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Assessment of the 1990 4WX herring fishery

by

R. L. Stephenson, M. J. Power, U. Buerkle, W. H. Dougherty
D. J. Gordon, J. B. Sochasky and G. D. Melvin
Marine Fish Division
Department of Fisheries and Oceans
Biological Station
St. Andrews, New Brunswick E0G 2X0

ABSTRACT

The 1990 4WX herring fishery was dominated by the purse seine fleet and the roe market. The spatial and temporal distribution of the fishery was similar to that of recent years. Reported landings totalled 101,912 t but this is shown to be an underestimate in that the total of processed roe at accepted yield levels would have required considerably more fish than was reported as landed.

The 1983 yearclass continued to dominate the stock fisheries in number and weight; while age 2 herring (1988 yearclass) dominated non-stock (N.B.) weir and shutoff fisheries.

The 1990 larval herring index was lower than the 1989 value - but above the average of the 19 year time series. Results from recent winter acoustic surveys in Chedabucto Bay were very low - but this is thought to be the result of a change in distribution rather than a reflection of stock size. An index of herring abundance from bottom trawl surveys appears to be useful as a general indicator of the state of the 4WX population.

An analytical assessment is not possible at the present time because of obvious and substantial errors in the recorded catch. In the absence of an analytical assessment, there is no basis for formal projections. The general impression from abundance indices is of a stock which is decreasing from recent high abundance of the late 1980's - but not as low as the late 1970's.

RÉSUMÉ

En 1990, la pêche du hareng dans les divisions 4WX a été dominée par les captures à la senne coulissante et par le marché de la rogue. Les caractéristiques spatio-temporelles de la pêche étaient comparables à celles des dernières années. Les débarquements déclarés se sont établis au total à 101 013 t, mais ce chiffre représente une sous-estimation des résultats car, selon les niveaux de rendement courants, la totalité de la rogue transformée a dû nécessiter une bien plus grande quantité de poisson.

La classe d'âge de 1983 a continué de dominer la pêche dans le stock, en nombre et en poids, tandis que le hareng de 2 ans (classe d'âge de 1988) predominait dans les pêcheries fixes et sennes de plage hors stock du Nouveau-Brunswick.

L'indice du relevé larvaire de 1990 a été inférieur à celui de 1989, mais supérieur à la moyenne de 19 ans. Les résultats d'un relevé acoustique dans la baie Chedabucto étaient très bas, mais l'on estime que c'est-là le résultat d'un changement dans la distribution plutôt qu'une indication de la grosseur du stock. Un indice d'abondance du hareng établi d'après des campagnes d'évaluation au chalut s'avère utile comme révélateur général de l'état de la population des divisions 4WX.

Pour le moment, il est impossible de procéder à une évaluation analytique en raison des erreurs manifestes et importantes des relevés de prises. En l'absence d'une telle analyse, on ne peut effectuer de projections officielles. Toutefois, si l'on se fie aux indices d'abondance, on a l'impression generale que le stock diminue - après avoir connu une forte abondance à la fin des années 80 - mais toutefois pas au point d'atteindre les seuils enregistrés à la fin des années 70.

INTRODUCTION

The 1990 herring fishery in NAFO Div. 4WX was dominated by a purse seine fleet of 40 vessels which accounted for 95% of the "stock" (see pg. 5) landings. The remaining landings came from approximately 250 weirs, a single midwater trawler, gillnetters, shutoffs, and traps (Table 1). The largest fishery took place on prespawning and spawning aggregations off southwest Nova Scotia (4Xqr; June-October), but there were also major fisheries off southern New Brunswick (4Xs; June-January) and off Cape Breton (4W Chedabucto Bay; October-January) (Fig. 1). The fishery continued to be highly influenced by markets. In 1990 the roe market regained its dominance of the fishery, and was followed in importance by domestic markets for large fish (e.g. fillets) and juveniles (e.g. sardines), and by over-the-side sales to foreign vessels (Table 2).

1990 MANAGEMENT PLAN

The 1990 Scotia-Fundy Region Herring Management Plan (Appendix 1) established quotas of 142,350 t for the purse seine fleet and 850 t for midwater trawl. In addition, an allowance of 8,000 t was made for catches by "inshore" components (gillnets, Nova Scotia weirs, Nova Scotia traps) for a TAC of 151,200 t. As in previous years, the New Brunswick weir and shutoff fishery, considered to rely on non-stock fish (i.e. Gulf of Maine origin), was excluded from the TAC. The historical summary of TAC, stock catch and total catch is presented in Table 3.

The purse seine fleet quota was allocated among seasonal fisheries as in recent years (Table I of Appendix 1) and to individual vessels according to the terms of the 1983 herring management ("10-year") plan (Table II of Appendix 1). The 1990 plan allowed for a fishery of 7,500 t in the upper Bay of Fundy; and placed a continuous 18-d closure (beginning Aug. 15) on the Trinity Ledge spawning grounds.

DESCRIPTION OF THE FISHERIES (SEE TABLES 4, 5)

[I] 4WX "STOCK" FISHERIES

4W (Chedabucto Bay, Winter) Purse Seine Fishery

The 1990 management plan allowed a fishery of up to 28,470 t (30% of the summer purse seine quota) between Nov. 1, 1989 and Mar. 1, 1990. A total of 8,316 t was reported from the fishery between November and January (Table 4). This is an increase of approx. 2,000 t over the reported landings of the previous year, but similar to other years since 1985 (Table 6). This fishery is limited by markets; the allocation is a standard 30% of the summer purse seine quota and the unused portion is transferred to the summer fishery. Log records indicate that fish were readily available and that catch rates were high (Power and Stephenson, 1991). The 1991 winter acoustic survey documented the aggregation of herring in the area (Buerkle, 1991).

4Xs (Bay of Fundy) Fall and Winter Purse Seine Fishery

The fall portion of this fishery on the New Brunswick side of the Bay of Fundy was open from Oct. 15, 1989 to Dec. 31, 1989 with a quota of 9000 t as in previous years. The winter portion (Jan. 1-Feb. 28, 1990) had a quota of 6000 t, double that of the previous year. The

total of reported landings (10,705 t) was the largest in this fishery since 1973 and almost double that of 1989 (Table 6). The increase is believed to reflect a combination of good market demand (New Brunswick plants) and fish availability.

4Xqr (Southwest Nova Scotia and Bay of Fundy) Summer Fishery

a) Purse seine

The 1989 management plan allowed a fishery between Apr. 1 and Oct. 14, 1990, with a quota of 96,280 t plus any uncaught quota from the fall, winter, Chedabucto Bay and upper Bay of Fundy fisheries. The fishery was similar in spatial distribution to the previous year, and was documented well by logbooks (see Power and Stephenson, 1991). Recorded landings amounted to 77,545 t but this is known to be an underestimate. The roe fishery alone resulted in 5,088 t of product, which at 6.5% yield implies landings of almost 78,000 t. Almost 18,000 t was sold to foreign factory ships in an OSS program (Table 5) and there was an additional amount (probably about 25,000 t) processed for the usual domestic markets including fillets. Therefore, landings in this fishery must have been at least 96,000 t - and were more likely about 120,000 t.

