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Georges Bank (5Z) herring 1992 update

by

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Abstract

The 1991 Canadian and United States fall herring survey data for Georges Bank are updated. Both surveys indicated that the Georges Bank herring stock continues to show positive signs of recovery. The bottom trawl survey index increased by two to three times the 1990 values. Although the larval index declined substantially, the 1991 hatching time was estimated to be much earlier and more protracted than in several previous years. Reproductively active herring combined with the presence of small larvae (<10 mm) again confirms spawning on Georges Bank. A dominance of 3- and 4-yr-old fish in Canadian bottom trawl catches and continued broadening of the age distributions are strong signs of recovery.

Given 5 yr of progressive recovery, it is recommended that a small exploratory fishery in 1993 of 5000 t or less would not be detrimental to the stock's recovery. Outstanding concerns which should be addressed prior to further development of the fishery are identified.

Résumé

On met à jour les données des campagnes d'évaluation des stocks de hareng du banc Georges réalisées en automne 1991 par le Canada et par les États-Unis. Il ressort de ces deux campagnes que le stock de hareng en question continue de présenter des signes de rétablissement. L'indice des prises de la campagne d'évaluation au chalut de fond révèle que les résultats ont doublé ou triplé par rapport à 1990. Bien que l'indice d'abondance larvaire soit en net recul, on estime que la période d'éclosion a été beaucoup plus précoce et plus étalée en 1991 que dans les années précédentes. La présence de harengs reproductifs et de petites larves (< 10 mm) confirme à nouveau l'existence d'une activité de frai sur le banc Georges. La prédominance des poissons de trois et quatre ans dans les prises canadiennes au chalut de fond et l'élargissement continu de la distribution des âges sont des signes patents du relèvement du stock.

Au terme de cinq années de relèvement progressif, il apparaît que la pratique d'une petite pêche exploratoire, de 5 000 t ou moins, en 1993 ne nuirait pas au stock. On traite également ici d'autres questions qu'il conviendra de régler avant de poursuivre plus avant le développement de la pêche.

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 (Fig. 1). The fishery peaked in 1968 with landings in the 374,000 mt range (Fogarty et al. 1989). The collapse of this fishery has been attributed to combined effects of several years of poor recruitment in the early 1970's and high levels of exploitation (Anthony and Waring 1980; Grosslien 1987). No directed fishery for herring has operated on Georges Bank since 1978.

Between 1978 and 1985, virtually no adult or larval herring were detected on the Bank by fall research surveys. The number of adult herring reported in US fall bottom trawl surveys during this period ranged from 0-0.10 herring per standard tow (Melvin et al. 1991). The first sign of a recovery occurred in 1984 when the Canadian R/V ALFRED NEEDLER collected more than 200 juvenile herring (mean length = 60.5 mm) in a midwater trawl (IYGPT) on Georges Bank (Stephenson and Power 1989; Stephenson and Kornfield 1990). However, it was not until 1986 that significant evidence appeared in both Canadian and the United States National Marine Fisheries Service (US) research surveys to indicate the stock was on its road to recovery. Details of the chronological reappearance of herring on the Bank are discussed in Stephenson and Power (1989) and Melvin et al. (1991).

Each year since 1986, more and more evidence has appeared to support the recovery of Georges Bank herring. In the spring of 1991, a detailed report (Melvin et al. 1991) of the available data was prepared to summarize our current knowledge on the stock status. The present report represents an update of last year's summary, with the latest data from the 1991 Canadian fall adult/larval herring and the US fall bottom trawl survey.

Data Sources

The sources of data used in this update are essentially the same as those of Melvin et al. (1991), except another year's data has been added. In 1991, the Canadian survey area was expanded to incorporate the entire northeastern portion of the Bank (Fig. 2). Data are summarized from the Canadian fall adult/larval herring survey (H235) and the US fall bottom trawl survey (DL9105). Additional information concerning a comparison of the Canadian and US larval survey results from 1987-91 is presented in Melvin and Fife (1992). All transformations and corrections applied to the data in the 1991 summary (Melvin et al. 1991) have also been utilized in this summary.

Adult Distribution

The distribution of adult herring during the fall spawning season in 1991 is consistent with that observed in previous years. Both the Canadian and US surveys found adult herring concentrated along the northern fringe of Georges Bank in the vicinity of Cultivator and Georges shoals (Fig. 3, 4). Large numbers of herring were detected in this area by the Canadian survey. A single 30-min tow netted in excess of 9000 adult fish. Sampling in this area of the Bank was, however, limited due to extremely poor weather conditions. A similar increase was noted in the 1991 US bottom trawl survey data for Nantucket Shoal (Fig. 4).

There is an indication that adult herring have extended their distribution deeper into the Canadian portion of the Bank. Adult herring were collected in 1991 much further east along the northern edge than in 1987, 1989 or 1990 (Fig. 5). The 1988 surveys, however, mark the furthest east when herring were collected during the fall on the northeast peak (Fig. 5b). As in previous years, few herring were caught in the central or southern areas of the Bank (Fig. 3).

Length Frequency

Length frequency data of herring collected during 1991 by Canadian and US surveys, in 1-cm intervals, for Georges Bank, Nantucket Shoal and Massachusetts Bay are presented in Fig. 6. As in previous years, there was a notable difference between the length frequency of herring caught in Massachusetts Bay and Georges Bank, with Nantucket Shoal fish lying between the two. Peak frequencies on Georges Bank centred around 27-28 cm compared to 26-27 cm in 1990. The mean length of all herring collected in 1991 by both the Canadian and US fall surveys was similar to that observed in 1990 (Table 1). Mean length of fish taken by the US survey, which was conducted approximately 3 wk earlier than the Canadian survey, was again larger for all fish and for those greater than 20 cm (27.8 vs 26.7 cm, respectively) (Table 2).

Age Distribution

During 1986, which was the first year that strong signs of recovery were observed, the catches by Canadian research surveys were dominated (75%) by 3-year-olds. Since then, there has been a gradual widening of the age distribution, with a strong representation of 3- and 4-year-olds (Fig. 7). Each year since 1987, these age groups have constituted approximately 60% or more of the survey catches on Georges Bank. The 1991 distribution was, however, different in that, unlike the past 3 years, 4-year-old fish from the 1987 year-class slightly exceed those of 1988. In 1991, 2-year-old fish were also well represented in the survey catches.

The continued strong representation of young fish (4 years old and younger) in annual catches since 1986 and the general increase in maximum age provides

evidence of good annual recruitment to the spawning stock and supports the recovery of Georges Bank herring. 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 Canadian fall survey were reproductively active adults. Approximately 50% were recovering, 12% recently spent and 14% in an advanced stage of maturity (Table 3). 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. A detailed comparison Canada and US larval surveys is presented in Melvin and Fife (1992).

The results of the 1991 Canadian survey are presented in Fig. 8. As recommended by CAFSAC, the 1991 survey area was expanded to cover more of the northeastern tip of the Bank to determine if the herring had reoccupied their historical spawning grounds in this area. The 1991 data showed the overall distribution of larvae to be similar to 1990. The majority of larvae were again found west of the International Boundary in the vicinity of Georges and Cultivator shoals. However, when the distribution of larvae less than 10 mm was examined to determine the approximate area of spawning, large numbers were detected eastward of the shoals and approaching the Canada/US boundary (Fig. 8). There was also some indication that spawning may have occurred over a much wider area than in the past 2 years, even though the overall number of larvae per 10 m² was reduced from 1988-90 levels. These results must be interpreted cautiously because survey timing appears to be a critical factor in what is observed. Major differences can be found over a relatively short period of time (Melvin and Fife 1992).

