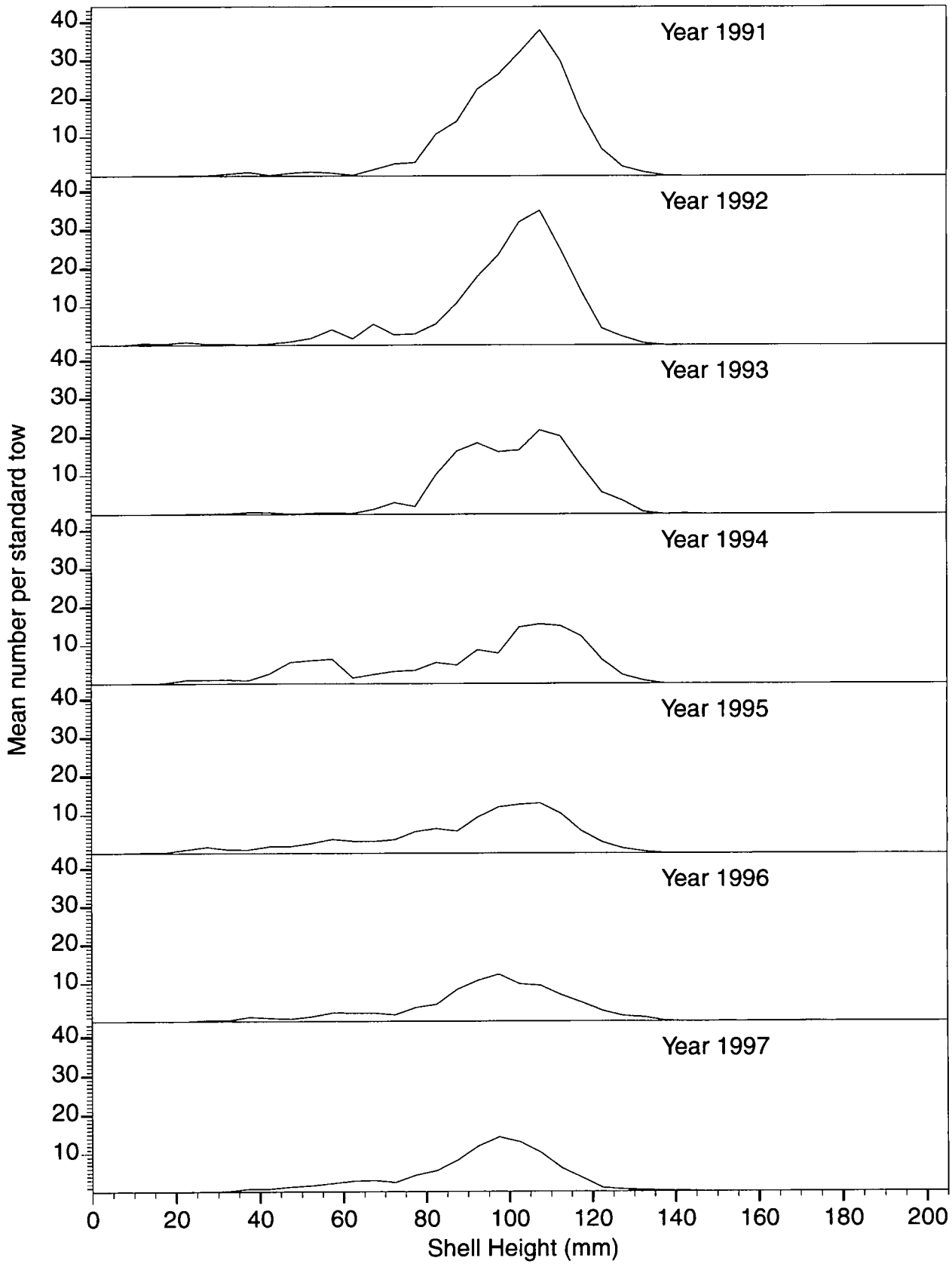


Figure 16. Survey estimates of the mean numer of scallops per standard tow at height for the area 8-16 miles offshore from Sandy cove to Hampton, Nova Scotia.