The summer fishery included an increased suballocation of 7,500 t in the upper Bay of Fundy. In recent years, this fishery has involved roe testing prior to the fishery, but in 1990 the fishery opened without prior testing on a predetermined date (July 22). The sub-allocation was taken in an intense fishery which lasted only a few days.

b) Gillnet

The gillnet segment of this fishery recorded only 243 t, somewhat higher than in 1989, but still one of the lowest landings on record (since 1963). This is consistent with the reduction in landings since 1985 which has been primarily the result of reduced effort due to an absence of markets.

c) Weirs

Nova Scotia weirs recorded 4,049 t, a slight increase over 1989 and well within the range of this fishery in recent years.

[II] 4WX "NON-STOCK" FISHERIES

4Xs (New Brunswick) Weir and Shutoff Fishery

The New Brunswick weir and shutoff fisheries recorded 48,560 t (Table 4), an increase of approximately 4,500 t over 1989 and the highest in the last 25 yr. Again, the weirs of Grand Manan Island dominated but considerable landings were made from weirs of Passamaquoddy Bay, Campobello and Deer Islands and along the shore to Saint John.

Approximately 32,000 t was landed for the domestic market (mostly for canning), but the fishery was enhanced by an OSS market which recorded 5,890 t.

CATCH STATISTICS

Reported landings for the 1990 fisheries (DFO, Scotia-Fundy Region, Statistics Div. records) are listed by month and gear segment

in Table 4, and the amounts landed to domestic and OSS markets are recorded in Table 5. Long-term trends in landings for the major gear segments are presented in Table 6 and Fig. 2. The total of recorded landings for the stock in 1990 was 101,912 t - but this is considered to be an underestimate. There have been several indications from the industry over the past year that the official landing statistics from this fishery are an underestimate, and at the Scotia Fundy Herring Advisory Committee meeting of October 1990 there was general industry agreement that misreporting was high.

We have heard increasing reports of misreporting in recent years but have been unable to verify or quantify them. This year we were able to demonstrate significant under-reporting in the summer fishery through product analysis.

A full reconstruction of the fishery from production figures is difficult because of the possibility of double counting due to the use of the by-product of one production process for another. For example, it is known that some roe fishery carcasses (and/or males) were subsequently used for fillets etc. - but it is difficult to determine how much.

Misreporting is not new to this fishery. In the early 1980's it was a substantial problem. The situation became critical in 1985, with the result that the catch statistics for the period 1978-1984 were revised (Mace 1985, Stephenson et al 1985) and drastic measures were taken to curb misreporting (Stephenson et al. 1986).

The situation seems to have been degrading since then. Nineteen-eighty-nine may not have been such a problem because a price dispute is known to have caused a late and (as a result) smaller fishery, but the 1988 fishery was a problem. Again, product analysis indicates that more fish must have been taken than were recorded; in that the roe production accounts for the entire summer domestic landings, and we know that there were also other domestic markets. The following table demonstrates the discrepancy. It compares the DFO statistics totals (recorded from purchase slips) with what must have been landed to have allowed the roe production recorded from DFO plant surveys. The roe production is an absolute minimum, as there is generally a requirement of 25,000 t for other domestic production.

	4x summer purse seine - domestic landings	
	Official Reported Landings	Minimum landings Calculated from roe production*
Year	(ooo t)	(000 t)
1990	59.8	77.9
1989	41.6	19.3
1988	69.1	70.4
1987	71.2	53.6
1986	55.7	24.6
1985	78.5	60.2

*using DFO plant production statistics and assuming 6.5% yield.

It may be possible to reconstruct the past history since 1985 (when it is believed that landing statistics were adequate) through a combination of the following three initiatives:

i) Interviews with purse seine captains to determine individual vessel landings over the past 5 years.

ii) Back calculation from production using Departmental records and updated conversion factors, and with industry guidance on the amount of "reprocessing" that has taken place.

iii) A processor survey to determine the amount of fish received over the past 5 years.

It would be hoped that two or preferably all three of these be undertaken so that the results could be compared.

ASSESSMENT DATA

STOCK COMPONENTS

As in previous assessments (e.g. Sinclair and Iles 1981; Stephenson et al. 1987), the 4WX fishery is divided into "stock" and "non-stock" components (Table 4). "Stock" fish are considered to belong primarily to the major SW Nova Scotia spawning groups, but this unit also encompasses smaller local stocks (e.g. Grand Manan, Scots Bay). The "non-stock" component is comprised of:

4Xs (N.B.) weirs 4Xs (N.B.) shutoffs	-considered to be migrants from Division 5 stocks
4X miscellaneous	-small localized Nova Scotia south shore stocks caught in 4Xm gillnet, 4Xm trap and bycatches in handline and longline fisheries
4W miscellaneous	-4W fish taken in gear other than purse seine, on the assumption that the fish are from local stocks.

In recent years, increasing amounts of herring have been taken from the N.B. weir fishery (Grand Manan) and sold to foreign factory ships in an OSS program. These are generally larger fish than have been taken historically by the weir fishery for domestic processing. The exclusion of weir fish from the "stock" was on the basis that they were predominantly juveniles which were known to migrate along the coast of Maine into the area. There has been debate regarding the validity of this assumption, and the presence of large fish which were resident in the area throughout much of the year raises further questions of stock structure. It is proposed that in future the large fish sold to OSS vessels be included in the "stock" landings. The catch at age for 1989 and 1990 will have to be modified to include 6000-8000 additional tons.

As in previous assessments, those segments of the fishery which span the winter months (4W and 4Xs purse seine), are considered on a quota year basis (Oct. 15, 1989-Oct. 14, 1990). All other segments are considered for the calendar year 1990.

BIOLOGICAL SAMPLING

As in previous years, sampling of commercial catches was stratified by area, gear segment and month (Hunt 1987) by:

1) obtaining as many length frequencies from individual catches as practical during routine port sampling in N.B. and N.S. and by observers on foreign vessels; and

2) collection of stratified "detail" samples (two fish per half cm size-class above 24 cm; one per half cm size-class at 24 cm and less) to a level of at least 200 fish per area, gear and month.

Sampling in 1989 resulted in 607 length frequencies and 11,233 fish analyzed in detail (including ages). The spatial distribution of sampling is shown in Fig. 3.

Biological samples were matched to landings by gear component on a monthly basis as in previous assessments (Table 7). Numbers at age from commercial catches were generated on the St. Andrews VAX 6210 in the traditional manner, using programs HERNLWO2 and HERNAGO9. For all gear components, length-frequency samples were applied on a monthly basis. Separate keys were applied for over-the-side (OSS) and domestic markets because of the differences in fish size.

As in the past, a correction of 2% was applied to length measurements to account for shrinkage due to freezing. This is within the range of values observed in several studies in Scotia-Fundy and Gulf Regions summarized by Hunt et al. (1986).

CATCH AT AGE

The age composition of landings in stock and non-stock segments of the 1990 fishery and the proportion by age for each fishery (based on reported, unadjusted landings) are presented in Tables 8, 9 and in Fig. 4. The 1983 year-class dominated major stock fisheries in number (19%) and weight (27%). Age 2 fish continued to dominate the non-stock fisheries on the New Brunswick side of the Bay of Fundy. The historical series of catch at age in number and weight for the 4WX herring fishery (1965-90; based upon reported landings) are presented in Tables 10 and 11.