The approximate time of hatching was again estimated by backcalculation from length at the time of capture assuming a growth rate of 0.24 mm/day (Chenoweth et al. 1989). The 1991 hatching period, like in 1988, extended over a much wider period than the other years in the time series (Fig. 9). This may account for the bimodal distribution of larval lengths observed in the November 1991 Canadian survey which was noted in the US December surveys from 1988-90. It appears that a shift in spawning season from Oct/Nov to Sept/Oct may have occurred in 1991, the shift being consistent with the 1960-70's observations.

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 tow (Canada and US) from 1986-91 are presented in Table 1 and Fig. 10. The 1991 Canadian bottom trawl catches represent the largest ever recorded in the time series and are almost triple the 1990 findings (Table 2). Although this may in part be explained by a single catch in excess of 9000 fish, removal of the tow still puts the mean catch per tow at about the 1990 level. There was also a decrease in the percent of catches with herring compared to the past 3 years. An extreme increase in the 1991 US mean catch per tow was observed as well.

The 1991 larval survey indicates the exact opposite of the bottom trawl index. The mean number of larvae/10 m² (Table 4, Fig. 11) is the lowest observed since 1987. This should not, however, be cause for alarm as it is considered to be an artifact of cruise timing. The comparison of Canadian and US larval surveys (Melvin and Fife 1992) clearly demonstrates that survey results are extremely sensitive to cruise timing. It appears that a major shift to an earlier hatching time occurred in 1991 compared with 1989-90. It is also probable that larvae in the range of 15-20 cm are the larvae which would normally have been collected at 5-10 mm by the November survey. In addition, approximately 14% of the adults collected during the survey were found to be in maturity stages 5 and 6 compared to 4.2 and 3.2% in 1990 and 1989, respectively (Table 4). This would indicate that further spawning was yet to come. If the current pattern of young larvae being observed in December by the US survey persists, it is anticipated the progeny of these unspawned fish, as well as eggs which may not have hatched at the time of the Canadian survey, will show up in the 1991 December survey data when analyzed.

Prognosis

The 1991 survey data provide further evidence of the continued recovery of the Georges Bank herring stock. The bottom trawl survey index increased by two to three times 1990 values. Although the larval index declined by more than 50%, data presented indicated that commencement of the 1991 spawning season was much earlier and more protracted than in 1987, 1989 and 1990. Therefore, if the number of larvae was adjusted to account for mortality and adult fish had not spawned at the time of the Canadian survey, the concentrations may well have exceeded those observed in 1990. The presence of reproductively active herring combined with larvae less than 10 mm again confirms that spawning took place on Georges Bank in 1991. The continued strong representation of 3- and 4-year-olds (1987 and 1988 year-classes) in the Canadian bottom trawl catches and the broadening of age distributions since 1987 are also key signs that a recovery continues to occur on Georges Bank.

Given five consecutive years of continued positive signs of recovery, it can no longer be recommended that Georges Bank remain closed to the commercial harvesting of herring on the basis of insufficient stock. It is proposed that a small exploratory fishery in 1993 of 5000 t or less would not be detrimental to the recovery

of this stock. However, a number of concerns related to this stock which should be investigated prior to further development of the fishery still remain. These include:

- 1) the incomplete occupation of herring on their historical spawning grounds on the northeastern portion of the Bank;
- 2) the uncertainty of the contribution of juveniles to the inshore fisheries of Canada and the US;
- 3) the unknown level of exploitation of this stock in the winter herring fishery south of Cape Cod; and
- 4) the transboundary nature of the stock.

Given that it will not be possible to undertake an analytical assessment of this stock for some time, it is recommended that alternate means of recommending catch levels of Georges Bank herring be investigated. For example, consideration should be given to establishing a decision framework for stock indicators, such as larval abundance, age structure, standard bottom trawl catches and spawning distribution.

Recommendations to Management

- (1) Because of the need for Canada and US cooperation and agreement in scientific and management initiatives, it is recommended that any management plans to develop a herring fishery on Georges Bank involve US input.
- (2) All vessels authorized to participate in the exploratory fishery be required to carry an observer to ensure that detailed biological information concerning the catch and location of the fishery are documented.
- (3) To maximize data on the distribution of the spawning stock, a portion of the 5000 t from the exploratory fishery should be taken in the fall (i.e. October/November). The information obtained from this approach would assist in the evaluation of the northeastern portion of the Bank.

Spawning stock biomass estimates in the early 1970's, prior to stock collapse and when larval abundance was similar to that seen in recent years, were about 400,000 t. A recent analysis of stock abundance by the US, using bottom trawl indices, estimates biomass in excess of 500,000 t. Both these estimates are considered preliminary but suggest that a catch of 5000 t would have a nominal impact on continued recovery.

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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	38	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	11-15	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	11-10	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	11-11	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	11-06	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	11-09	83	27	33	6051	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

Table 2. Comparison of Canadian and U.S. Georges Bank fall cruise data from 1987-91. 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

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

Table 4. Summary of larval herring survey data (1987-91). 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	47	200.9	474.74	10.38	1.94	5	19	291	7.71	253	312
H195	28 Oct - 7 Nov (301-311)	4075	76	66.41	104.45	13.09	3.05	6	21	274	14.2	238	309
H207	25 Oct - 5 Nov (298-309)	4386	91	54.37	164.87	12.41	1.78	7	21	277	7.34	238	301
H222	31 Oct - 10 Nov (304-314)	5903	79	98.20	167.86	11.64	1.88	7	19	280	8.08	248	299
H235	04 Nov - 12 Nov (307-315)	1508	73	41.12	80.96	13.41	3.73	5	20	275	15.44	247	311

