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Georges Bank (5Z) Herring 1993 Update

by

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Abstract

The 1992 Canadian and United States fall herring survey data for Georges Bank are updated. Both surveys indicate that this stock continues to show strong signs of recovering. The Canadian larval index continued its general upward trend, after a decline in 1991 and the distribution of recently hatched larvae increased substantially, with observations on the Canadian portion of the bank. The US adult herring bottom trawl index (Catch/tow) decreased slightly, but represents the second largest in more than 20 yr. Age 3 and 4 fish again dominated catches indicating good recruitment to the spawning stock. In 1992 three independent surveys documented the extension of spawning into historical spawning areas on the Northeastern peak. An experimental herring fishery was also approved for 1993.

Résumé

On met à jour les données des relevés de recherche sur les stocks de hareng du banc Georges réalisés en 1992 par le Canada et par les États-Unis. Il ressort de ces deux relevés que le stock de hareng en question continue de présenter des signes très nets de rétablissement. L'indice d'abondance larvaire établi par les Canadiens poursuit sa courbe ascendante, après avoir chuté en 1991, et la distribution des larves venues récemment à éclosion a notablement augmenté, d'après les observations réalisées sur la partie canadienne du banc. L'indice d'abondance du hareng adulte établi par les Américains au moyen de captures au chalut de fond (prises par trait) a légèrement diminué, mais suit au deuxième rang le niveau record en plus de vingt ans. Une fois encore, les poissons de trois et quatre ans étaient prédominants parmi les prises canadiennes, ce qui révèle un bon recrutement du stock de géniteurs. En 1992, trois relevés de recherche indépendants ont permis de confirmer que le frai s'est étendu aux frayères historiques de la pointe nord-est. Une pêche expérimentale du hareng a été approuvée pour 1993.

Introduction

Prior to its collapse in 1977, Georges Bank supported the largest Atlantic herring fishery on the western Atlantic. During the late 1960's and early 1970's, reported commercial landings exceeded 200,000 mt annually. The fishery peaked in 1968 with reported landings in the 374,000 mt range (Fogarty et al. 1989), however actual landings may have been substantially higher. By 1977 reported landings had declined to less than 2,000 mt. The collapse of this stock has been attributed to over-fishing and poor recruitment.

The recovery of Georges Bank herring stock has been monitored by annual fall adult/larval surveys since 1986. Each year the data has generally indicated an increasing relative level of abundance of herring on the bank. Details of the recovery are provided by Stephenson et al, 1989 and Melvin et al (1991) and the status of the stock until 1991 in Melvin et al (1992).

As in previous years the information available on stock status is presented in an annual update for review. This report represents the third in the series and incorporates the most recent data from the 1992 Canadian fall adult/larval herring and the US fall bottom trawl survey.

Data Sources

The sources of data in this update are the same as those of past years, except another year's data has been added and a few new sources of information have been incorporated. In 1992 the Canadian survey was again expanded to cover, geographically, not only the entire northeastern portion of the bank, but a large area west of the original survey grid (Fig. 1). Data are from the Canadian fall adult/larval herring survey (P049/P421), and the US fall bottom trawl survey (DL9206). In addition, the data obtained from the 1992 fall seiner survey (Melvin and Fife, 1993) are discussed where appropriate.

In 1992 major problems were encountered with vessel availability and the survey was conducted with 2 ships instead of the traditional one. While the larval component of the survey, delayed 3 weeks, was extremely successful the ground fishing section (P421) is not considered reliable. The vessel, the "E.E. Prince" because of its size could not operate the standard bottom trawl gear nor work on a continuing basis. The data collected from the survey are extremely limited and not comparable with previous years. All data transformations used in former years were again applied in this summary.

Adult Distribution

The Canadian fall bottom trawl survey data were extremely poor, in 28 sets only 36 adult/juvenile herring were collected on the bank. The distribution of sampling locations and catches with and without herring are presented in Fig. 2. Because of the different gear type

and poor catches the data, although presented, are considered not to reflect the distribution of herring on the bank, thus the results are non-comparable with previous years.

The United States 1992 fall bottom trawl survey found the distribution of adult herring west of the International Line consistent with that observed in previous years (Fig. 3). Adult herring were concentrated in an arc between the 100-200 m isobath north of Cultivator shoal to the International Boundary along the northern fringe of Georges Bank. East of the boundary the arc continues from just west of the northern edge in a southeast direction towards the centre of the Canadian portion of Georges Bank. This is further evidence that adult herring have continued to extend their distribution deeper into the Canadian portion of the bank and consistent with the observed concentrations of herring during the fall seiner survey (Melvin and Fife, 1993). As in previous years, few herring were caught in the central or southern areas of the bank. The combined Canada-US survey data for 1992 are presented in Fig. 4 and for 1987-92 in Fig. 5a-e.

Length Frequency

Length frequency data of herring collected during 1992 by Canadian and US surveys, in 1 cm intervals, for Georges Bank, Nantucket Shoal and Massachusetts Bay are presented in Fig. 6. As in past years, there were notable differences between the length frequency of herring caught in Massachusetts Bay and Georges Bank, with Nantucket Shoal fish lying between the two (Fig. 6). Modal length on Georges Bank was 27 cm for both the Canadian (includes length frequency from the seiner survey) and US fall surveys. The length mode was slightly greater in 1991 and slightly less in 1990. The mean length of all herring collected in 1992 by both the Canadian and US fall surveys in the Massachusetts Bay area was the smallest since 1987 but this is based on only four sets (Table 1). For both Nantucket Shoal and Georges Bank the 1992 mean length, although greater, is not significantly different from 1991. Mean length of fish taken by the US survey, which was conducted about five weeks earlier than the Canadian survey, was again larger for all fish as well as for those greater than 20 cm (27.5 vs 26.0 and 27.7 vs 26.2 cm, respectively) (Table 2). A Canadian seiner survey was carried about one week after the US survey. Mean length of all herring from the combined Canadian surveys was 26.6 cm.

Age Distribution

The 1992 Canadian survey was again dominated (72%) by 3- and 4-yr-old herring (Fig. 7). This in part may be due to the limited catches of herring and the inability of the gear to capture larger fish. However, the strong presence of 2-yr-old fish in 1991 is continued forward to 1992 where 3-yr-old herring represent approximately 54% of the total catch. It is also interesting to note that fish 5 yr old and older are well represented (36%) in the 1992 catches. Caution with the direct extrapolation of the age data is however warranted due to the

change in gear type and low catches. Only 36 herring were available to the age distribution for 1992.

The continued strong representation of young fish (4 yr old and younger) in annual catches since 1986 and the general presence of older fish provides evidence of good annual recruitment to the spawning stock and continues to support the expansion of Georges Bank herring. The 1986 and 1987 year-classes are also well represented. No data on the age distribution of the US catch are available to date.

Spawning/Larval Distribution

The majority of herring collected on Georges Bank during the fall Canadian survey were reproductively active adults. Approximately 58% of the fish collected in 1992 were stage 3, suggesting that they were unlikely to spawn. Nineteen percent of the herring were recently spent with only one male containing ripe gonads (Table 3). The observed gonad stages are characteristic given the lateness of the survey and imply that most of the spawning on Georges Bank was complete for the fall of 1992.

The results of the 1992 Canadian larval survey are presented in Fig. 8. The survey was again expanded in 1992 to cover the area west of the original grid where large concentration of larvae were thought to occur in previous years. The 1992 data showed the overall distribution of larvae to be much broader in area than in 1991 when there were very few larvae caught near the International Boundary and when no larvae were found in the southeast portion of the US side of Georges Bank. In 1992 larvae were caught at almost every station sampled except for a few (4) stations just south of the northeastern peak. Larval abundance also was much higher in 1992 than in 1991. The distribution of larvae from 1987-91 are presented in Fig. 9a-e.

Examination of the distribution and abundance of larvae <10 mm revealed several centres of newly hatched larvae, with two on the Canadian portion of the bank. This is a major change from the 1991 surveys and is positive evidence of herring spawning on the Canadian side of Georges Bank. Furthermore, the occurrence larvae <10 mm just east of the boundary is in the approximate location where spawning was documented during the fall seiner survey (October, 1992). The US also reported large concentrations of small larvae in this area during their 1992 November larval survey.

This is the seventh consecutive year that successful spawning on the bank has been demonstrated by the presence of small (<10 mm) larvae in the ichthyoplankton samples collected by research surveys since 1987, but it is the first year that large numbers were observed on the Canadian portion of the bank. A detailed comparison of Canadian and US larval surveys is presented in Melvin & Fife (1992).

The approximate time of hatching was again estimated by backcalculation from larval length at the time of capture, assuming a growth rate of 0.24 mm/d (Chenoweth et al. 1989). The 1992 hatching period ranged from early September to late November with a mean hatching date of October 17 (Table 4). This is the latest mean hatching date since 1987 when the series first began. In other years the mean date of hatching occurred around the beginning of October. The 1992 spawning season was also protracted relative to previous years.

Indices

Two indices were again used to evaluate the trends in abundance of the Georges Bank herring stock - one the number of herring caught per standard random bottom trawl tow from research surveys (Canada and US fall) and the other, the estimated number of larvae/10 m² in the Canadian fall larval survey.

The number of herring per standard bottom trawl from 1986-92 are presented in Table 1 and Fig. 10. Due to a vessel and gear change the 1992 Canadian data were considered incomparable with the previous years. Mean catch per tow dropped from 1248 herring in 1991 to 4.5 in 1992 which was the lowest level in the time series. Only 36 herring were collected in 31 sets. By comparison the US survey showed a decrease in catch/tow for sets with herring, yet the index represents the second highest value in the series and far exceeds all catches prior to 1991. The US data are believed to be far more representative of stock status than the Canadian data. Increased catches/tow were observed for both Nantucket Shoal and Massachusetts Bay.

The 1992 larval data indicated the opposite of the bottom trawl index. The mean number of larvae/10 m² was the highest since 1987, even though the cruise was approximately three weeks later than usual (Fig. 11). An attempt was made to adjust the index for difference in cruise timing by estimating the number of larvae at hatching from growth and mortality rates. Briefly summarized the adjusted index indicated that the 1992 larval abundance was far greater than any of the previous years. Furthermore, the concerns expressed last year regarding the 1991 low LAI were unfounded. The 1991 LAI within the original survey grid system was second only to 1992 and for all stations sampled on the bank about average for the time series. Unfortunately, because of the high inter-year variability of growth and mortality the estimates of numbers at hatching were not considered reliable. Index adjustment to the number of larvae at 10 mm length will be undertaken for next years assessment.

The ability of the two indices currently being used to track the relative abundance of Georges Bank herring (ie. larval and bottom trawl) is uncertain. Large variances about mean values make it difficult to determine whether or not annual changes reflect stock abundance. It is therefore recommended that alternate approaches such as acoustics be investigated to estimate abundance and biomass.

Biomass Estimate

One of the main concerns with measuring stock status based on relative indices of abundance is the difficulty in translating the index into biomass without some reference point. It was hoped that a biomass estimate could be extrapolated from the LAI. However, given the uncertainty of input parameters and the sensitivity to small changes in mortality rates and larval age no estimate was made.

Prognosis

In summary the 1992 data indicate that the Georges Bank herring stock is well on its way to recovering from the collapse in 1977. The 1992 US bottom trawl survey index was second only to 1991 and far above earlier periods when catch levels were much higher. The standard larval abundance index was also the second highest in the time series and 3 times that observed in 1991. Although poorly sampled, the age structure of herring collected continued to show a dominance of 3-yr-old fish in the catches, indicating successful recruitment. Both newly hatched (ie. <10 mm) and older larvae, displayed a much broader geographical distribution than in the post-crash years. Finally, spawning on the Canadian side of the bank was documented in 1992 by three independent surveys (Autumn purse seiner, Canadian larval and the US fall larval).