LENGTH AND WEIGHT AT AGE

Average weight and length at age has been calculated by gear segment in Table 12. Recent assessments (e.g. Stephenson and Power 1988, 1989) have used fishery weighted, weights at age (mean for stock fish weighted by gear) and this series has been extended in Table 13.

COMMERCIAL FISHERY LOGBOOKS

a) Purse Seine

The detailed purse seine logbook introduced in 1985 (Power and Stephenson 1986, 1987) was used for the sixth consecutive year. Coverage was again high (100 % of trips; 94% of Statistics Division landings) as logbook submission remained a condition of license, and information was of good quality as in previous years. The 1990 logbook information (see Power and Stephenson, 1991) was used to document various aspects of the Div. 4WX purse seine fishery, including catches by fishing ground, location and total effort on specific components as well as recent patterns of releases.

RESEARCH SURVEY DATA

a) Larval Abundance

The 1990 larval herring survey was undertaken between Oct. 26 and Nov. 6 (E.E. PRINCE, Cruise P408). All 79 of the traditional larval abundance index stations were sampled (Fig. 5). The 1990 index (27.0 m^{-2}) is considerably lower than the 1989 value and continues the decrease from the record high 1988 point. It is, however, above the average of the 19 yr time series. (Table 14, Fig 6).

b) Acoustic Survey

Buerkle (1991) presents results of the 1991 winter herring acoustic survey in Chedabucto Bay as well as further analysis of the comparable 1990 survey.

Results from the 1990 survey indicate that herring left the Chedabucto Bay survey area during the survey period. The mean nightime abundance from 1990 surveys was 87,291 tonnes, but with herring moving out of the area it makes little sense to calculate a mean for the entire survey period. The mean abundance from Jan. 6-7, when the surveys did encounter herring was 238,130 t and is considered more indicative of 1990 Chedubucto Bay winter biomass.

The 1991 surveys (cruise N147) were undertaken during the nights of Jan 5-28. These surveys encountered very few herring (max 31,000 t; approximately one tenth that estimated in previous years). While a decline in the abundance of the 4WX spawning stock is also indicated by the larval abundance index, the amount of the decline indicated by the acoustic survey is considered unrealistic. Judging from comments by herring seiners, it is likely that the major concentrations of herring were present in December - and that the January surveys missed them. Herring have been observed departing the survey area during January in previous years, but little is known about what affects the timing of this movement. It seems, because of this movement that the January survey of the index area is not encountering a constant portion of the population, and is therefore invalid as a time series of abundance. It is proposed that this problem be investigated during the next year by surveying in December 1991 and in January 1992.

c) Groundfish Survey Bycatch

An index based upon the by-catch of herring in annual (July) stratified random research groundfish surveys, first presented in 1989 (Stephenson et al. 1990), was re-evaluated.

The previous index (for the years 1978 to 1989) was extended to a 21-yr series, 1970-1990 (Table 15). An index based on only those sets with herring was also considered and these are compared in Table 15 and Fig. 7. The curves show similar patterns.

Fig. 8 shows the survey strata. The distribution of catch by strata over the entire index time series is presented in Fig. 9. It is apparent that there are two general areas of herring occurrence - on the outer Scotian Shelf and in the Bay of Fundy during the summer surveys (these areas are highlighted on Fig. 8) and raises the possibility of calculating separate indices.

Examination of the length composition from recent surveys showed that the index is not being influenced by occasional large catches of juvenile herring. Little could be done to determine if changes in survey vessel affected herring catches. Three vessel changes occurred in the period 1981-83 - but this would not have influenced the index in recent years (Table 15).

It is proposed that an index based upon the stratified mean results from the entire survey is a general indication of the state of the 4WX herring population. Maps of distribution and abundance from the survey (Fig. 10) show the relative distribution and abundance each year. The results of this survey index are consistent with our view of the recent history of this stock and with the general pattern of the larval abundance index.

ESTIMATION OF STOCK SIZE

The traditional analytical assessment (SPA, tuned with larval and/or acoustic survey results) is not possible at the present time because of obvious and substantial underestimates in the catch at age. The 1990 catch figure is known from production analysis to be a underestimate and there is considerable doubt about the 1988 figure. It appears that the error in the catch at age has not been constant - but has increased since 1985. It is impossible to estimate recent catches at present (because of the unknown amount of "double counting" when converting production records) but it may be possible to reconstruct the catch history from fishermen surveys, production analysis and possibly plant surveys.

ASSESSMENT RESULTS AND PROGNOSIS

In the absence of an analytical assessment, there is no basis for formal projections. The larval index indicates a further decline since the record high of 1988 - but is still well above the mean of the (19 yr) series. The acoustic estimate for 1991 is considered unrepresentative of stock size. The summer bottom trawl index indicates a decline from recent high values - but (as in the larval index) is above the long term mean.

The general impression from these indices is of a stock which is decreasing from recent high levels (late 1980's) but not as low as the late 1970's.

Fishery information (including purse seine logbook comments) is consistent with this conclusion. There is no indication of an absence of fish (except for the Trinity Ledge spawning ground), but no

indication either of the increasing abundance which was noted in the late 1980's.

In the last advice CAFSAC predicted that, in the absence of strong recruitment, the stock would decrease with the degradation of the dominant 1983 year class. While there is an indication of possible strong recruitment in the logbook comments (of small fish), we have no way of confirming or quantifying yearclass strength.

The 1991 management plan imposed the same TAC as in recent years (151,200 t) anticipating a catch in line with CAFSAC's recommendation that it should not exceed the recent high (i.e. 125,000 t). A number of restrictive measures including a limit on the number of carriers, weekend closures and a Trinity Ledge closure, have been implemented in order to prevent increased catches in the summer fishery.

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Table 1. Landings (t) for gear types involved in the 1985-90 4WX herring fishery.

Gear	1985	1986	1987	1988	1989	1990
Purse seine	101337	67918	91625	14750	80154	96566
Weirs	30786	29470	33408	40072	46783	42273
Gillnet	5584	4318	2919	1151	382	457
Traps	1304	296	440	1284	123	183
Shutoffs	1139	371	698	867	637	554
Midwater trawl	98	28	17	423	783	871
Miscellaneous	1612	103	74	1329	552	501
Total	141860	102504	129181	159876	129414	141405

Table 2. Market components of the 4X summer purse seine fishery 1988-1990 (from logbook analysis - Power and Stephenson, unpubl. data).

Market	1988 Landings t (logged t)	%	1989 Landings t (logged t)	%	1990 Landings t (logged t)	%
Roe	32,509	38	13,268	21	31,523	43
Adult shore	29,361[1]	34	24,201	39	25,941	35
Over-the-side	21,755	25	19,190	31	13,387	18
Bait	449	1	1,950	3	855	1
Fillet	410	1	805	1	50	0
Sardine[2]	99	0	57	0	308	0
U.S. buyers	23	0	64	0	57	0
Unspecified	1,135	1	2,422	4	125	0

[1]Includes a considerable amount of fish which actually went to the roe market.

[2]Sardine market was supplied predominantly by weirs and purse seine landings in other seasons.