NAFO Herring Landings. 1960 - 1988

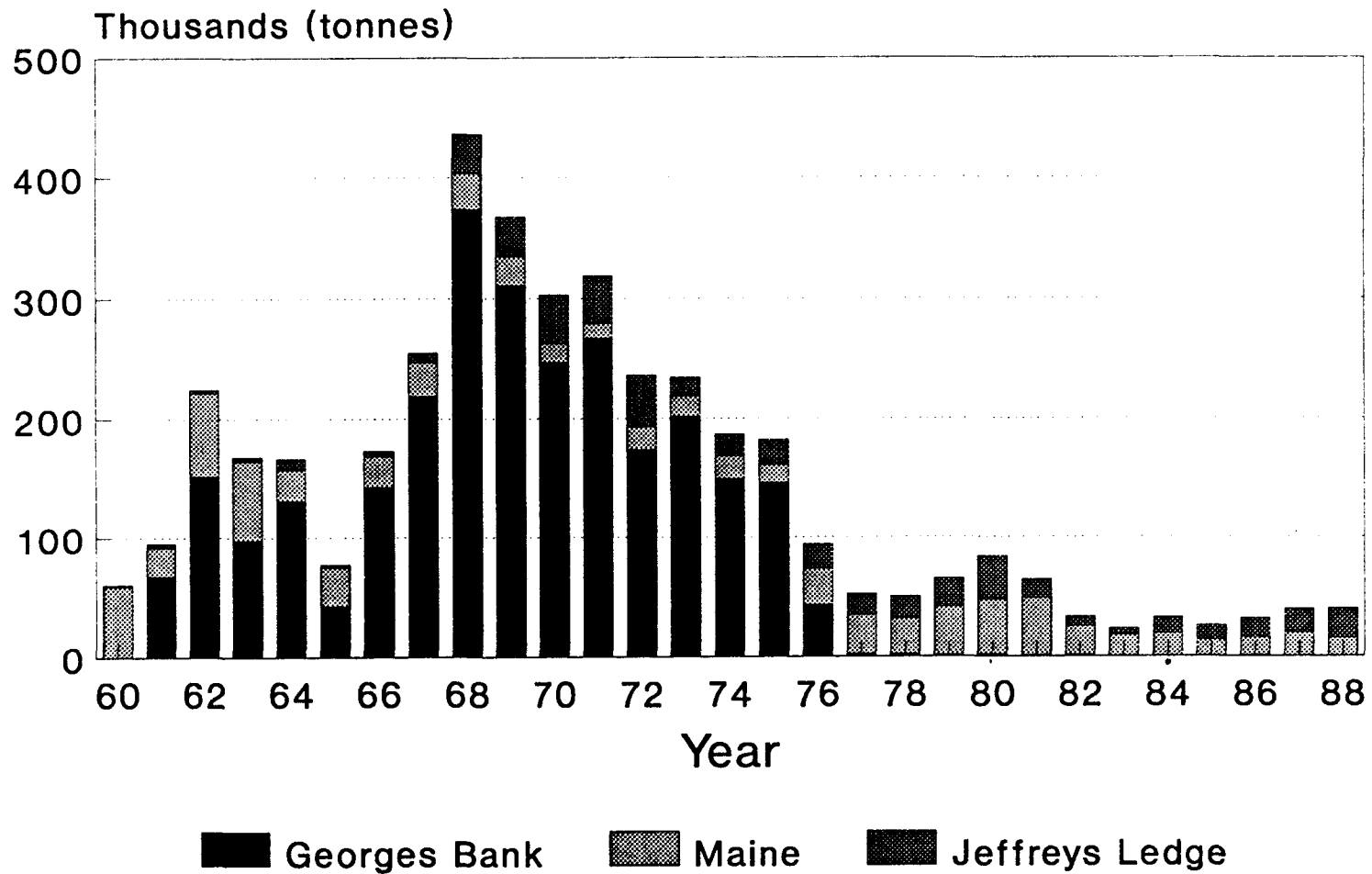


Figure 1. Reported herring catches.

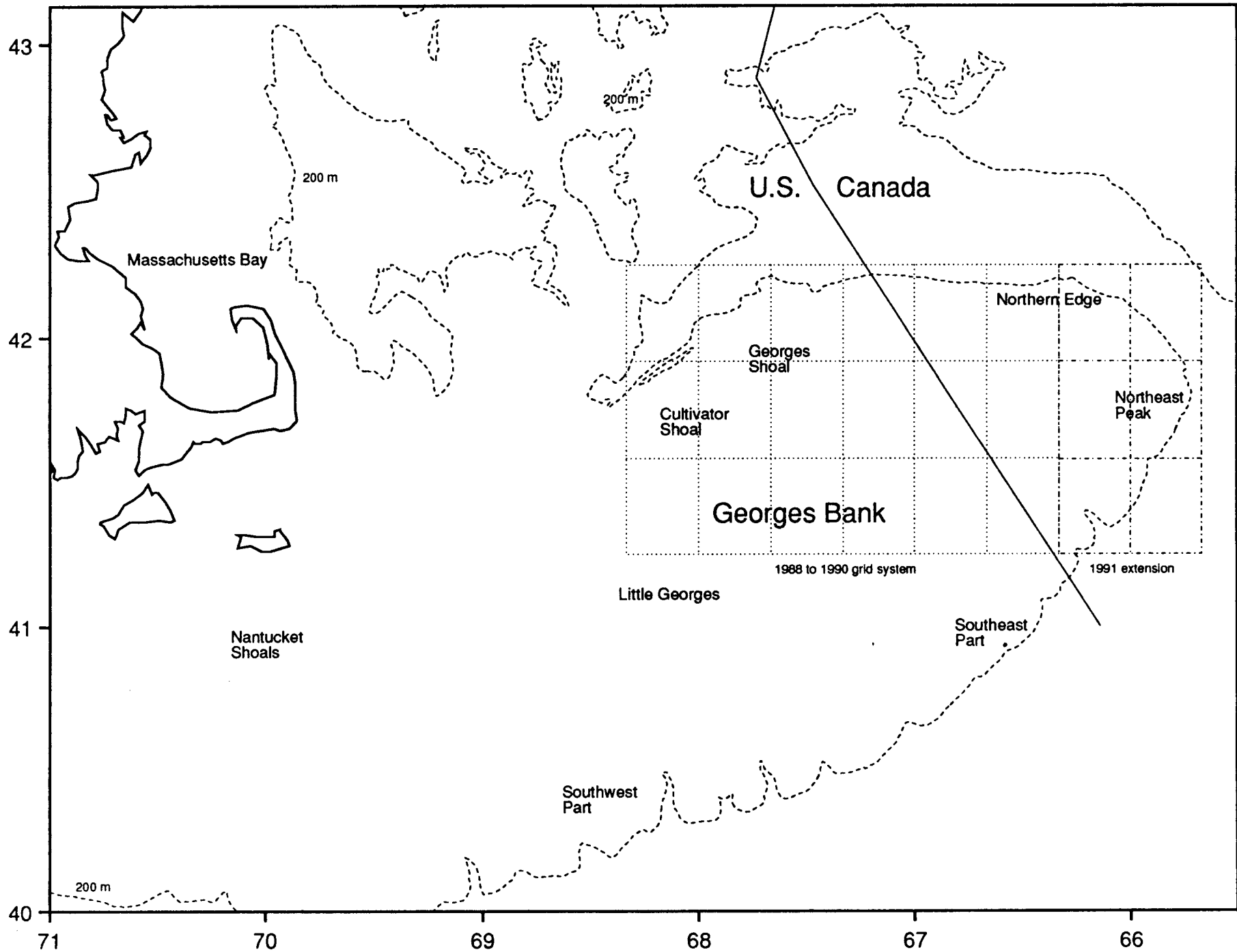


Figure 2. Herring survey area.