Anecdotal data from ground fish and scallop fishermen have indicated large concentrations of herring on the northeastern throughout most of the summer and early. Several reports of herring eggs in the stomach of ground fish and fishing activity in the observed area of spawning were also received during 1992.

The proposed 1993 experimental fishery of 5,000 t or less will hopefully provide further information on the distribution and age structure of fish and is unlikely to impede the stocks recovery. However, until such time as the impact of opening a fishery can be evaluated, catch levels should be maintained at a minimum. For 1994, an experimental fishery with a combined Canadian and United States herring catch in the same order as 1993, is not considered to be detrimental to the continued recovery of the Georges Bank herring stock.

Research Recommendations

- (1) Investigate alternative survey approaches such as acoustics. Implement an acoustical survey of the bank during the 1993 fall survey, if feasible;
- (2) Adjust the LAI by estimating the number of larvae at 10 mm instead of at the time of hatching.
- (3) Investigate the seasonal distribution of herring on Georges Bank.

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Table 1. Summary of Canada and US fall research cruise data combined for area 1 - Massachusetts Bay, Area 2 - Nantucket Shoals, and Area 3 - Georges Bank, by year. Note Canadian cruises started in 1986; before then the summary is based on US catches only.

Year	Area	Date start	Date finish	Total sets	Sets with herring	% with herring	No. herring	Catch all sets		Catch sets with herring		Length	
								x	STD	x	STD	x	STD
1982	1	11-06	11-08	7	3	43	4	0.57	0.98	2.0	0.0	32.6	0.0
	2	10-12	11-09	40	6	15	10	0.25	0.74	1.67	1.21	31.1	2.02
	3	10-19	11-11	72	3	4	7	0.10	0.61	2.33	2.31	32.9	2.77
1983	1	10-26	11-09	16	7	44	22	1.37	2.15	3.14	2.27	29.2	5.20
	2	10-12	11-09	33	5	15	18	0.55	1.79	3.60	3.43	33.3	3.02
	3	10-09	10-23	95	3	3	4	0.04	0.25	1.33	0.58	30.9	4.74
1984	1	10-11	11-06	9	6	67	145	16.11	27.74	24.17	31.59	33.1	3.49
	2	10-05	11-17	21	4	19	22	1.05	4.13	5.50	9.00	31.7	4.96
	3	10-07	10-25	73	0	0	0	-	-	-	-	-	-
1985	1	11-13	11-15	6	4	67	435	72.5	170.8	108.8	208.2	31.1	2.85
	2	10/18	11-07	28	4	14	16	0.57	1.55	4.0	1.83	31.5	1.87
	3	10-22	10-25	63	2	3	4	0.06	0.40	2.0	1.41	28.5	0.55
1986	1	10-27	11-05	8	3	37.5	9	1.13	1.64	3.00	1.00	32.8	3.31
	2	10-09	10-28	22	4	18	89	4.05	15.34	22.25	33.26	29.9	2.08
	3	10-09	10-21	103	23	22	241	2.06	6.83	9.21	12.12	27.71	1.51
1987	1	10-08	10-27	8	6	75	438	54.75	118.17	73.0	133.98	27.5	2.85
	2	10-02	10-29	24	10	42	832	34.66	108.43	83.2	159.88	28.9	3.12
	3	10-03	10-18	75	28	61	346	9.89	39.78	26.50	62.30	29.7	2.57
1988	1	10-26	10-27	11	9	82	85	7.73	8.67	9.44	8.71	38.7	3.03
	2	09-29	10-18	25	7	28	1650	66.00	248.24	235.71	447.02	29.2	2.66
	3	10-07	10-18	81	39	48	2127	22.48	71.17	46.69	97.50	27.3	4.64
1989	1	10-21	10-30	11	10	91	5182	471.09	751.74	518.2	775.10	31.20	2.67
	2	10-07	10-17	19	5	26	280	14.74	42.83	56.00	73.25	30.2	2.40
	3	10-08	10-25	88	46	52	881	10.22	36.99	19.56	49.58	27.9	3.64
1990	1	10-16	10-23	7	4	57	234	33.42	41.41	58.5	38.39	30.8	3.09
	2	09-27	10-16	35	9	26	3044	86.97	326.61	338.22	598.15	27.5	2.32
	3	10-06	10-11	83	27	33	2059	72.90	314.7	224.11	526.47	26.9	2.37
1991	1	10-17	10-24	6	4	67	29	4.83	6.40	7.25	6.7	32.2	2.66
	2	09-30	10-16	24	12	50	757	31.54	96.65	63.08	131.75	28.83	2.59
	3	09-30	11-12	77	17	22	14421	187.28	1168.18	848.29	2426.17	27.23	2.42
1992*	1	10-20	10-27	4	4	100	1934	483.50	1610.34	483.5	1610.34	29.49	2.14
	2	10-06	10-20	30	15	50	4590	153.00	2101.62	306.0	2138.82	29.09	2.89
	3	10-08	10-14	62	12	19	2548	41.10	1078.10	134.10	1098.67	27.53	2.87

*US data only.

Table 2. Comparison of Canadian and U.S. Georges Bank fall cruise data from 1986-1992. Mean length of all herring collected and those > 20 cm is presented for comparisons.

Year	Country	Date start	Date finish	Total sets	Sets with herring	% with herring	No. herring	Catch all sets		Catch sets with herring		Length all		Length (>20 cm)	
								x	STD	x	STD	x	STD	x	STD
1986	Can. USA	10-29 10-09	11-05 10-21	41	12	29.2	83	2.0	5.49	6.9	8.52	27.3	1.46	27.3	1.46
				62	11	17.6	129	2.1	7.63	11.7	15.17	28.1	1.47	28.1	1.47
1987	Can. USA	11-03 10-03	11-10 10-18	11	5	45.5	396	36.0	59.16	79.2	66.87	26.5	2.50	26.5	2.51
				64	17	26.5	346	5.4	34.12	20.4	65.27	29.7	2.34	29.7	2.34
1988	Can. USA	11-06 10-07	11-11 10-18	20	14	70.0	1328	66.4	104.69	94.9	114.50	27.4	5.09	29.1	1.83
				61	19	31.2	493	8.1	49.31	25.9	87.26	28.0	4.70	29.4	1.96
1989	Can. USA	11-04 10-08	11-06 10-25	24	15	62.5	694	29.9	65.04	47.5	77.73	28.2	2.75	28.2	2.75
				64	22	34.4	187	2.9	12.09	8.5	19.71	26.8	5.74	28.6	3.20
1990	Can. USA	11-07 10-06	11-09 10-11	21	18	85.7	6022	286.8	584.6	334.5	620.7	26.8	2.34	26.8	2.34
				62	6	9.6	29	0.5	2.70	4.8	7.96	30.1	2.58	30.1	2.58
1991	Can. USA	11-03 09-30	11-12 10-10	19	9	47.4	11239	591.5	2263.0	1248.7	3255.7	25.66	2.88	25.7	2.84
				58	8	14.0	3182	54.86	360.54	397.75	950.05	27.82	1.91	27.82	1.91
1992	Can. USA	11-18 10-08	11-25 10-14	31	8	25.8	36	1.2	3.28	4.5	5.37	25.96	2.21	26.2	1.85
				62	19	30.0	2548	41.10	1078.1	134.10	211.06	27.53	2.87	27.67	2.49

Table 3. Summary of gonad development stage of herring collected on Georges Bank during October and November. The values 1-8 represent gonad stages of a modified Hjort Scale. Percent of sample is included in brackets.

Year	1	2	3	4	5	6	7	8	Number samples
1986	-	10 (9.3)	1 (0.9)	-	6 (5.6)	30 (2.8)	2 1.9	59 (54.6)	108
1987	1.0 (.2)	181 (45.9)	-	-	10 (2.5)	24 (6.1)	14 (3.6)	164 (41.6)	394
1988	23 (7.7)	24 (8.8)	5 (1.7)	3 (1.0)	1 (0.3)	1 (0.3)	13 (4.3)	230 76.7	300
1989	-	24 (19.0)	4 (3.2)	-	1 0.8	3 2.4	33 (26.2)	61 (48.4)	126
1990	46 (8.8)	115 (22.0)	-	-	18 (3.4)	4 (.8)	120 (23.)	218 (41.8)	582
1991	14 (5.2)	48 (17.7)	-	-	19 (6.9)	20 (7.4)	33 (12.1)	137 (50.3)	272
1992	1 (2.8)	4 (11.1)	21 (58.3)	-	-	1 (2.8)	7 (19.4)	2 (5.5)	36

Table 4. Summary of larval herring survey data (1987-92). The number in brackets under date of sampling are Julian days.

Cruise #	Date of sampling	Number Caught	# of Stations	#/10m ²		Length				Estimated Hatching Day (Julian)			
				Mean	STD	(mm) mean	STD	(mm) min.	(mm) max.	Mean	STD	Min.	Max.
H181	23 Oct - 10 Nov (296-314)	4898	40	200.9	474.74	9.38	1.94	5	19	291	7.71	253	312
H195	28 Oct - 7 Nov (301-311)	4075	76	51.8	104.45	13.09	3.05	6	21	274	14.2	238	309
H207	25 Oct - 5 Nov (298-309)	4386	90	72.6	164.87	12.41	1.78	7	21	277	7.34	238	301
H222	31 Oct - 10 Nov (304-314)	5903	79	98.2	167.86	11.64	1.88	7	19	280	8.08	248	299
H235	04 Nov - 12 Nov (307-315)	1508	76	30.9	80.96	13.41	3.73	5	20	275	15.44	247	311
P049	24 Nov - 30 Nov (329-335)	7743	86	118.2	157.90	14.55	4.40	5	29	291	18.25	232	333