Table 3. TAC, reported stock, adjusted stock and total 4WX (stock + non-stock) landings ('000 t).

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
TAC	-	-	-	-	109.0	110.0	99.9	65.0[1]	100.0	80.2	82.0	80.0	125.0	97.6[2]	126.5	151.2	151.2	151.2
Reported stock[3] 4WX catch	122.7	149.7	143.9	115.2	117.1	95.9	59.0	79.6	87.7	84.7	84.4	78.1	112.4	73.7	101.2	124.6	84.5	101.9
Adjusted stock[4] 4WX catch						114.0	77.5	107.0	137.0	105.8	117.4	135.9	-	-	-	-	-	-
Reported total 4WX catch	142.6	170.3	174.7	143.9	150.7	134.7	96.2	93.2	106.8	110.7	94.1	88.7	141.9	101.8	130.2	159.9	129.4	141.4

[1]TAC raised from 60.0 t to 65.0 t in mid-season.
[2]Excludes an allowance of 13,000 t for inshore 4Xn fixed gear.
[3]Excludes 4Xb weir + shutoff, 4Xn gill + trap, 4W inshore gear.
[4]Includes 1978-1984 adjustment for misreporting and omissions.

Table 4. Landings (t) by gear component and month for the 1990 4WX herring fishery (data from D.F.O., Scotia Fundy Region Statistics Division).

Gear component	1989			1990											1989	1990	1989/90	Quota	
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Totals	Totals	Totals	Totals	
4W Purse Seine		3484	3292	1540										10327	4461	6776	16328	23104	8316	(1)
4Xqr (N.S.) P.Seine	9442							92	9739	23616	8022	28404	7672			9442	77545	86987	77545	(2)
4Xs (N.B.) Purse	1311	1456	56	3617	4265								530	626	554	2823	9592	12415	10705	(3)
4X Gillnet						0	2	111	65	44	20	1				0	243	243	243	(4)
4Xr (N.S.) Weirs								231	939	1482	879	472	46			0	4049	4049	4049	(4)
4X Traps	43	1					0	0	0	143	38	2				44	183	227	183	(4)
4Xs (N.B.) Midwater				205	305	361										0	871	871	871	(4)
Stock Totals	10796	4941	3348	5362	4570	361	2	434	10743	25285	8959	28879	8248	10953	5015	19085	108811	127896	101912	
4Xs (N.B.) Weirs	7233	2158						93	65	4885	14648	11059	7306	168		9391	38224	47615		
4Xs (N.B.) Shutoff	391									3	168	319	56	8		391	554	945		
4X Misc. Gears	22						1	1	16	19	8	41	44	1		22	131	153		
4W Gillnet	1						124	69	9	5	1	0			6	1	214	215		
4W Misc. Gears							2	3	0	0	0	0	0			0	5	5		
4WX Russian OTB-stern									365							0	365	365		
Non-stock totals	7647	2158	0	0	0	0	127	166	455	4912	14825	11419	7406	177	6	9805	39493	49298	0	
4WX Total all Gears	18443	7099	3348	5362	4570	361	129	600	11198	30197	23784	40298	15654	11130	5021	28890	148304	177194	101912	
4Vn Purse Seine		296	1782											4712		2078	4712	6790	4712	
4Vn Gillnet							6	21	4							0	31	31		
4Vn Trap/Misc.	2							92	40	7		0				2	139	141		
4Vn Totals	2	296	1782	0	0	0	6	113	44	7	0	0	0	4712	0	2080	4882	6962	4712	
4VWX Overall	18445	7395	5130	5362	4570	361	135	713	11242	30204	23784	40298	15654	15842	5021	30970	153186	184156	106624	

(1) Quota period from Nov. 1, 1989 to Mar. 1, 1990.
(2) Quota period from Apr. 1 to Oct. 14, 1990.
(3) Quota period from Oct. 15, 1989 to Feb. 28, 1990.
(4) Quota period from Jan. 1 to Dec. 31, 1990.

Table 5. Monthly landings (t) to domestic (Canadian) and OSS (foreign over-the-side sales) markets for gear components involved in the 1990 OSS program.

Gear component	1990												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	1990 Totals
4W Purse Seine Total	1540										10327	4461	16328
4W Purse Seine Dom.	921										7041	3086	11048
4W Purse Seine OSS	619										3286	1375	5280
4Xa P.Seine Total					92	9739	23616	8022	28404	7672			77545
4Xa P.Seine Dom.					92	5293	14720	3624	28404	7672			59805
4Xa P.Seine OSS					0	4446	8896	4398	0	0			17740
4X NS Weirs Total					231	939	1482	879	472	46			4049
4X NS Weirs Dom.					231	939	1482	540	354	46			3592
4X NS Weirs OSS					0	0	0	339	118	0			457
4Xb (NB) Weir Total					93	65	4885	14648	11059	7306	168		38224
4Xb (NB) Weir Dom.					93	65	4354	10824	9524	7306	168		32334
4Xb (NB) Weir OSS					0	0	531	3824	1535	0	0		5890
4Vn P.Seine Total											4712		4712
4Vn P.Seine Dom.											3928		3928
4Vn P.Seine OSS											784		784
Gear Totals	1540				416	10743	29983	23549	39935	15024	15207	4461	140858
Domestic Totals	921				416	6297	20556	14988	38282	15024	11137	3086	110707
OSS Totals	619				0	4446	9427	8561	1653	0	4070	1375	30151

Table 6. Historical series of annual landings (t) for major components of the 4WX herring fishery (1963-89 from Stephenson et al, 1990).

Year	4W P.seine	4Xqr P.seine	4X Gillnet	4Xr Weir	4Xs P.seine	4Xs Shutoff & Weirs	Stock Total *	TAC
1963		15093	2955	5345	6871	29366		
1964		24894	4053	12458	15991	29432		
1965		54527	4091	12021	15755	3346	86394	
1966		112457	4413	7711	25645	35805	150226	
1967		117382	5398	12475	20888	30032	156741	
1968		133267	5884	12571	42223	33145	196362	
1969	25112	84525	3474	10744	13202	26539	150462	
1970	27107	74849	5019	11706	14749	15840	190382	
1971	52535	35071	4607	8081	4868	12660	129101	
1972	25656	61158	3789	6766	32174	32699	153449	
1973	8348	36618	5205	12492	27322	19935	122687	
1974	27044	76859	4285	6436	10563	20602	149670	
1975	27030	79605	4995	7404	1152	30819	143897	
1976	37196	58395	8322	5959	746	29206	115178	
1977	23251	68538	18523	5213	1236	23487	117171	109000
1978	17274	57973	6059	8057	6519	38842	114000	110000
1979	14073	25265	4363	9307	3839	37828	77500	99000
1980	8958	44986	19804	2383	1443	13525	107000	65000
1981	18588	53799	11985	1966	1368	19080	137000	100000
1982	12275	64344	6799	1212	103	25963	105800	80200
1983	8226	63379	8762	918	2157	11383	117400	82000
1984	6336	58354	4490	2684	5683	8698	135900	80000
1985	8751	87167	5584	4062	5419	27863	112385	125000
1986	8414	56139	3533	1958	3365	27883	73733	97600
1987	8780	77706	2289	6786	5139	27320	101157	126500
1988	8503	98371	695	7518	7876	33421	124670	151200
1989	6169	68089	95	3308	5896	44112	84463	151200
1990	8316	77545	243	4049	10705	48560	101912	151200
1991								151200

* Includes all purse seine, 4Xa gillnet, 4Xa weir, 4Xa traps, and 4Xb midwater trawl.