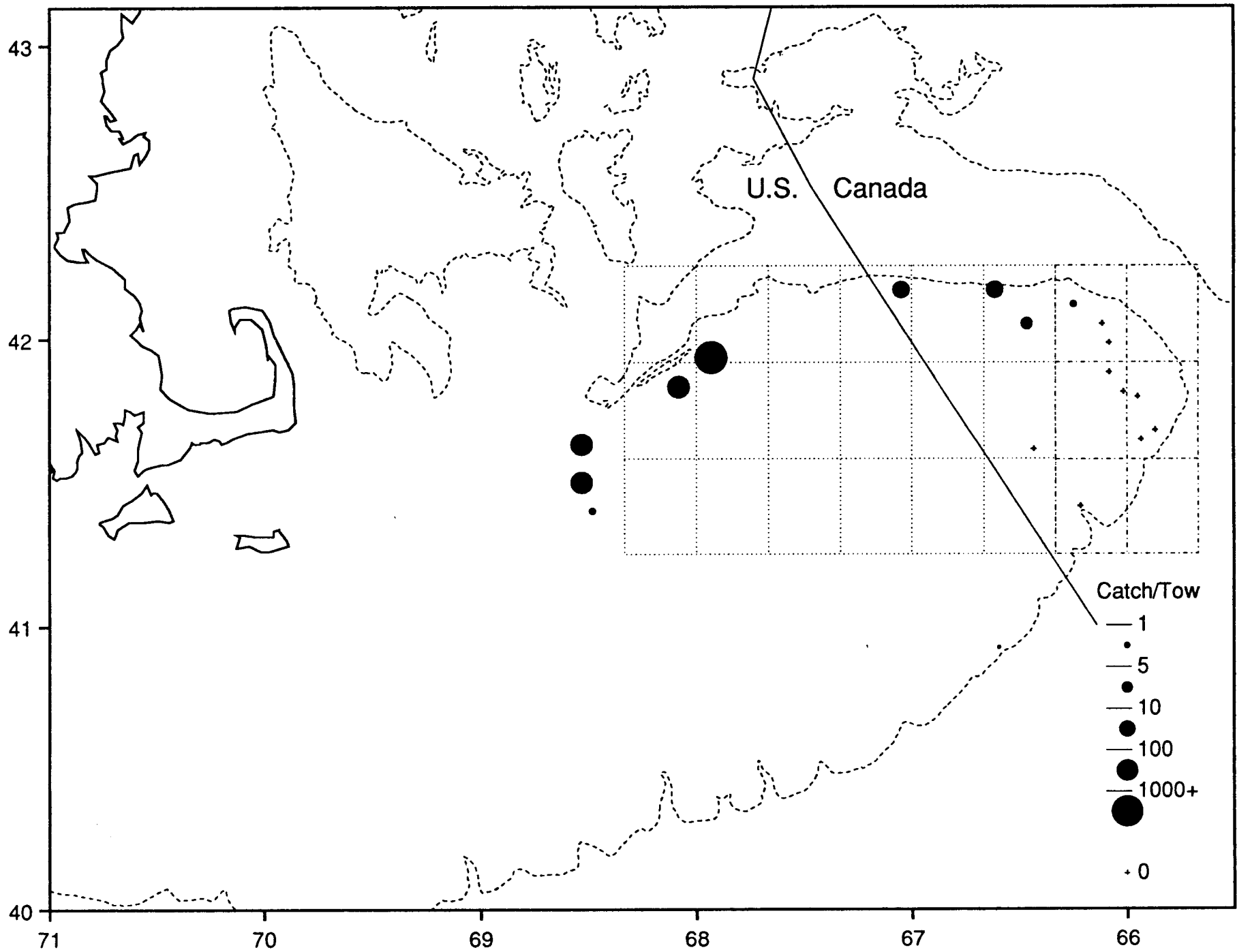


Figure 3. Canadian 1991 survey. Herring as per scale

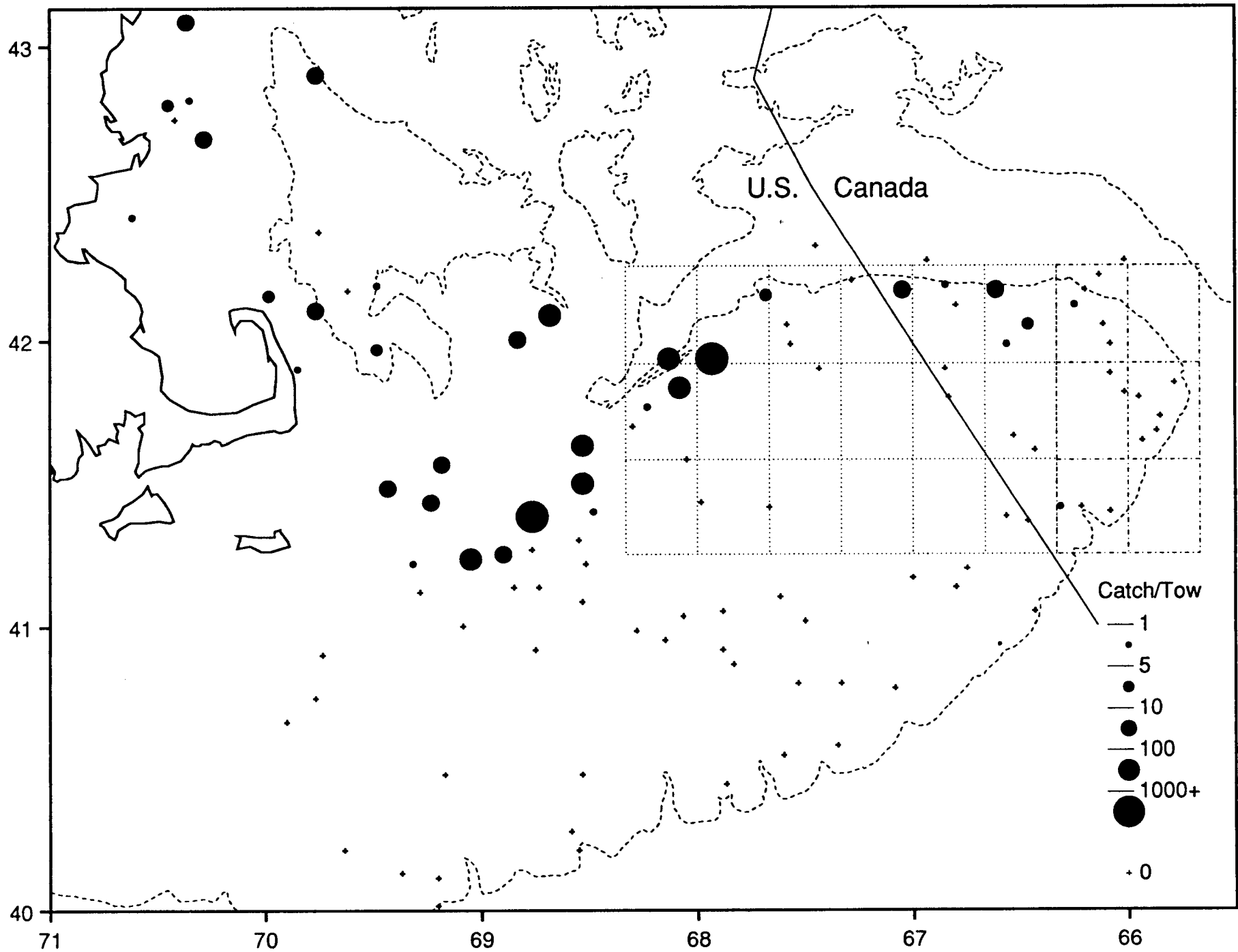


Figure 4. US and Canadian 1991 surveys combined. Herring as per scale

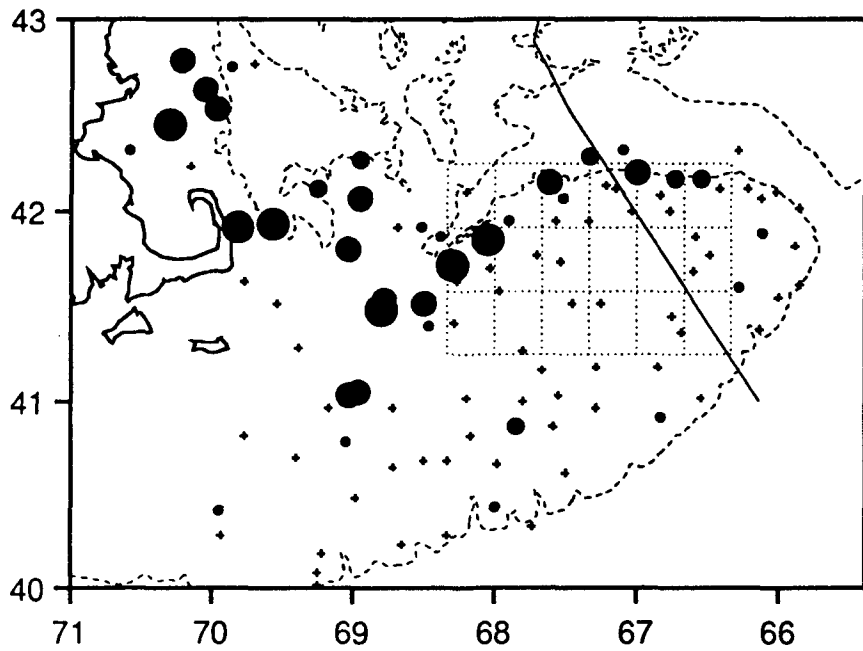


Figure 5a. US and Canadian 1987 surveys combined.
Herring as per adjacent scale.