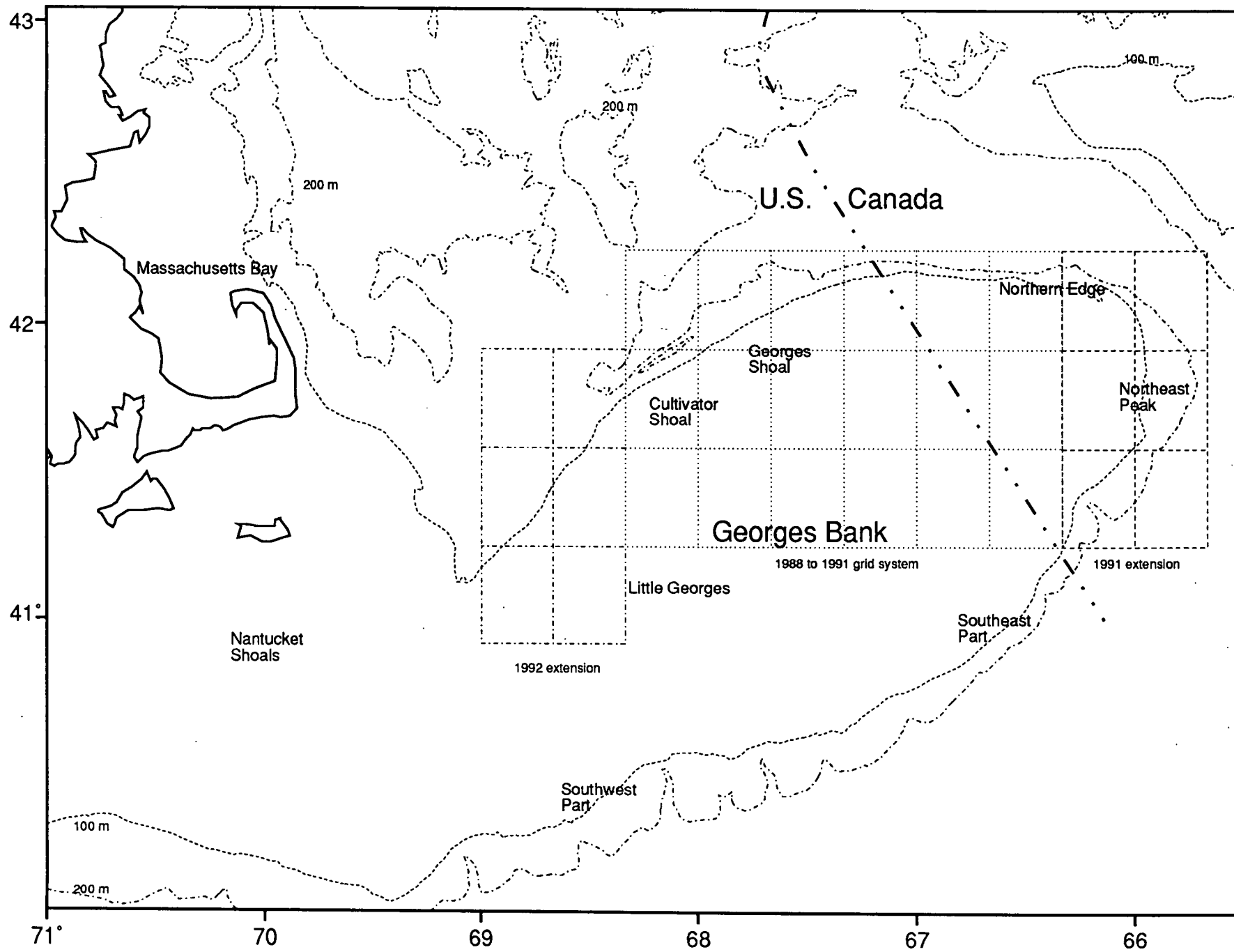


Figure 1. Georges Bank Atlantic herring survey area.

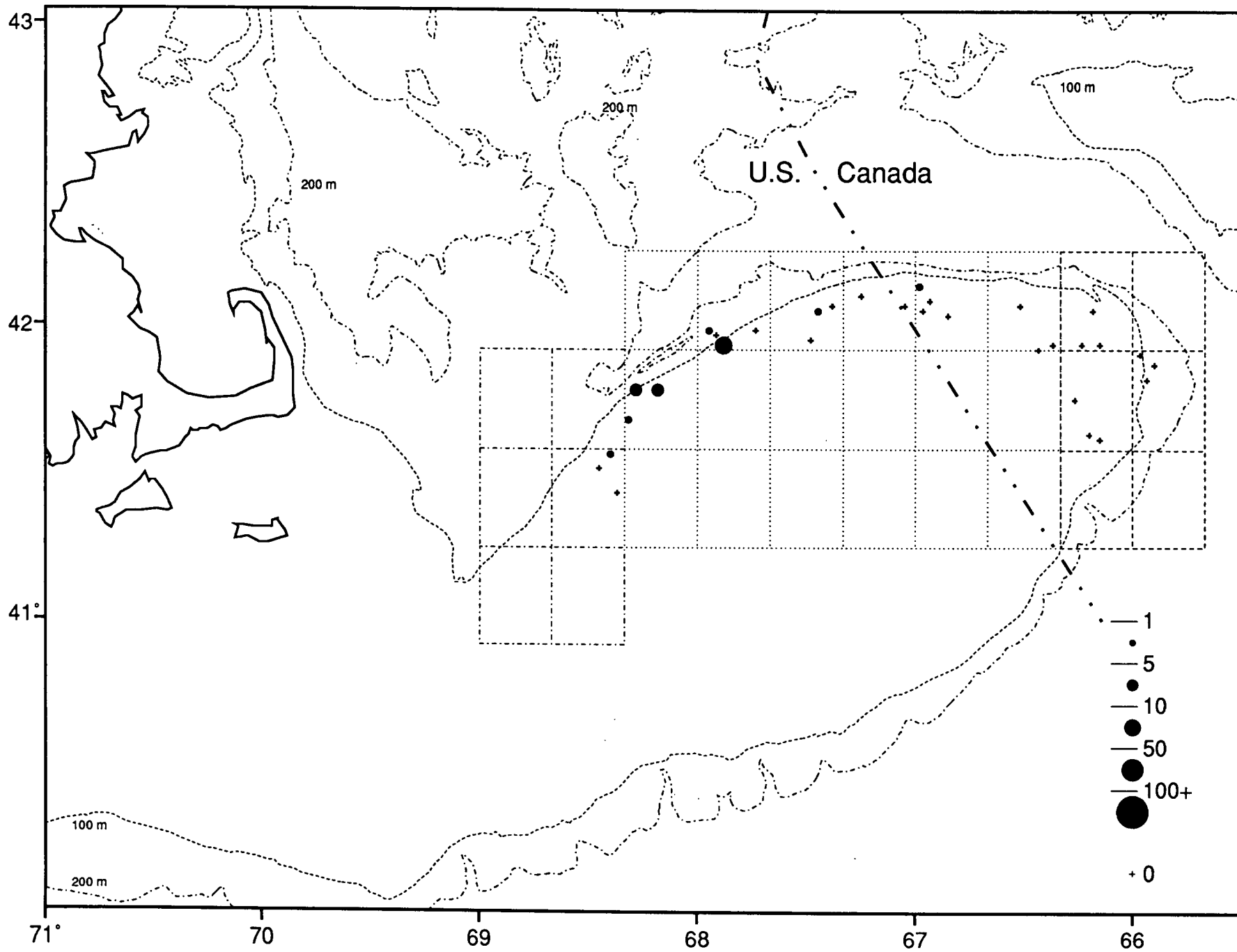


Figure 2. Canadian 1992 adult herring sampling stations and catches. Numbers as per scale