** 1978-1984 include adjustment for misreporting and ommisions

Table 7. Distribution of biological samples from the 1990 4WX herring commercial fishery by area, gear component and month.

Area Year	Gear Component Month	Market	Catch	L.F. Samples	L.F. Fish	Detail Samples	Detail Fish	Catch Per Detail Fish	Catch Per L.F. Sample
4W	Purse Seine, Chedabucto Bay								
1989	Nov.	DOM	2416	3 \	431	3 \	124 \	19.48	805.33
	Nov.	OSS	1068	9 \12	1623	1 \4	48 \172	22.25	118.67
	Dec.	DOM	760 \	0 \	0	0 \	0 \		
	Dec.	OSS	2532 \3292	22 \22	4276	4 \4	193 \193	13.12	115.09
1990	Jan.	DOM	921	18	4298	8 \	399	2.31	51.17
	Jan.	OSS	619	5	1124	0 \8	<Key from Jan. DOM detail>		123.80
	Nov.	DOM	7041	11	2350	7	322 \	21.87	640.09
	Nov.	OSS	3286	40	10362	2	73 \395	45.01	82.15
	Dec.	DOM	3086	7	1771	5	263 \		
	Dec.	OSS	1375	13	2937	7	290 \553	4.74	105.77
4Xqr	Purse Seine, Nova Scotia								
1990	May	DOM	92 \	1 \	180 \	1	49 \	1.88	92
	Jun.	DOM	5293 \5385	16 \17	2673 \2853	12	489 \538	10.82	330.81
	Jun.	OSS	4446	41	5978	4	105	42.34	108.44
	Jul.	DOM	14720	21	3983	15	578 \	25.47	700.95
	Jul.	OSS	8896	39	9075	10	429 \1007	20.74	228.10
	Aug.	DOM	3624	11	1931	9	358 \	10.12	329.45
	Aug.	OSS	4398	19	6769	4	179 \537	24.57	231.47
	Sept.	DOM	28404	6	1053	6	255	111.39	4734
	Oct.	DOM	7672	6	1094	6	258	29.74	1278.67
4Xs	Purse Seine, New Brunswick								
1989	Oct.		1311 \	1 \	172 \	1 \	28 \	46.82	1311
	Nov.		1456 2823	1 2	139 311	1 \2	26 54		
	Dec.		56 /	0 /	0 /	0	0 /		
1990	Jan.		3617	25	4667	18	683	5.30	144.68
	Feb.		4265	26	5311	13	538	7.93	164.04
	Oct.		530	4	1147	3	129 \381	4.11	132.50
	Nov.		626	9	2541	5	252 /	2.48	69.56
	Dec.		554	8	1997	6	278	1.99	69.25
4X	Gillnet								
1990	Apr.		2 \	0	0 \	0 \			
	May		111 \	0	0 \	0 \			
	Jun.		65 243	1	153 \	1 \	35	1.86	65
	Jul.		44 /	0	0 /	0 /	<Key from 4X "All Gears" May/Sept.>		
	Aug.		20 /	0	0 /	0 /			
	Sept.		1 /	0	0 /	0 /			
4Xr	Weir, Nova Scotia								
1990	May		231	5	1276	4	95	2.43	46.20
	Jun.		939	13	2891	13	369	2.54	72.23
	Jul.		1482	11	2462	10	244	6.07	134.73
	Aug.	DOM	540 \	11	2148	10	474	1.14	49.09
	Aug.	OSS	339 \879	0	0	0			
	Sep.	DOM	354	0	0	0	<Key from 4Xqr P.Seine Sept. DOM>		
	Sep.	OSS	118	0	0	0	<Key from 4Xqr P.Seine Aug. OSS>		
	Oct.	DOM	46	1	236	1	51 <Key from 4Xqr P.Seine Oct. DOM>		

... continued

Table 7, cont'd.

Area Year	Gear Component Month	Market	Catch	L.F. Samples	L.F. Fish	Detail Samples	Detail Fish	Catch Per Detail Fish	Catch Per L.F. Sample
4X	Trap								
1990	May		92 \	0	\				
	Jun.		40 \143	0	/	<Key created from "All Gears" for May/June>			
	July		7 /						
	Aug.		38 \	0	\				
	Sept.		2 \40	0	/	<Key created from "All Gears" for Aug./Sept.>			
4Xs	Midwater Trawl, New Brunswick								
1990	Jan.		205	12	2202	11	355	.58	17.08
	Feb.		305	7	1952	6	219	1.39	43.57
	Mar.		361	2	286	2	98	3.68	180.50
4Xs	Weir, New Brunswick								
1990	May		93	8	1980	7	306	.30	11.63
	Jun.	DOM	65	2	572	2	39	1.67	32.50
	Jul.	DOM	4354	20	4032	11	309	14.09	217.70
	Jul.	OSS	531	0	0	0	0		
	Aug.	DOM	10824	54	10021	19	505	21.43	200.44
	Aug.	OSS	3824	12	2380	2	100	38.24	318.67
	Sept.	DOM	9524	31	6242	12	351	27.13	307.23
	Sept.	OSS	1535	16	3335	3	177		95.94
	Oct.	DOM	7306	27	5857	9 \10	222 \249	32.91	270.59
	Nov.	DOM	168	1	251	1 /	27 /	6.22	168
4Xs	Shutoff, New Brunswick								
1990	Jul.		3	0	0	0	0		
	Aug.		168	2	468	2	24	7	84
	Sept.		319	4	740	4	47	6.79	79.75
	Oct.		56	1	226	1	16	3.50	56
	Nov.		8	1	367	1	20	.40	8
4WX	Misc.								
1990	Apr.		127 \						
	May		73 594	<Key created from "All Gears" for Apr/May/June>					
	Jun.		394 /						
	Jul.		24	<Key created from "All Gears" for July>					
	Aug.		9	<Key created from "All Gears" for Aug.>					
	Sept.		41	<Key created from "All Gears" for Sept.>					
	Oct.		44 \						
	Nov.		1 /51	<Key created from "All Gears" for Oct,Nov,Dec>					
	Dec.		6 /						

Table 8. Catches by age in numbers (thousands) and percent numbers for stock and non-stock gear components of the 1990 4WX herring fishery.