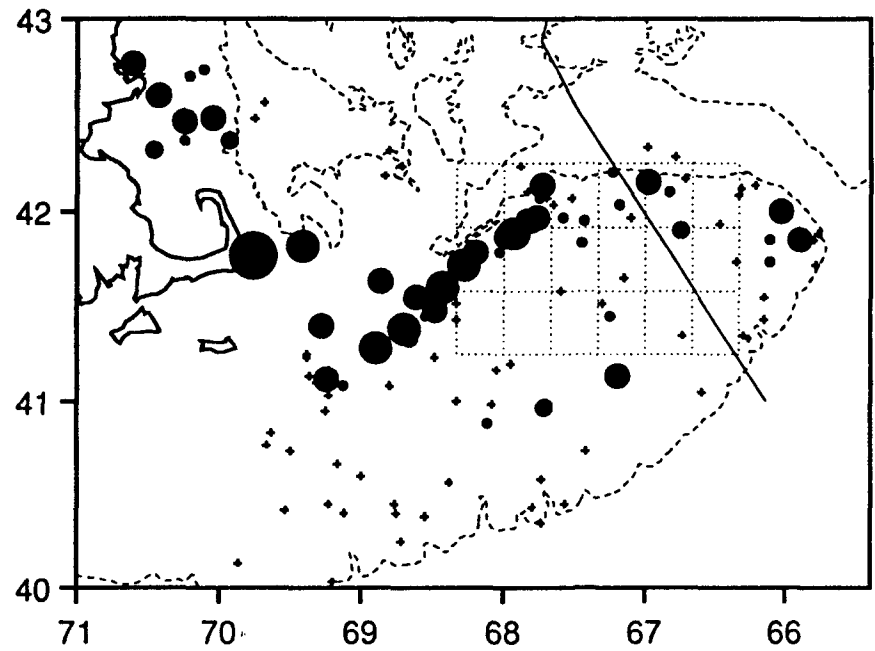


Figure 5b. US and Canadian 1988 surveys combined.
Herring as per adjacent scale.

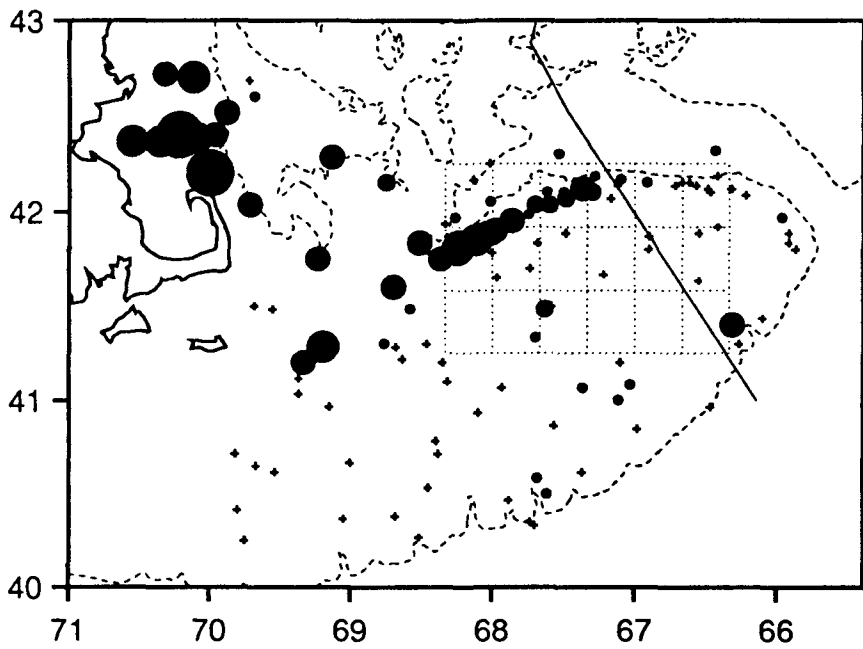


Figure 5c. US and Canadian 1989 surveys combined.
Herring as per adjacent scale.

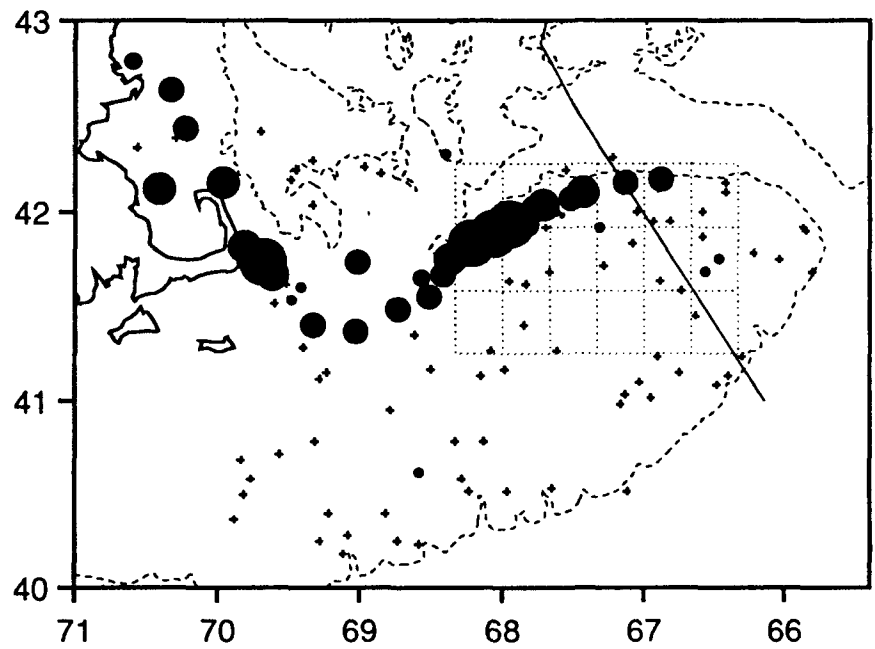
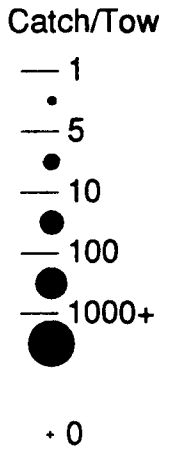


Figure 5d. US and Canadian 1990 surveys combined.
Herring as per adjacent scale.



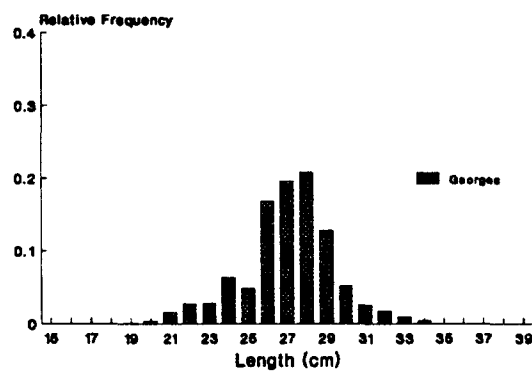
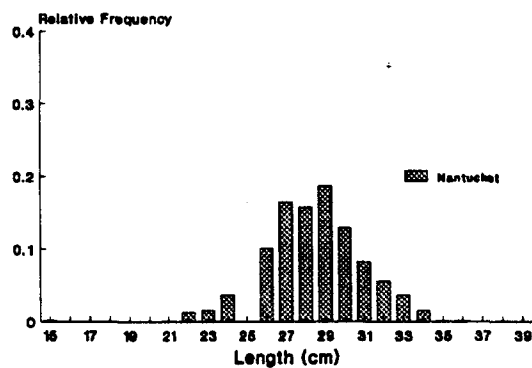
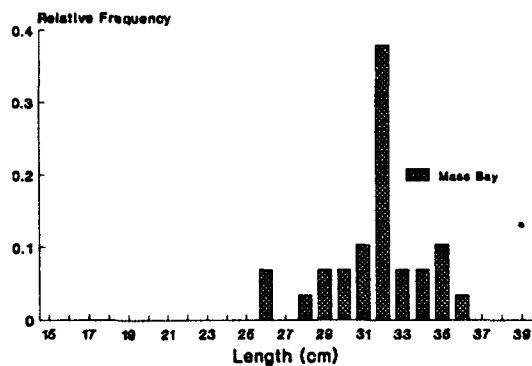