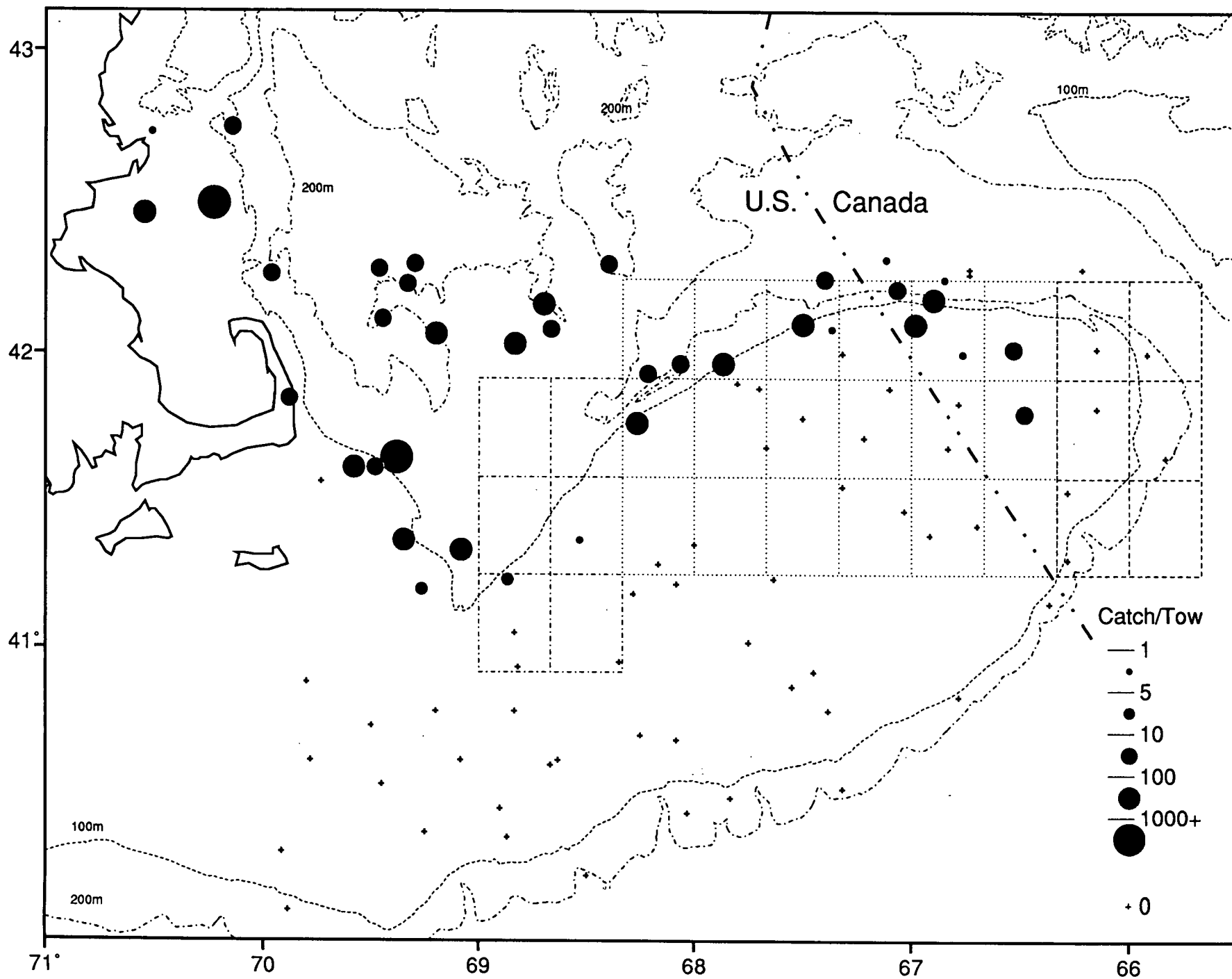


Figure 3. USA 1992 fall survey. Adult herring as per scale

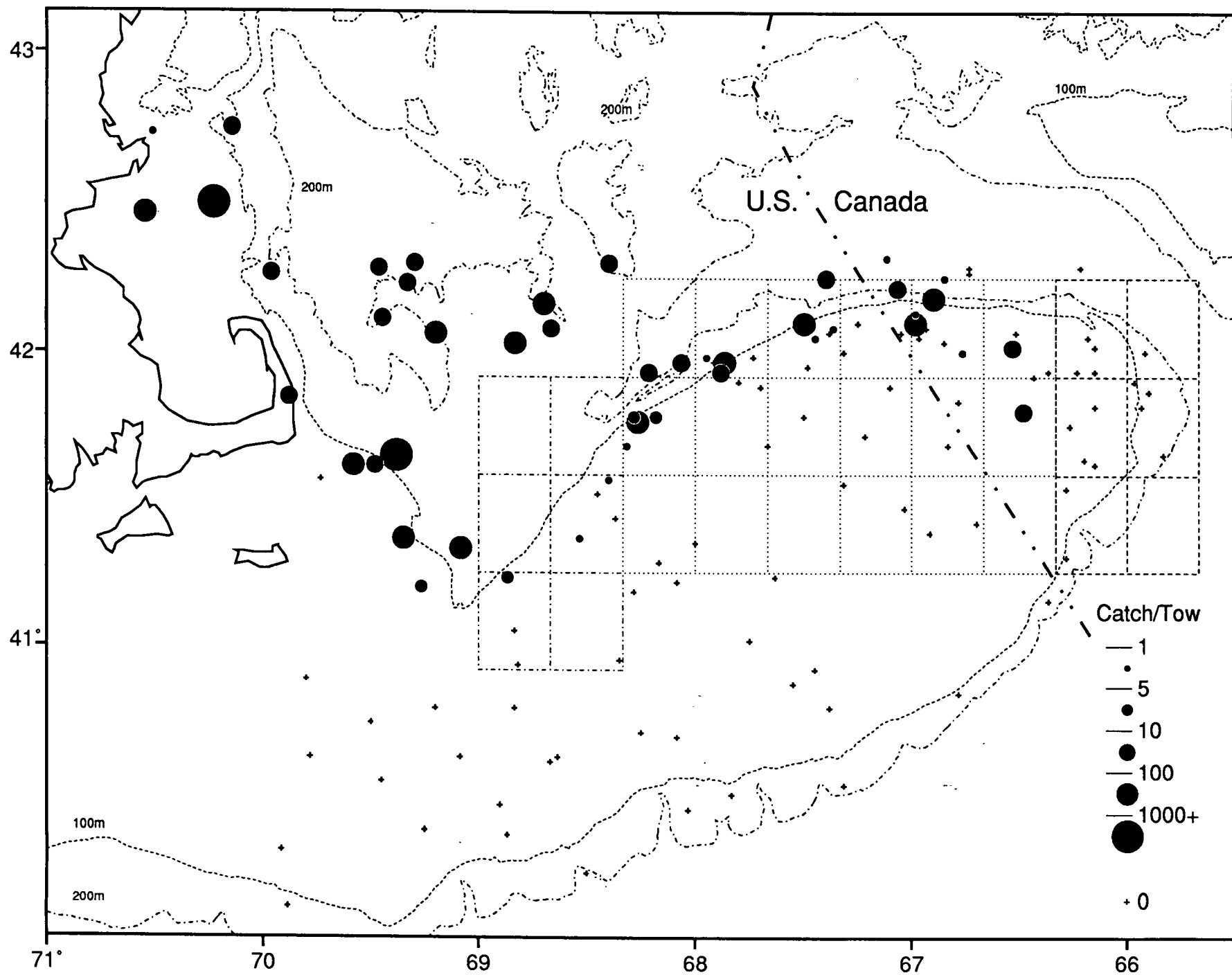


Figure 4. US and Canadian 1992 surveys combined. Adult herring as per scale

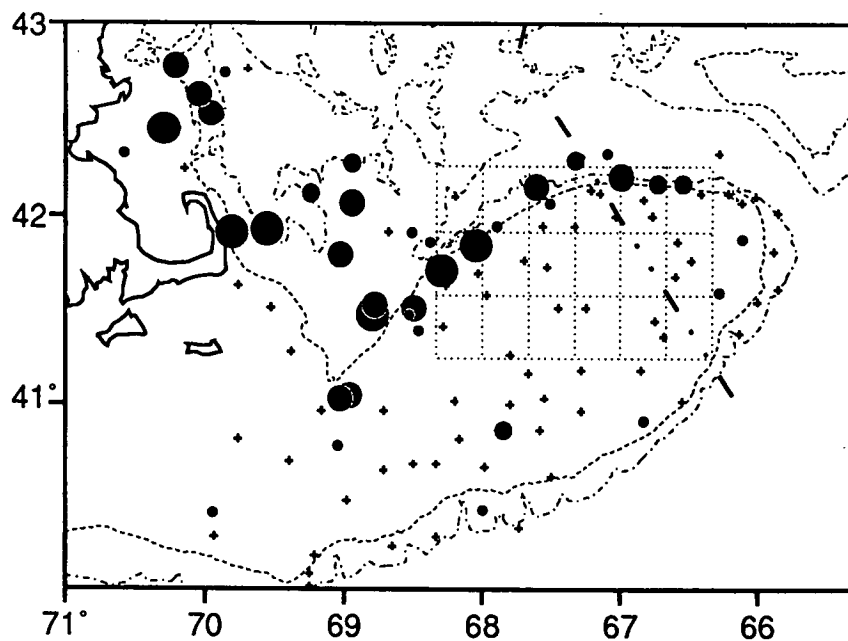


Figure 5a. US and Canadian 1987 surveys combined. Adult herring as per adjacent scale.

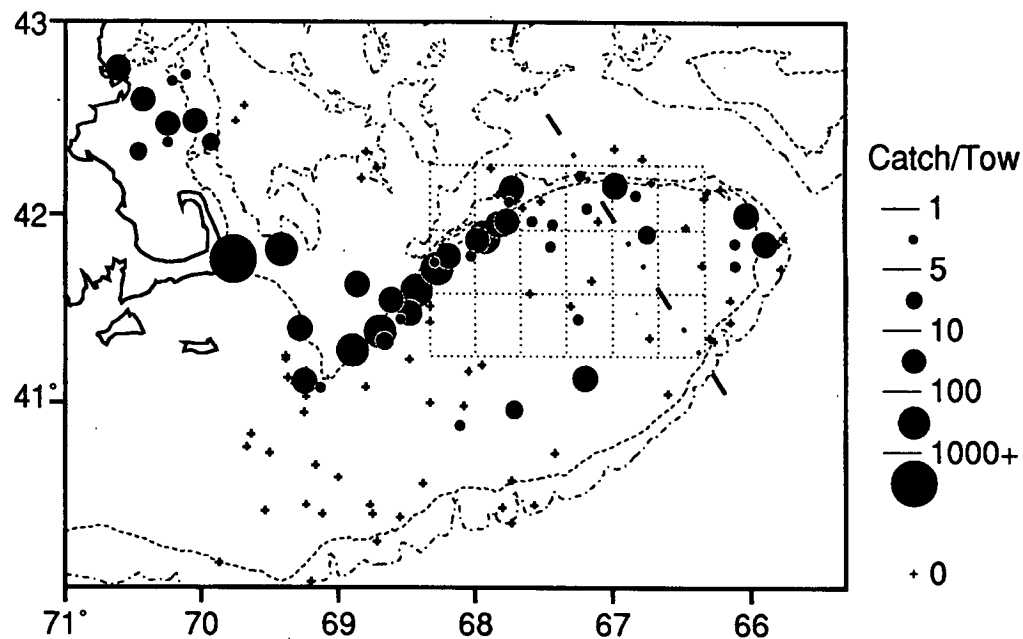


Figure 5b. US and Canadian 1988 surveys combined. Adult herring as per adjacent scale.

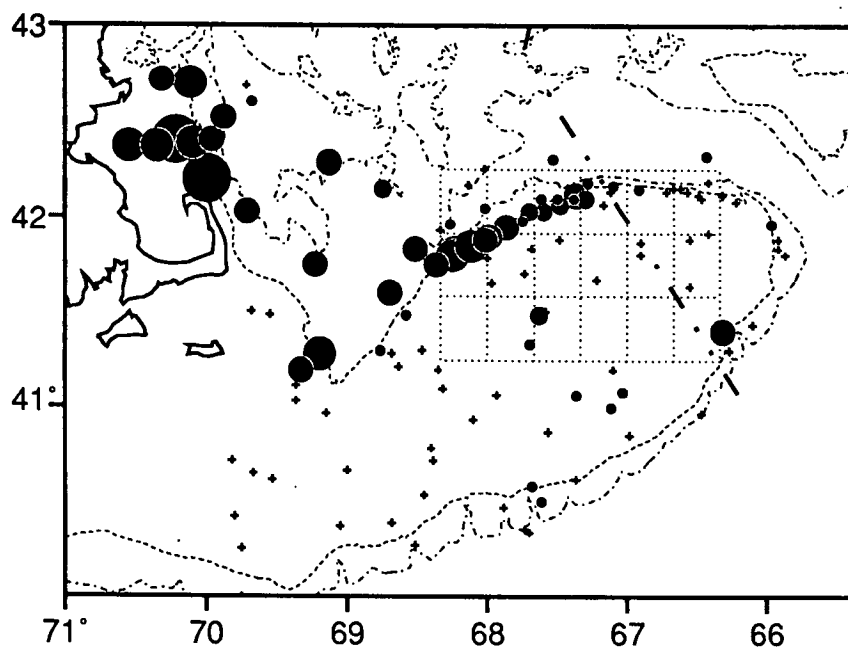


Figure 5c. US and Canadian 1989 surveys combined. Adult herring as per adjacent scale.

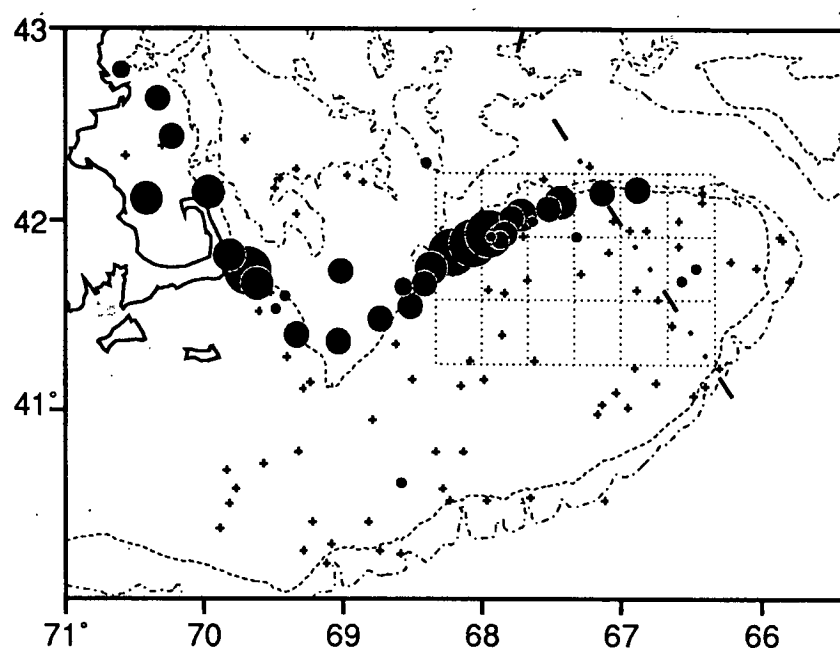
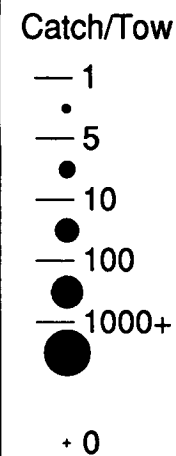


Figure 5d. US and Canadian 1990 surveys combined. Adult herring as per adjacent scale.