Stock Gears

Catch Nos.	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Total
4W Purse Seine	0	231	5059	8563	5944	5659	9373	6905	2337	1348	1268	46687
4X Summer P.Seine	0	18389	37489	68121	34347	40971	79756	46895	13456	4137	2347	345908
4X Fall/Winter P.Seine	0	17235	18843	11708	5988	6512	16682	8016	777	184	59	86004
4X Gillnet	0	0	79	676	240	82	102	52	10	3	3	1247
4X N.S. Weirs	0	52187	4931	2613	1535	1195	2641	1366	461	61	30	67020
4X Traps	0	1121	98	300	179	83	99	57	17	5	5	1964
4X Midwater Trawl	0	7739	4157	1137	574	354	933	98	21	0	5	15018
Total Nos. by Age	0	96902	70656	93118	48807	54856	109586	63389	17079	5738	3717	563848

% Numbers	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Total
4W Purse Seine	0	0	11	18	13	12	20	15	5	3	3	100
4X Summer P.Seine	0	5	11	20	10	12	23	14	4	1	1	100
4X Fall/Winter P.Seine	0	20	22	14	7	8	19	9	1	0	0	100
4X Gillnet	0	0	6	54	19	7	8	4	1	0	0	100
4X N.S. Weirs	0	78	7	4	2	2	4	2	1	0	0	100
4X Traps	0	57	5	15	9	4	5	3	1	0	0	100
4X Midwater Trawl	0	52	28	8	4	2	6	1	0	0	0	100
Overall % Nos. by Age	0	17	13	17	9	10	19	11	3	1	1	100

Non-stock Gears

Catch Nos.('000s)	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Total
4X N.B. Weirs	12460	436060	68390	30661	6358	7230	15031	3420	2520	620	310	583060
4X N.B. Shutoffs	116	18742	614	28	0	0	0	0	0	0	0	19500
4WX Misc. Gears	0	755	229	516	376	431	783	499	108	25	12	3734
Total Nos. by Age	12576	455557	69233	31205	6734	7661	15814	3919	2628	645	322	606294

% Catch Nos.	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Total
4X N.B. Weirs	2	75	12	5	1	1	3	1	0	0	0	100
4X N.B. Shutoffs	1	96	3	0	0	0	0	0	0	0	0	100
4WX Misc. Gears	0	20	6	14	10	12	21	13	3	1	0	100
Total Nos. by Age	2	75	11	5	1	1	3	1	0	0	0	100

Table 9. Catches by age in weight (t) and percent weight for stock and non-stock gear components of the 1990 4WX herring fishery.

Stock Gears

Catch Weight (t.)	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Total
4W Purse Seine	0	7	383	1051	890	1034	1943	1624	612	366	405	8315
4X Summer P.Seine	0	1133	4335	11745	7379	10199	21575	14298	4479	1484	917	77545
4X Fall/Winter P.Seine	0	316	1072	1463	999	1246	3509	1832	196	53	19	10705
4X Gillnet	0	0	12	118	46	20	27	16	3	1	1	243
4X N.S. Weirs	0	1355	457	414	311	270	665	397	147	22	12	4049
4X Traps	0	18	10	50	34	18	26	18	6	2	2	183
4X Midwater Trawl	0	160	214	129	91	65	185	21	5	0	1	871
Totals Catch t. by Age	0	2990	6482	14971	9750	12851	27929	18206	5447	1928	1357	101912

% Catch Weight (t.)	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Total
4W Purse Seine	0	0	5	13	11	12	23	20	7	4	5	100
4X Summer P.Seine		1	6	15	10	13	28	18	6	2	1	100
4X Fall/Winter P.Seine		3	10	14	9	12	33	17	2	0	0	100
4X Gillnet		0	5	49	19	8	11	6	1	0	0	100
4X N.S. Weirs		33	11	10	8	7	16	10	4	1	0	100
4X Traps		10	6	27	19	10	14	10	3	1	1	100
4X Midwater Trawl		18	25	15	10	7	21	2	1	0	0	100
Overall % by Age	0	3	6	15	10	13	27	18	5	2	1	100

Non-stock Gears

Catch Weight (t.)	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Total
4X N.B. Weirs	356	18880	5989	4347	1219	1732	3688	964	732	201	116	38223
4X N.B. Shutoffs	3	499	50	2	0	0	0	0	0	0	0	554
4WX Misc. Gears	0	17	24	85	75	106	210	151	37	9	5	719
Total Catch t. by Age	359	19396	6063	4434	1294	1838	3898	1115	768	210	121	39496

% Catch Weight (t.)	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Total
4X N.B. Weirs	1	49	16	11	3	5	10	3	2	1	0	100
4X N.B. Shutoffs	0	90	9	0	0	0	0	0	0	0	0	100
4WX Misc. Gears	0	2	3	12	10	15	29	21	5	1	1	100
Totals Catch t. by Age	1	49	15	11	3	5	10	3	2	1	0	100

Table 10. 4WX herring stock catch at age in numbers (thousands).

	1965	1966	1967	1968	1969	1970	1971	1972
1	270378	154323	722208	164703	108875	699720	87570	0
2	1084719	914093	613970	2389061	290329	576896	404224	649254
3	34835	448940	153626	224956	531812	76532	183896	71984
4	234383	73382	266454	83109	132319	286278	106630	148516
5	49925	321857	110051	290285	162439	201215	113566	77207
6	10592	45916	159203	73087	112631	120280	75593	75384
7	1693	13970	57948	90617	62506	111937	93620	49065
8	561	7722	4497	31977	22595	41257	50022	48700
9	54	1690	409	15441	6345	21271	36618	26055
10	37	215	296	5668	2693	7039	7536	13792
11	1	1	148	1175	722	2674	5695	11679
1+	1687178	1982109	2088810	3370079	1433266	2145099	1164970	1171636
2+	1416800	1827786	1366602	3205376	1324391	1445379	1077400	1171636
3+	332081	913693	752632	816315	1034062	868483	673176	522382

	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	754	14151	2870	240	1164	35381	311	1623	0
2	126421	596153	264491	48470	140494	346719	170523	9566	75713
3	595992	72381	180898	176226	28659	36177	226442	60559	33174
4	109530	616622	92487	130598	192958	11338	47200	359484	68816
5	34422	53199	384646	72334	106061	107627	4639	21958	306716
6	25562	15254	50599	219788	55066	60431	19695	3583	21728
7	19361	8120	9357	18960	150588	27286	15521	3507	1631
8	17604	5313	3238	4967	12466	96741	9981	4951	1914
9	19836	10964	3481	3556	2873	9838	35386	2009	1366
10	9661	5787	2842	1835	1253	2169	3834	8179	361
11	11120	7359	4599	3071	3448	1499	2042	2105	1442
1+	970263	1405303	999508	680045	695030	735206	535574	477524	512861
2+	969509	1391152	996638	679805	693866	699825	535263	475901	512861
3+	843088	794999	732147	631335	553372	353106	364740	466335	437148

	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	3589	3367	0	5762	40	1398	91	6	0
2	72591	128378	72301	138419	80019	50422	89298	77698	96902
3	122380	101017	141067	215599	176197	76865	68122	87092	70656
4	17756	168379	131251	193369	186983	320651	117398	47206	93118
5	73025	16946	84920	94308	36361	147483	261272	60647	48807
6	154542	41607	13633	27081	20180	27924	142065	129020	54856
7	10910	63468	13803	8989	6878	11843	25594	58535	109586
8	1535	7334	16299	11609	2759	4433	12762	13971	63389
9	977	1351	5418	5107	1879	2043	2519	6313	17079
10	886	434	1263	767	866	1897	2285	2911	5738
11	719	895	5207	300	223	395	1712	2333	3717
1+	458910	533176	485162	701310	512385	645354	723118	485732	563848
2+	455321	529809	485162	695548	512345	643956	723027	485726	563848
3+	382730	401431	412861	557129	432326	593534	633729	408028	466946

Table 11. 4WX herring stock catch weight (t) at age.