Figure 6. Length frequency of adult herring from Massachusetts Bay, Nantucket Shoals and Georges Bank

Age Distribution Georges Bank Herring 1988-1991

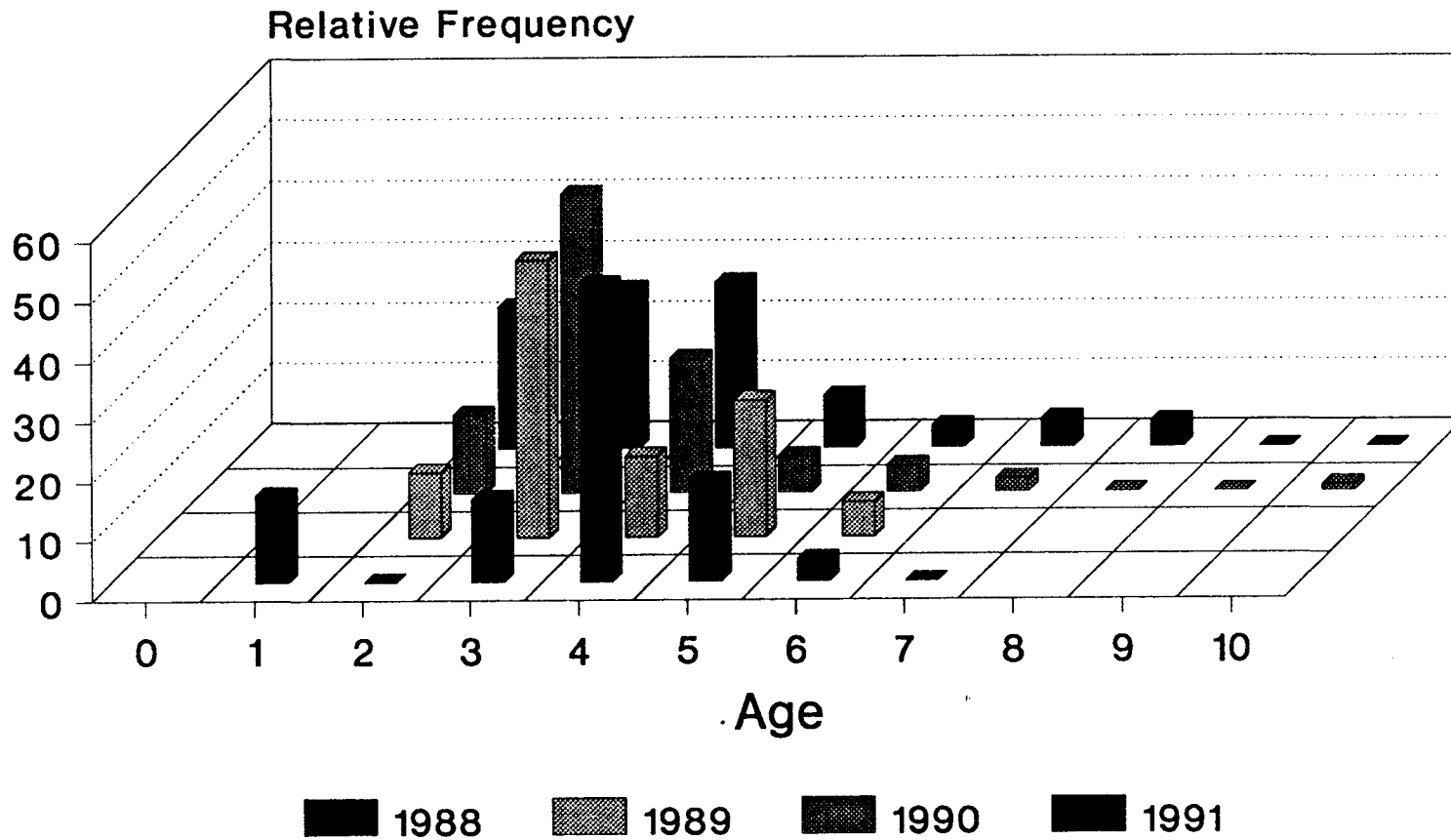


Figure 7. Age distribution of Georges Bank Herring.

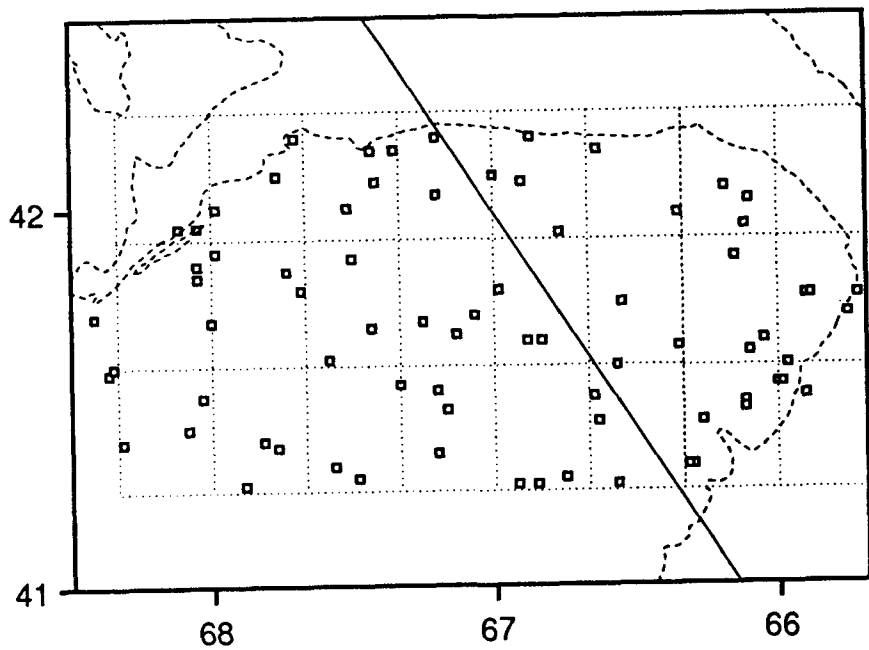


Figure 8a. 1991 Canadian larval survey (Nov 4 - 15).
Sampling stations.

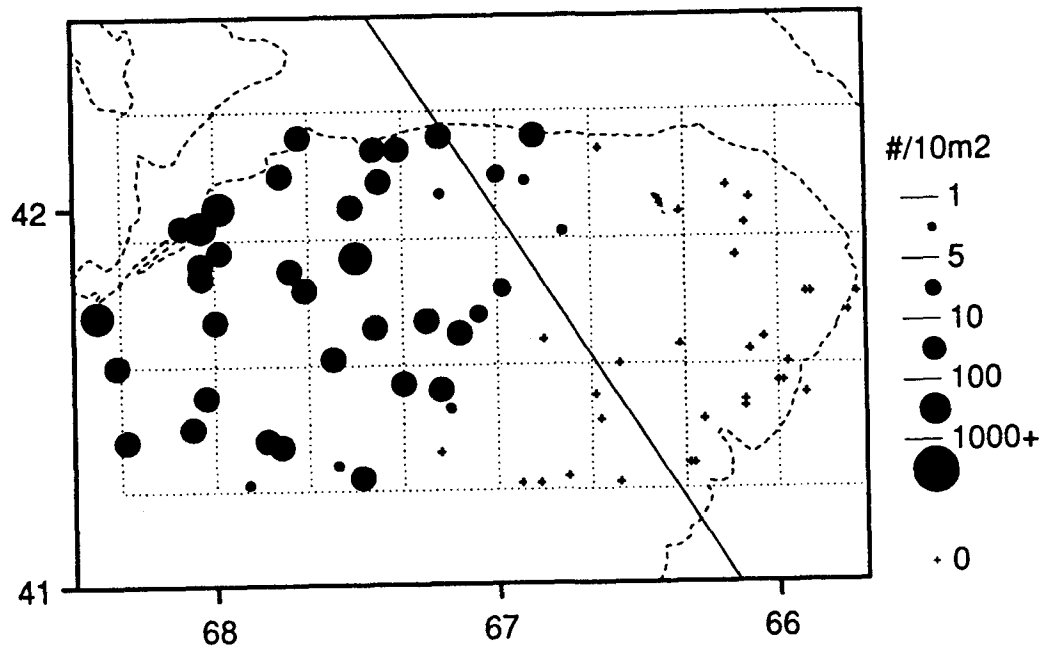


Figure 8b. 1991 Canadian larval survey (Nov 4 - 15).
Larvae as per adjacent scale.