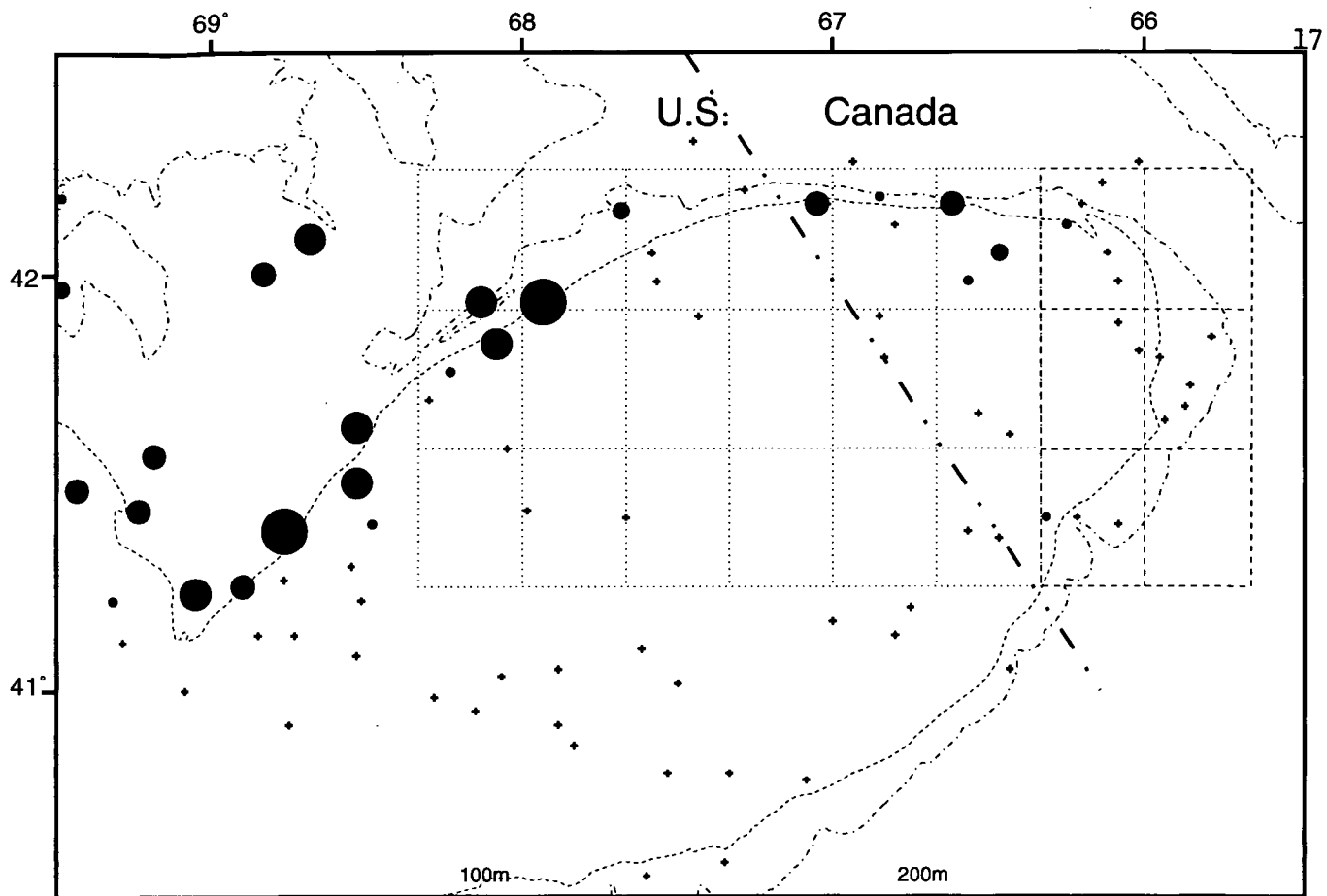


Figure 5e. US and Canadian 1991 Georges Bank survey. Adult herring as per scale

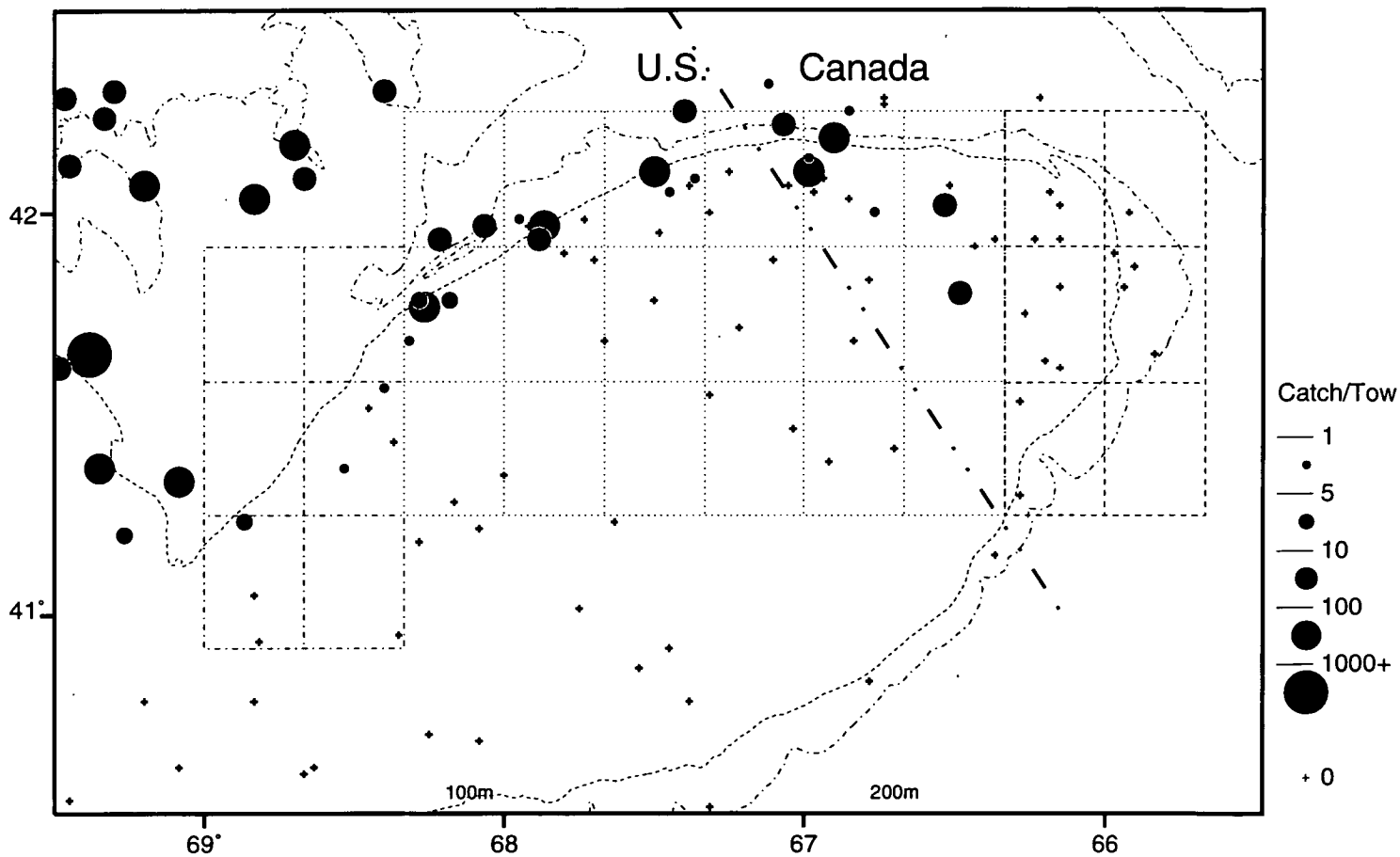


Figure 5f. US and Canadian 1992 Georges Bank survey. Adult herring as per scale

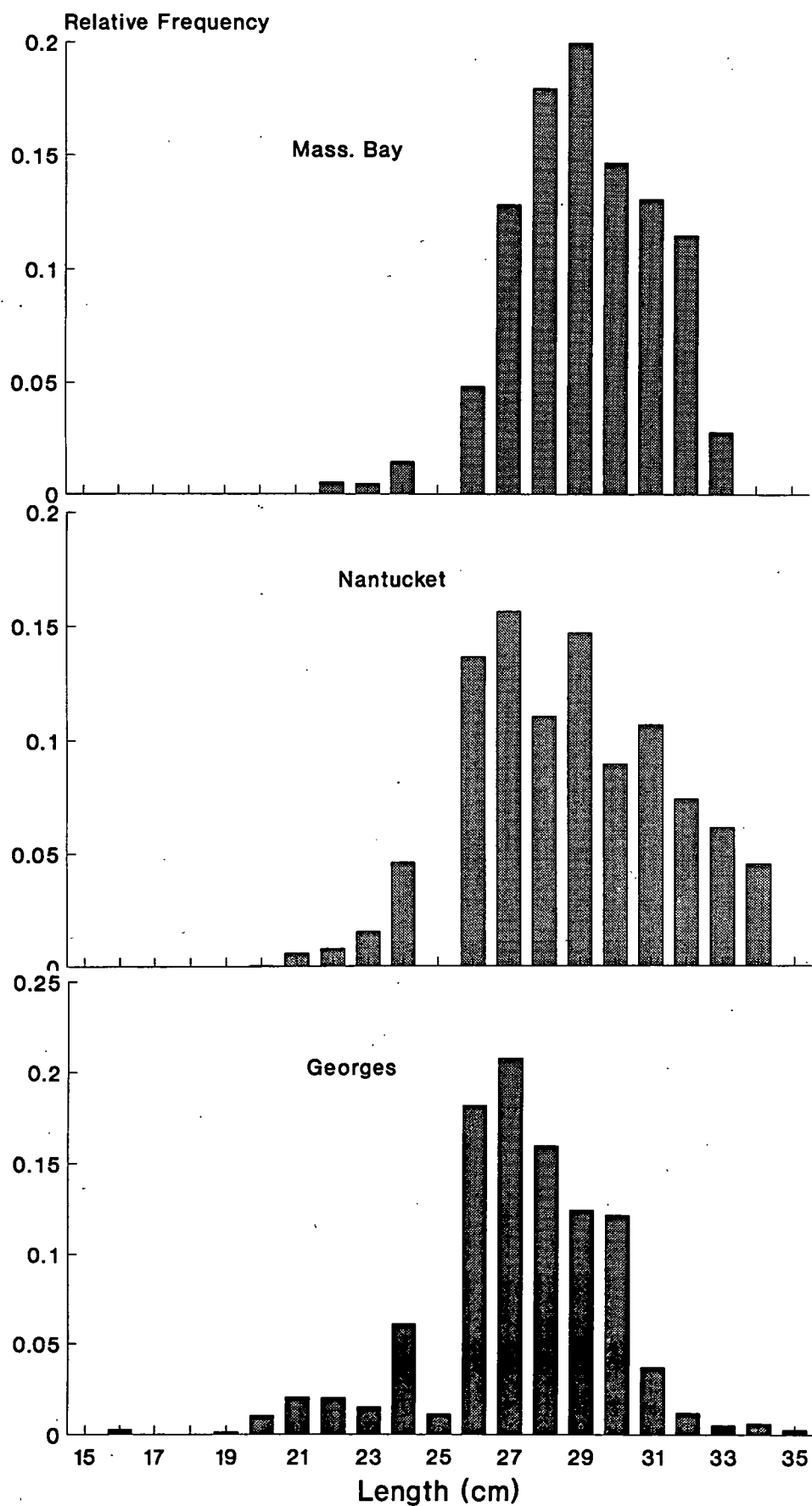


Figure 6. Length frequency of adult herring from Massachusetts Bay, Nantucket Shoals and Georges Bank.