	1965	1966	1967	1968	1969	1970	1971	1972	1973
1	2704	1543	7222	0	0	0	0	0	0
2	44473	37478	25173	78122	10800	18288	26719	28762	3641
3	3902	50281	17206	25195	56106	9123	26224	9905	62996
4	40314	12622	45830	12300	21475	48295	21230	28560	15696
5	10884	70165	23991	53587	33657	42376	26132	17333	7731
6	2690	11663	40438	17862	27234	30888	19170	19751	6429
7	484	3995	16573	24983	17627	32708	27403	14302	5404
8	181	2494	1453	12759	6910	13697	16447	15667	5830
9	19	598	145	5216	2117	7840	13256	8989	7139
10	14	84	115	2321	1051	2740	2922	5246	3757
11	0	0	58	481	282	1041	2208	4443	4325
1+	105666	190923	178203	232827	177260	206996	181710	152958	122948
2+	102962	189380	170981	232827	177260	206996	181710	152958	122948
3+	58489	151902	145808	154704	166460	188709	154991	124196	119307

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0	0	0	0	0	3	16	0	36	34
2	28436	5501	1585	9160	9812	6991	392	3104	2976	5263
3	7976	17059	20107	3247	4055	25362	6783	3715	13707	11314
4	108155	16555	20778	33613	2050	8118	61831	11836	3054	28961
5	10938	82930	16883	22665	24604	1011	4787	66864	15919	3694
6	3659	12124	54815	15099	15627	5003	910	5519	39254	10568
7	2251	2503	5256	44122	8243	4439	1003	466	3120	18152
8	1711	1079	1576	4055	31944	3224	1599	618	496	2369
9	3754	1246	1360	943	3453	12527	711	484	346	478
10	2037	1077	742	521	861	1491	3182	140	345	169
11	2590	1743	1241	1433	595	794	819	561	280	348
1+	171509	141816	124343	134859	101245	68964	82033	93309	79532	81351
2+	171509	141816	124343	134859	101245	68960	82017	93309	79496	81317
3+	143073	136315	122758	125699	91433	61969	81625	90204	76520	76053

	1984	1985	1986	1987	1988	1989	1990
1	0	0	0	17	1	0	0
2	2713	7313	4400	2539	1856	2531	2990
3	18630	25442	21781	7501	6006	6869	6484
4	25122	39432	34032	48975	18026	7644	14971
5	19418	23516	8704	29294	51108	12541	9750
6	3533	7536	5469	6843	34340	30699	12851
7	3863	2833	2102	3245	7201	16019	27929
8	4828	3879	907	1287	3878	4234	18206
9	1674	1757	677	650	817	2048	5447
10	460	337	346	664	785	1026	1928
11	1895	132	89	138	635	850	1357
1+	82135	112177	78507	101153	124654	84462	101913
2+	82135	112177	78507	101136	124652	84462	101913
3+	79422	104864	74107	98597	122796	81931	98923

Table 12a. Average weight (g) and length (cm) at age for stock gear components of the 1990 4WX herring fishery.

STOCK GEAR COMPONENTS Average Wt. at Age	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
4W Purse Seine	0	31	76	123	150	183	207	235	262	272	316
4X Summer P.Seine	0	62	116	172	215	249	271	305	333	359	391
4X Fall/Winter P.Seine	0	18	57	125	167	191	210	229	252	287	322
4X Gillnet	0	0	150	175	190	238	264	298	323	353	359
4X N.S. Weirs	0	26	93	159	203	226	252	291	319	361	391
4X Traps	0	16	107	165	190	224	258	310	336	360	394
4X Midwater Trawl	0	21	51	114	159	183	198	218	218	0	252
Average for Stock Gears	0	31	92	161	200	234	255	287	319	336	364

Average Length at Age	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
4W Purse Seine	0	17	23	26	28	30	31	33	34	34	36
4X Summer P.Seine	0	21	25	28	30	31	32	33	34	35	36
4X Fall/Winter P.Seine	0	14	20	26	29	30	31	32	33	34	35
4X Gillnet	0	0	27	28	29	31	32	33	34	35	35
4X N.S. Weirs	0	16	23	28	30	31	32	33	34	35	37
4X Traps	0	14	24	28	29	30	32	33	34	35	36
4X Midwater Trawl	0	14	20	26	29	30	31	32	32	0	33
Average for Stock Gears	0	16	23	28	30	31	32	33	34	35	36

Table 12b. Average weight (g) and length (cm) at age for non-stock gear components of the 1990 4WX herring fishery.

NONSTOCK GEAR COMPONENTS Average weight	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
4X N.B. Weirs	29	43	88	142	192	240	245	282	290	324	374
4X N.B. Shutoffs	23	27	81	84	0	0	0	0	0	0	0
4WX Misc. Gears	0	22	105	164	200	245	268	303	337	356	399
Average for nonstock	29	43	88	142	192	240	247	285	292	325	375

Average length	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
4X N.B. Weirs	13	18	24	27	30	31	32	33	34	34	35
4X N.B. Shutoffs	15	16	23	23	0	0	0	0	0	0	0
4WX Misc. Gears	0	15	24	28	29	31	32	33	34	35	36
Average for nonstock	13	18	24	27	30	31	32	33	34	34	35

Table 13. Average weights at age for the 4WX herring fishery (stock gear components) for 1965-90.

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	10	10	10	0	0	0	0	0	0	0	0	0	0
2	41	41	41	33	37	32	66	44	29	48	21	33	65
3	112	112	112	112	106	119	143	138	106	110	94	114	113
4	172	172	172	148	162	169	199	192	143	175	179	159	174
5	218	218	218	185	207	211	230	225	225	206	216	233	214
6	254	254	254	244	242	257	254	262	252	240	240	249	274
7	286	286	286	276	282	292	293	292	279	277	268	277	293
8	323	323	323	399	306	332	329	322	331	322	333	317	325
9	354	354	354	338	334	369	362	345	360	342	358	382	328
10	389	389	389	410	390	389	388	380	389	352	379	404	416
11	389	389	389	410	390	389	388	380	389	352	379	404	416

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0	10	10	0	10	10	0	0	0	12	13	7	0
2	28	41	41	41	41	41	38	53	55	50	21	33	31
3	112	112	112	112	112	112	132	118	124	98	88	79	92
4	181	172	172	172	172	172	191	204	182	153	154	162	161
5	229	218	218	218	218	218	229	249	239	199	196	207	200
6	259	254	254	254	254	254	259	278	271	245	242	238	234
7	302	286	286	286	286	286	280	315	306	274	281	274	255
8	330	323	323	323	323	323	296	334	329	290	304	303	287
9	351	354	354	354	354	354	309	344	360	318	327	324	319
10	397	389	389	389	389	389	364	440	400	350	341	353	336
11	397	389	389	389	389	389	364	440	400	350	371	365	364

Table 14. Larval index (LAI)[1] for the 1990 4WX herring assessment.