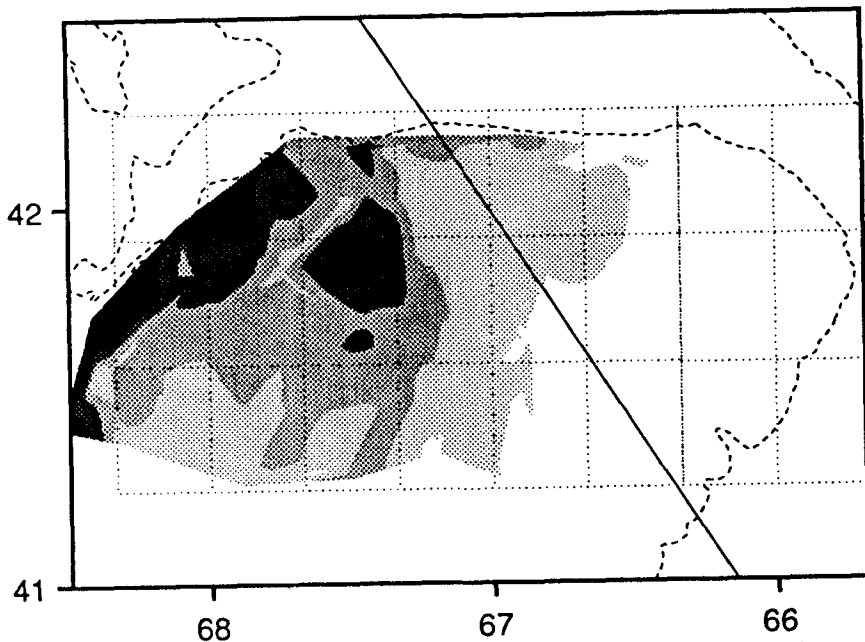


Figure 8c. 1991 Canadian larval survey (Nov 4 - 15).
All larvae. Contours as per adjacent scale.

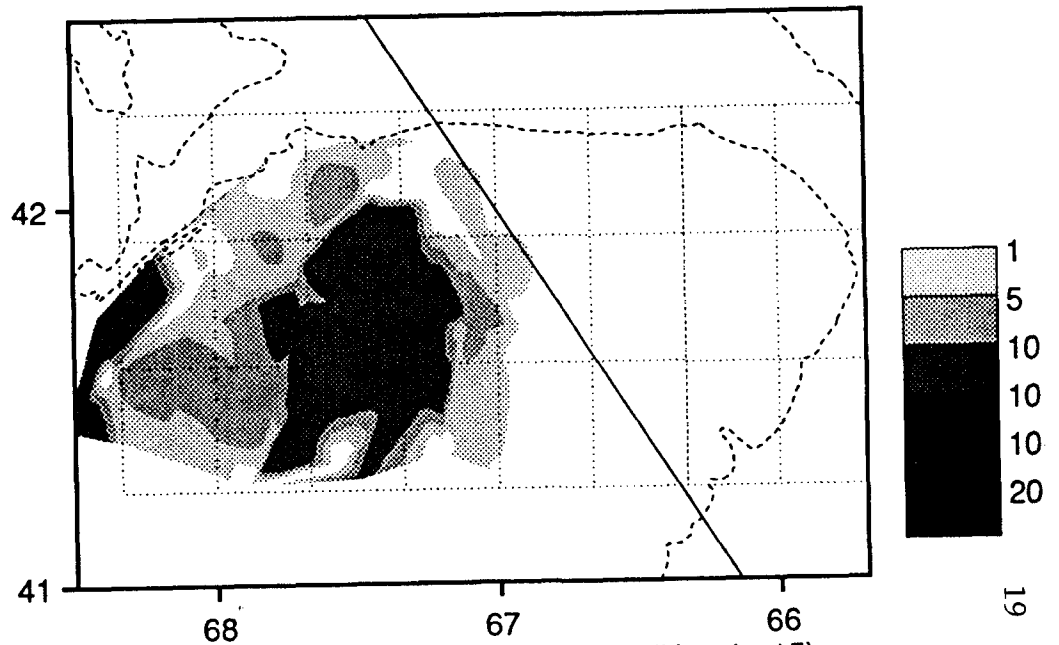


Figure 8d. 1991 Canadian larval survey (Nov 4 - 15).
Larvae (<10mm). Contours as per adjacent scale.

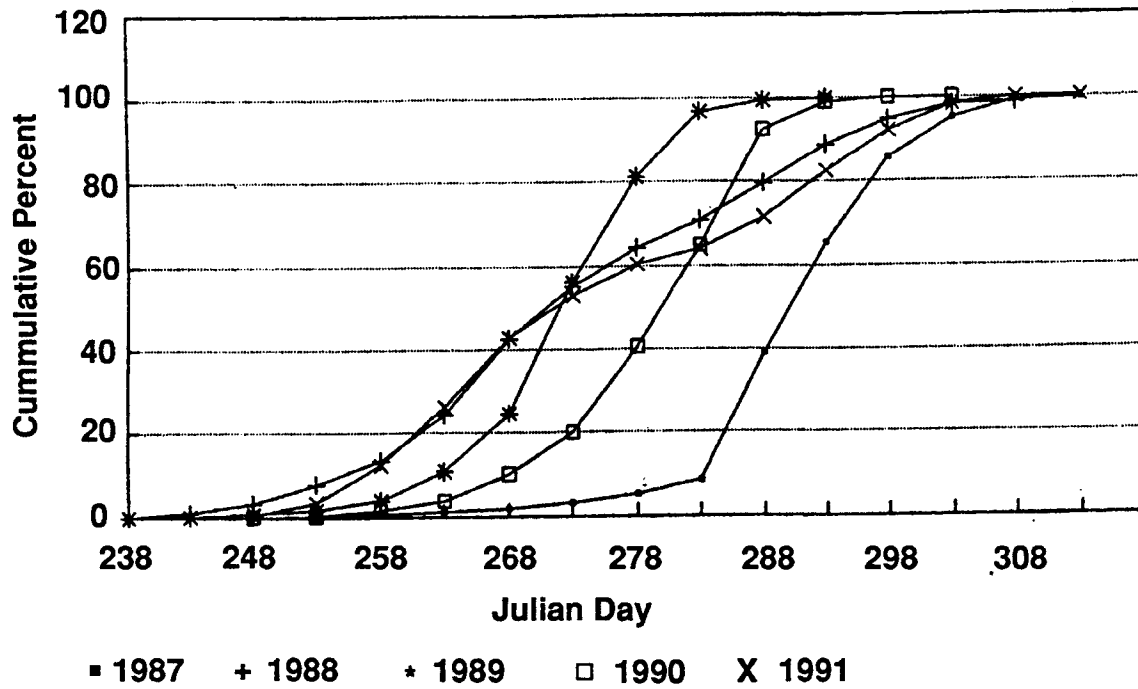


Figure 9. Estimated hatching time (Julian day) of Georges Bank herring larvae.