Age Distribution Georges Bank Herring 1987-1992

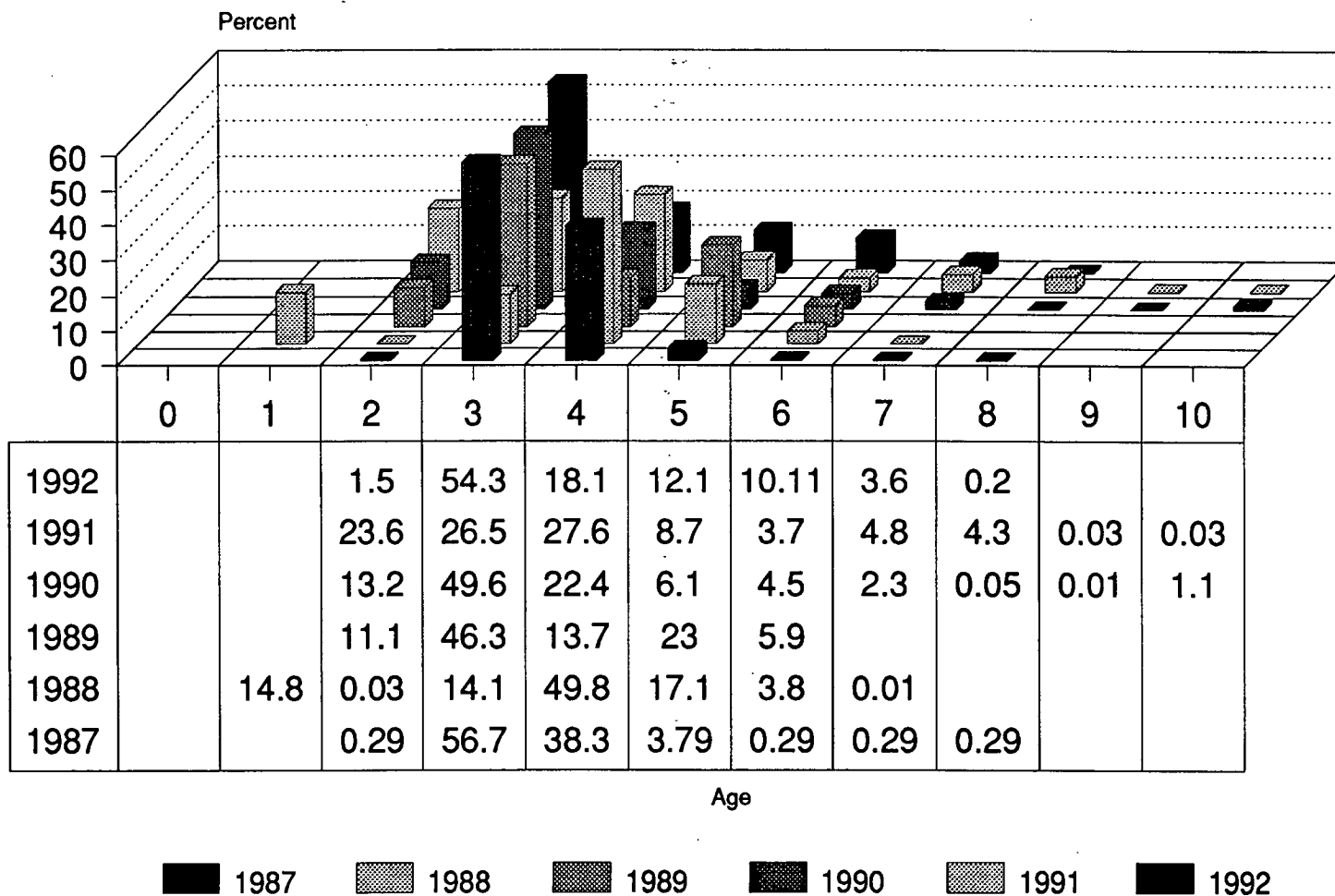


Figure 7. Age distribution of Georges Bank Herring.

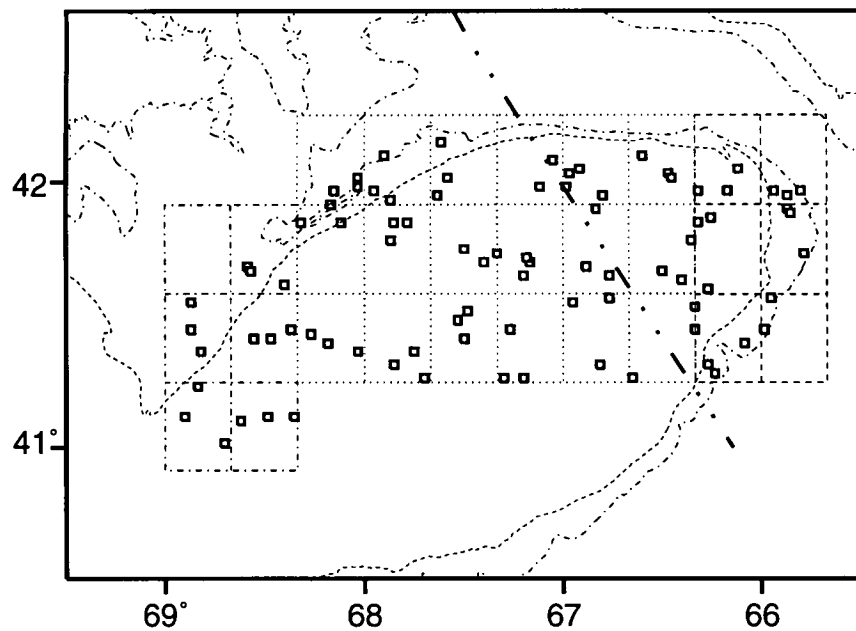


Figure 8a. 1992 Canadian larval survey (Nov 18 - 25). Sampling stations.

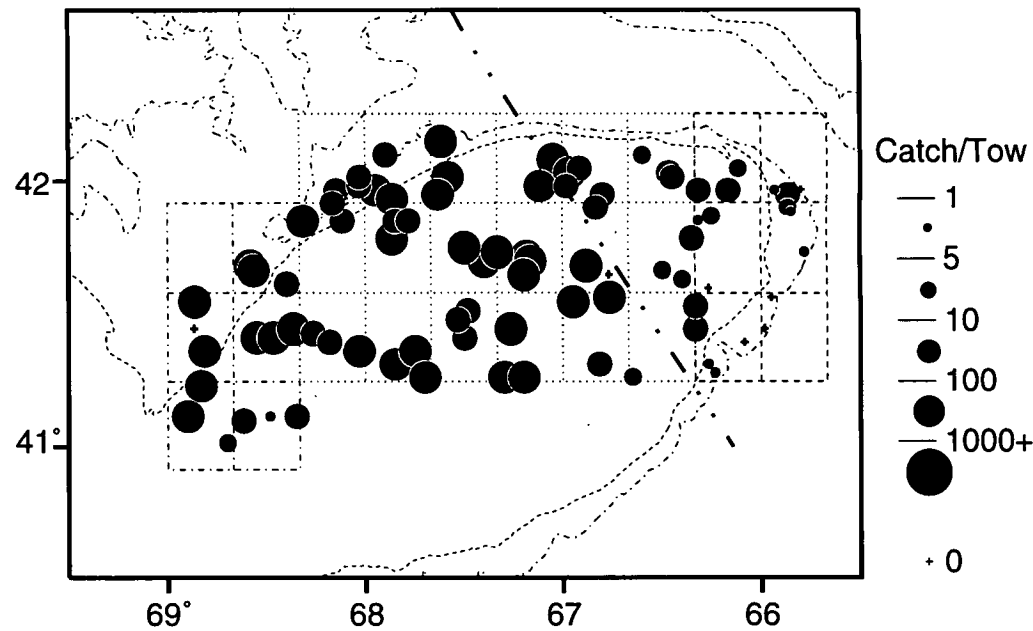


Figure 8b. 1992 Canadian larval survey (Nov 18 - 25). Larvae as per adjacent scale.

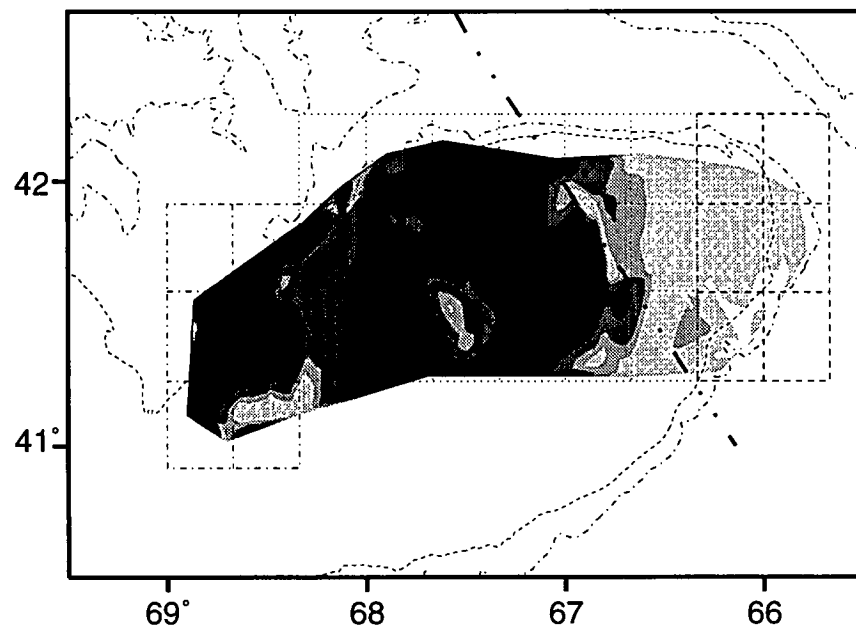


Figure 8c. 1992 Canadian larval survey (Nov 18 - 25). All larvae. Contours as per adjacent scale.

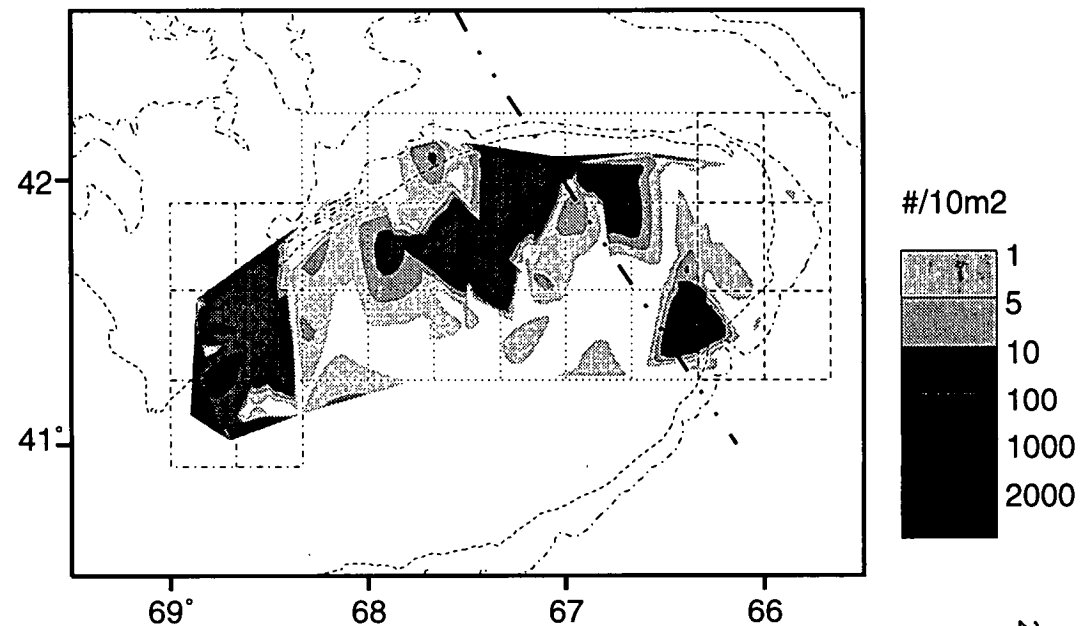


Figure 8d. 1992 Canadian larval survey (Nov 18 - 25). Larvae (<10mm). Contours as per adjacent scale.

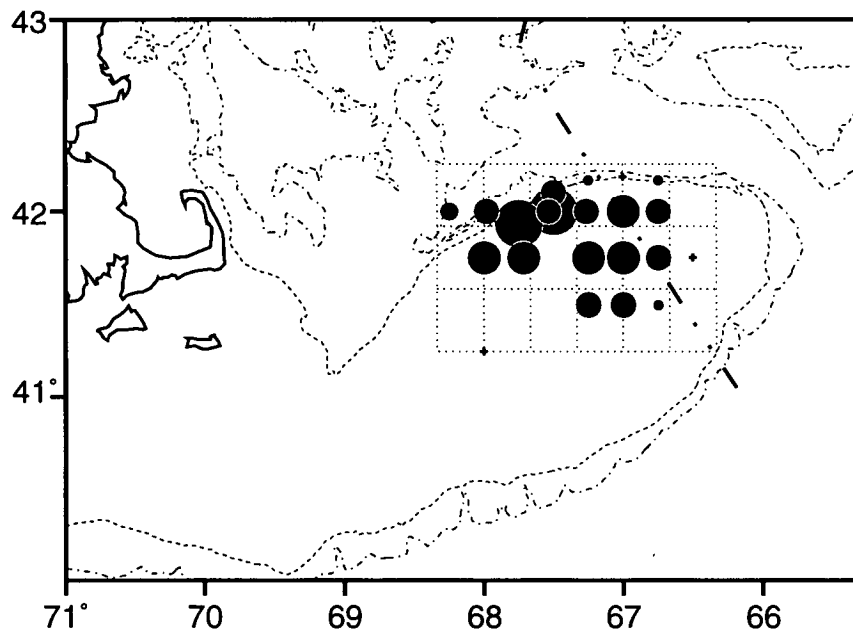


Figure 9a. Canadian 1987 larval survey.
Larval herring as per adjacent scale.

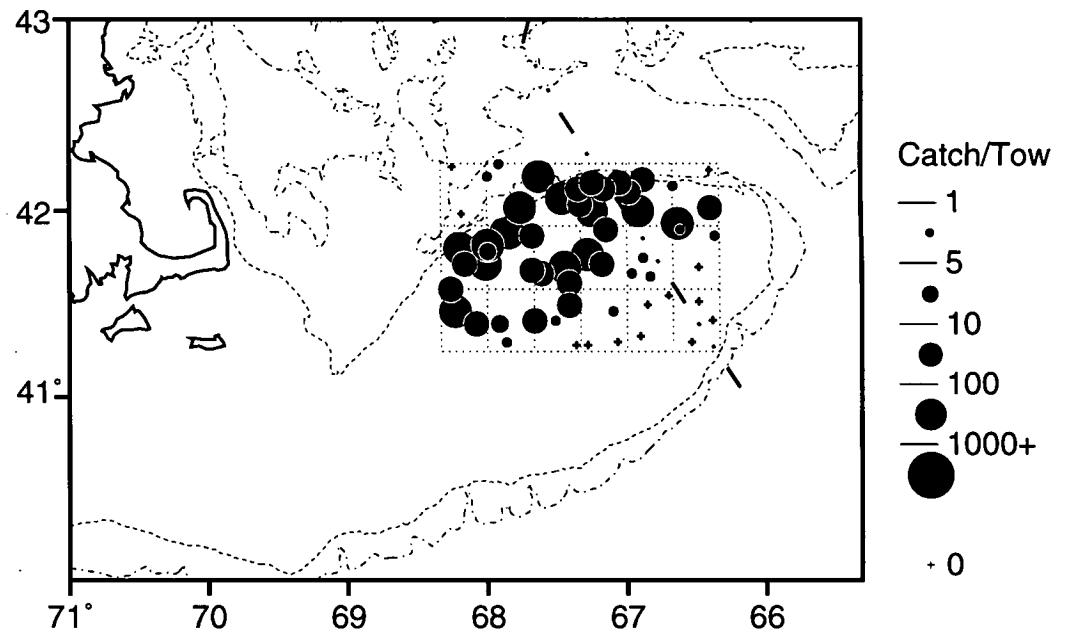


Figure 9b. Canadian 1988 larval survey.
Larval herring as per adjacent scale.

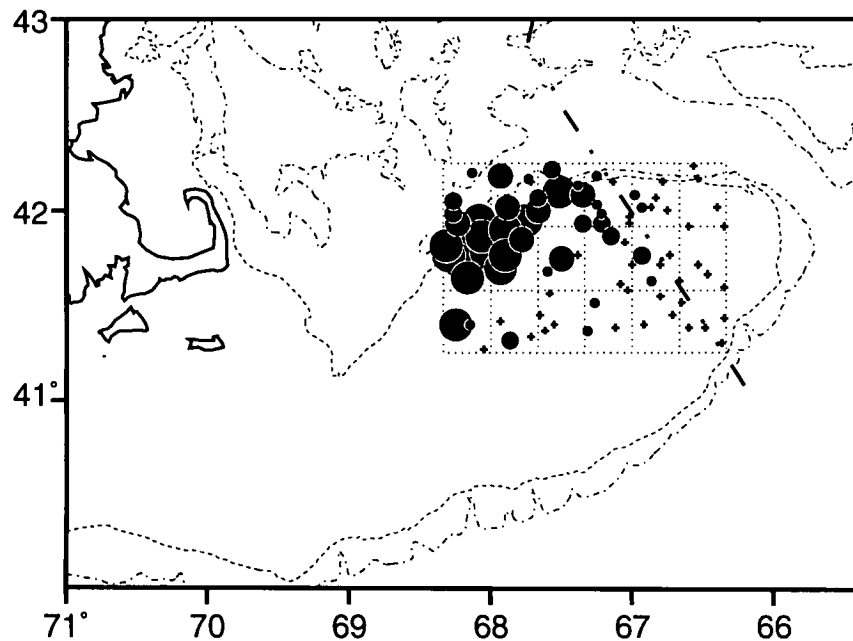


Figure 9c. Canadian 1989 larval survey.
Larval herring as per adjacent scale.

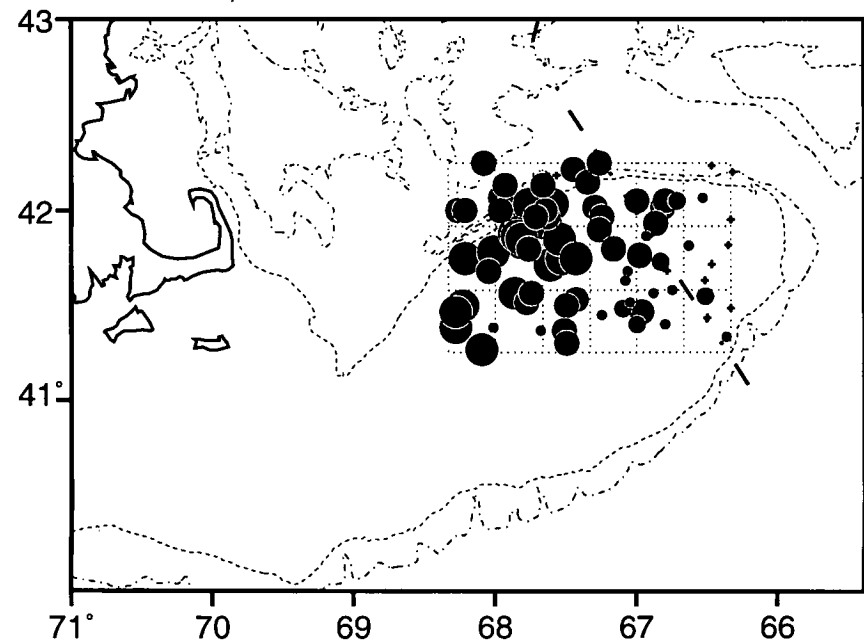
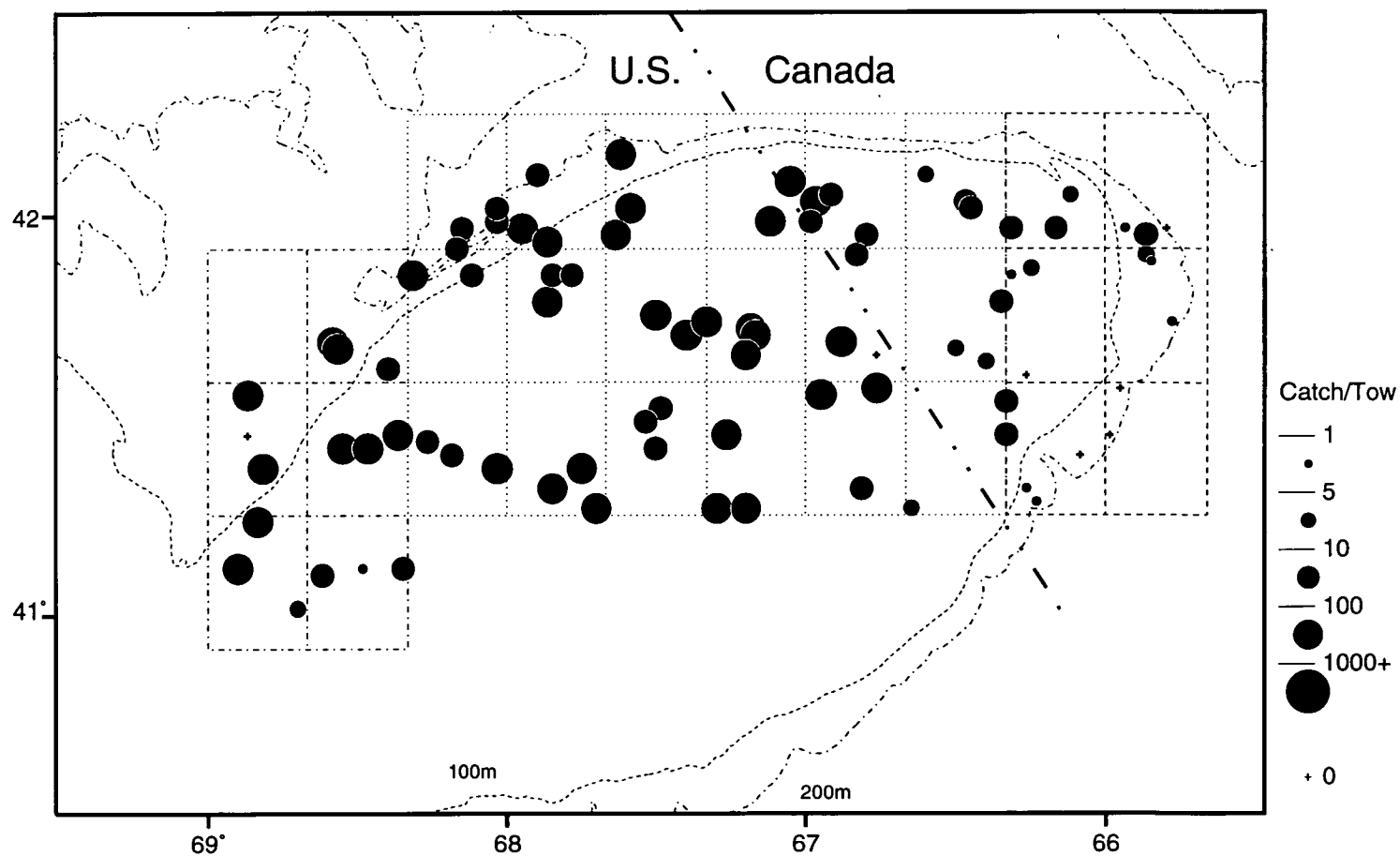
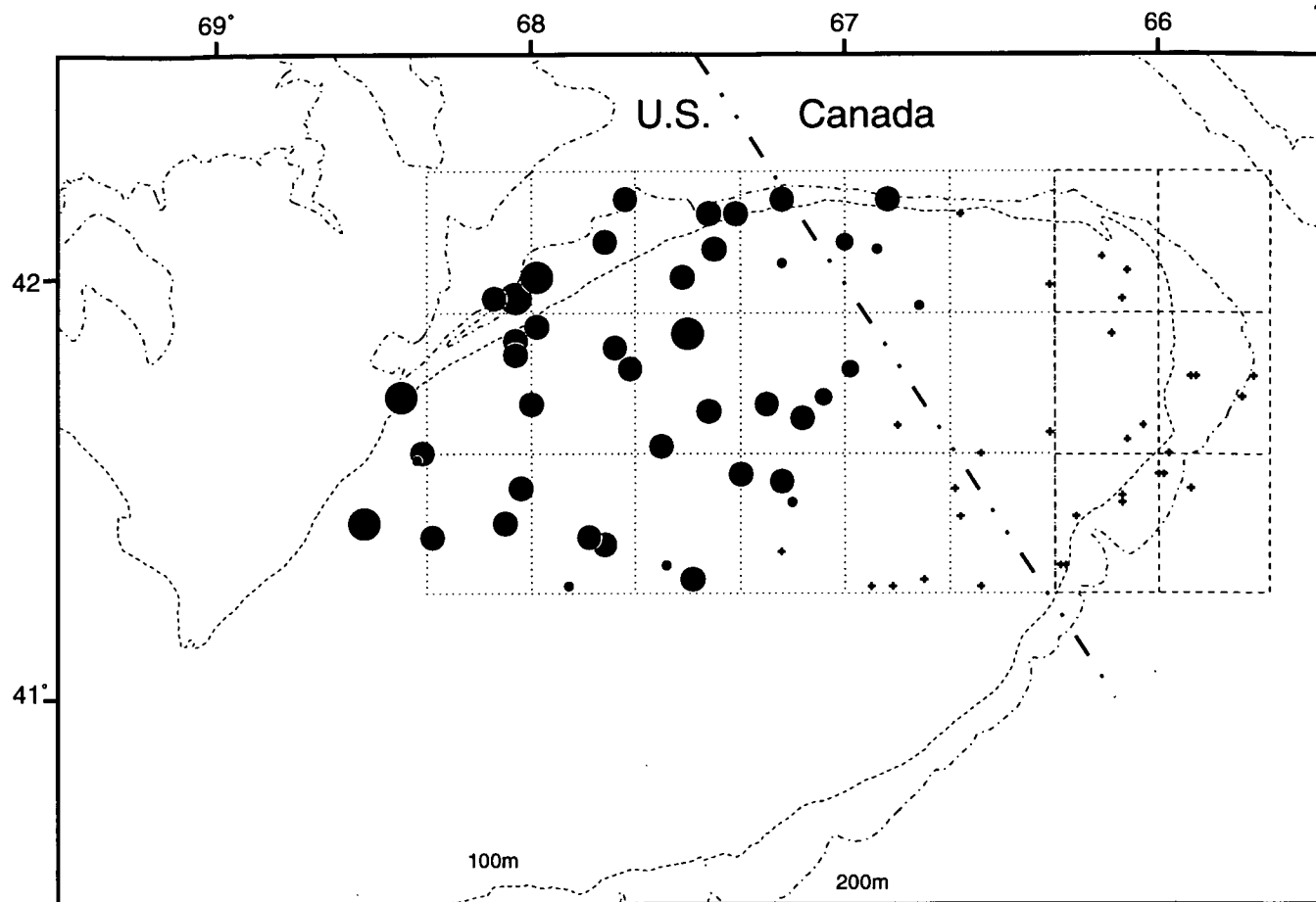