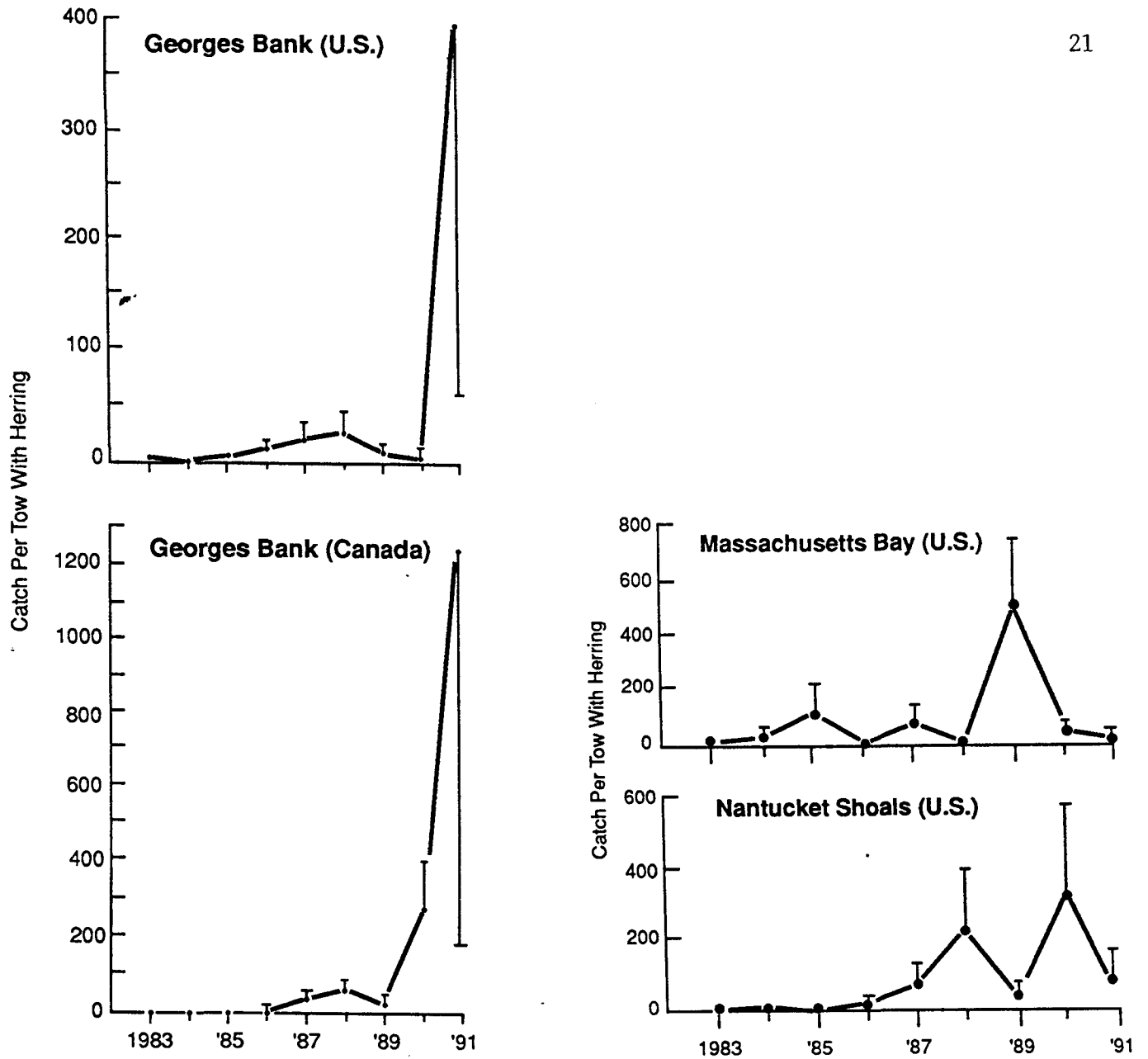


Figure 10. Number of herring per standard bottom trawl tow.

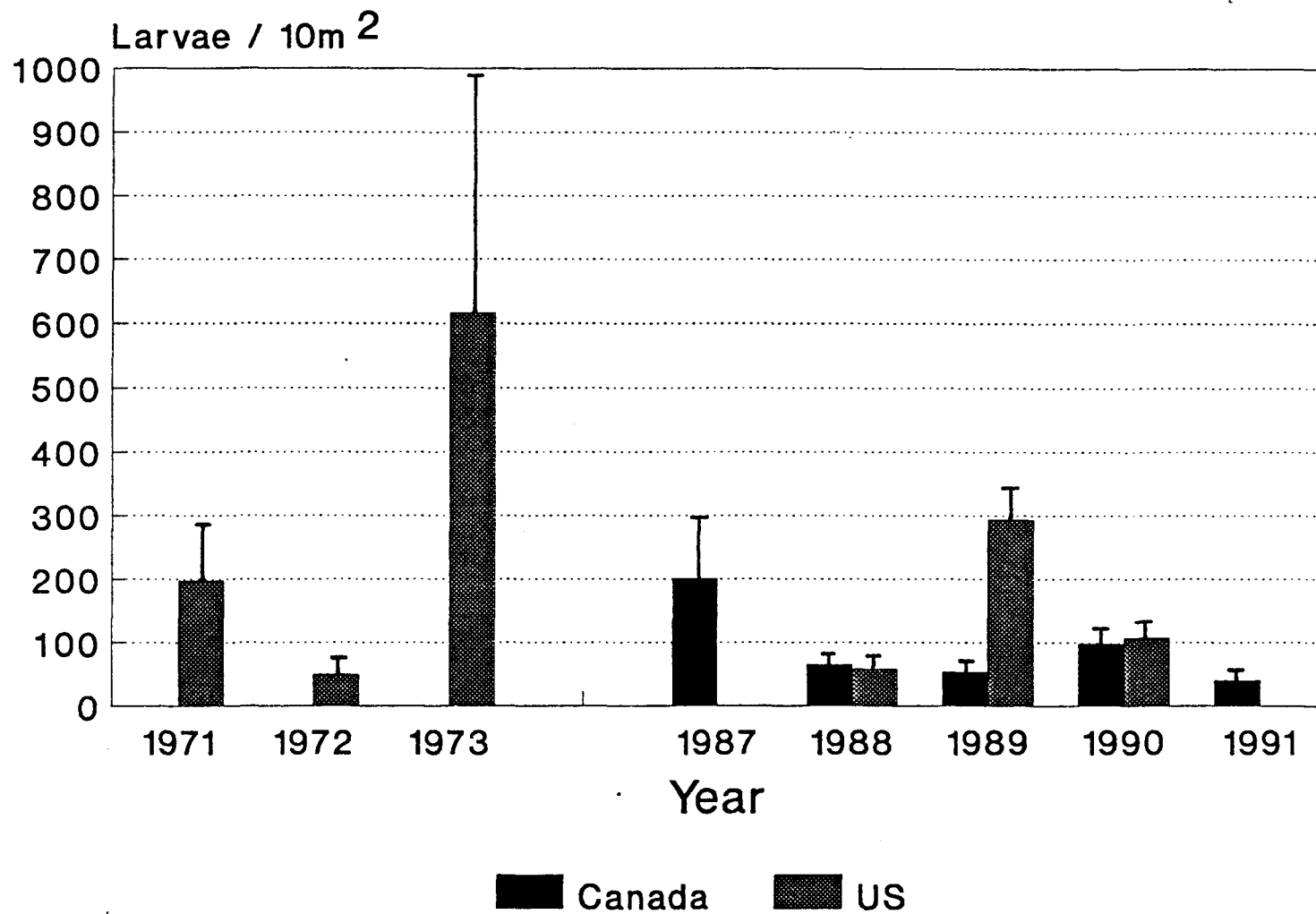


Figure 11. Mean number of larvae per 10m².