Figure 9d. Canadian 1990 larval survey.
Larval herring as per adjacent scale.



US Fall Survey Stratified Mean Number

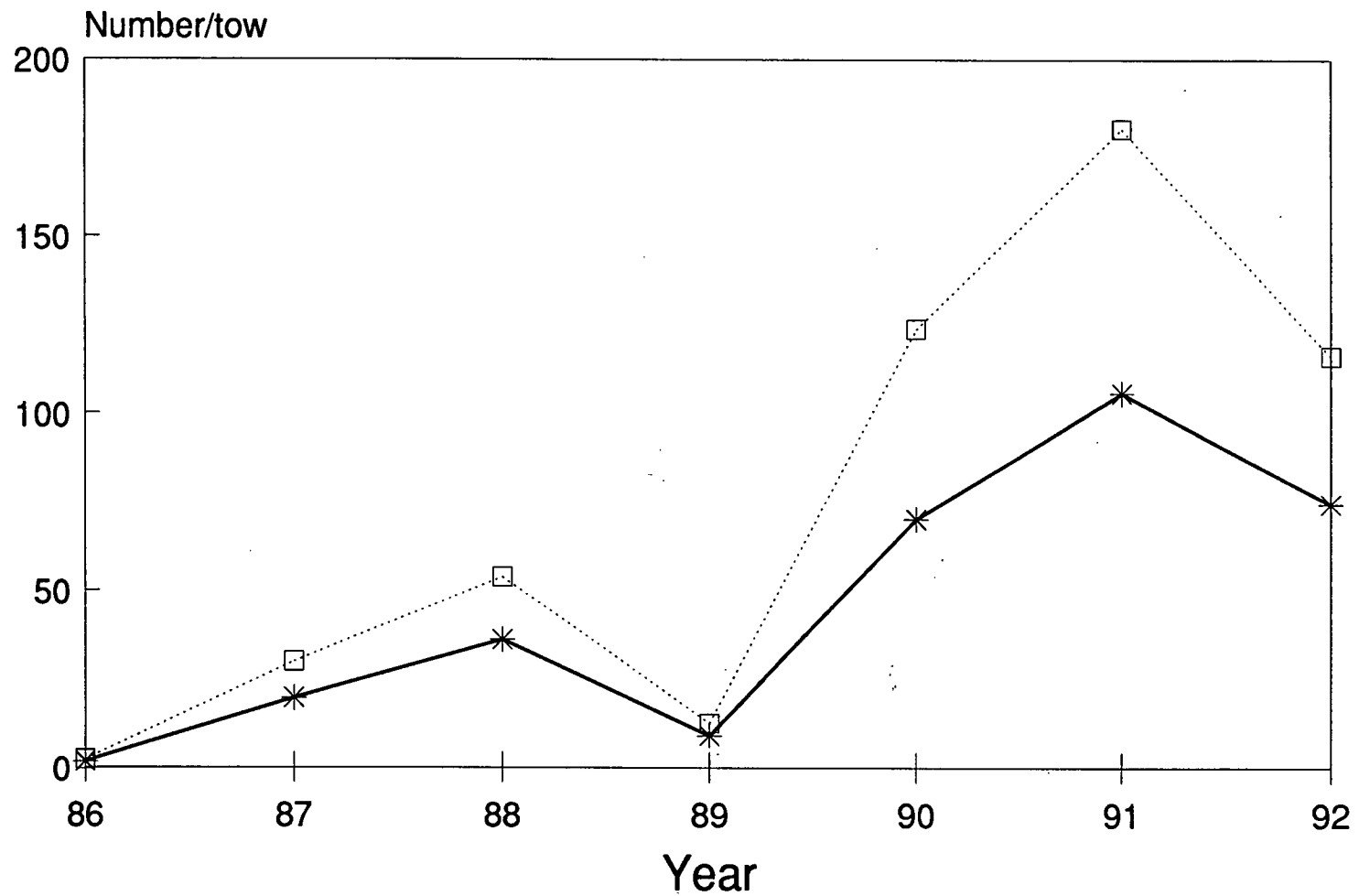


Figure 10. US Bottom Trawl Index (Dots represent 2 Std. Err)

Georges Bank Larval Abundance Index

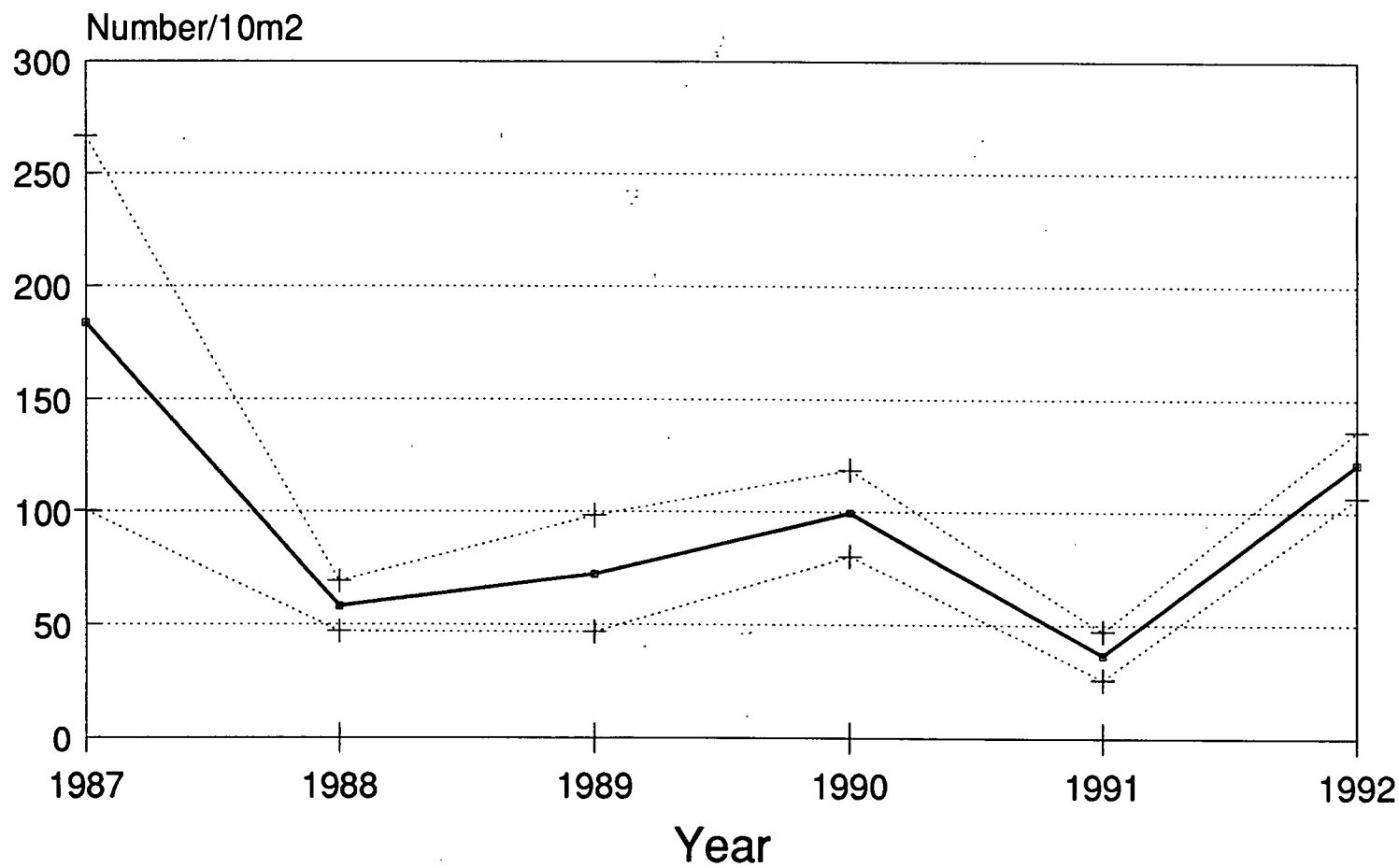


Figure 11. Larval Abundance Index (Dotted lines represent 2 Std. Dev.).