Cruise	Year	LAI[1]	SE	CV
P109	1972	9.4	1.8	
P127	1973	6.6	1.3	
P147	1974	49.5	10.9	
P160	1975	8.6	1.8	
P175	1976	13.5	2.9	
P190	1977	6.3	1.0	
P207	1978	4.5	1.8	
P232	1979	7.1	2.1	
P246	1980	26.2	6.7	
P263	1981	2.7	0.4	
P280	1982	12.4	2.1	
P298	1983	13.1	2.8	
P315	1984	12.6	2.1	
P329	1985	41.8	7.2	
P344	1986	21.3	4.0	
P361	1987	31.2	9.3	
P377	1988	98.2	22.3	.229
P391	1989	54.5	11.2	.205
P408	1990	27.0	7.5	.278

[1]Arith. mean (number of larvae m^{-2}) of 79 stations as used in previous assessment (Stephenson and Power 1990).

Table 15. An index of herring by-catch (stratified mean number per tow) in summer groundfish research surveys of 4WX, strata 52-95, 1970-1990; (N = number per set for all sets) (N^h = number per set for sets with herring).

YEAR	CRUISE	DATE	TOTAL SETS (N)	NO. SETS WITH HERRING	TOTAL HERRING	NO./SET (N)	NO./SET (N^h)	STRATIFIED MEAN NO./TOW	SE
1970	A175-176	6-30/07	95*	23	383.82	4.13	16.69	4.07	1.54
1971	A188-189	29/06-22/07	86*	23	296.88	3.49	12.91	3.97	1.87
1972	A200-201	23/06-19/07	105	23	117.41	1.12	5.10	1.37	0.62
1973	A212-213	9/07-2/08	96	20	77.08	0.80	3.85	0.92	0.31
1974	A225-226	9/07-3/08	102*	15	54.77	0.54	3.65	0.72	0.25
1975	A236-237	15/07-6/08	104	12	131.09	1.26	10.92	0.89	0.36
1976	A250-251	12/07-5/08	103*	10	53.43	0.52	5.34	0.36	0.20
1977	A265-266	9/07-30/08	106	9	81.54	0.77	9.06	0.54	0.30
1978	A279-280	9-31/07	103*	4	32.03	0.31	8.01	0.34	0.32
1979	A292-293	6-27/07	106*	5	71.06	0.68	14.21	0.64	0.46
1980	A306-307	7-27/07	105	3	93.51	0.89	31.17	0.54	0.51
1981	A321-322	4-25/07	104	4	195.05	1.88	48.76	1.51	1.35
1982	H080-081	10-30/07	108	14	130.44	1.21	9.32	1.54	0.90
1983	N012-013	5-27/07	106	25	230.95	2.18	9.24	2.36	0.80
1984	N031-032	1/07-2/08	102	31	678.06	6.65	21.87	6.98	3.53
1985	N048-049	4-25/07	111	19	418.58	3.77	22.03	3.38	1.83
1986	N065-066	7-17/07	118	36	2152.13	18.24	59.78	23.20	14.92
1987	N085-087	29/07-6/08	135	33	2118.70	15.69	64.20	10.35	5.56
1988	N105-106	4-27/07	127	31	280.90	2.21	9.06	2.08	0.62
1989	N123-124	5-27/07	124	46	939.52	7.58	20.42	8.35	1.78
1990	N139-140	3/07-31/08	156*	46	779.44	5.03	16.94	5.56	1.88

* Total includes strata with only one set.

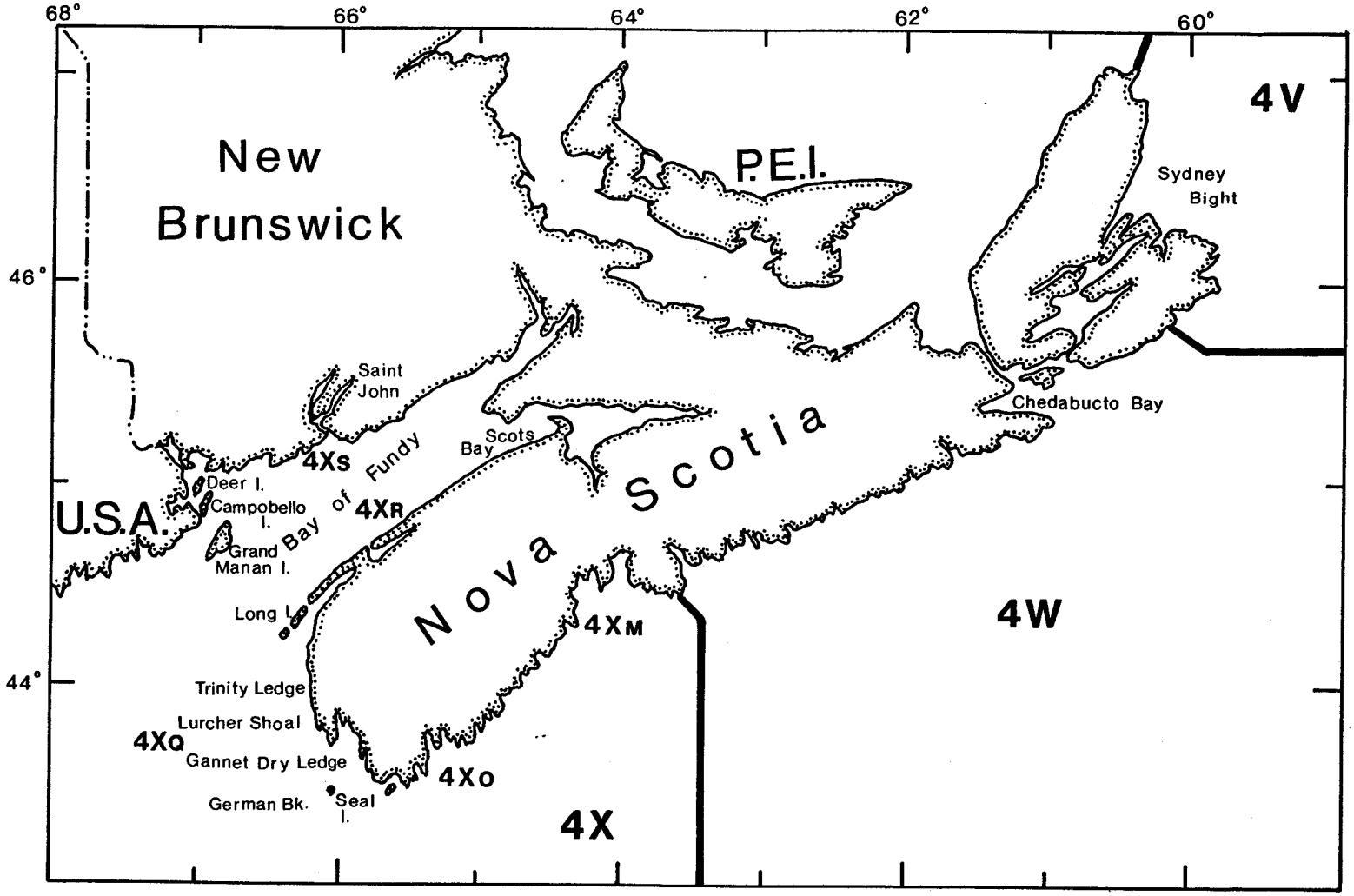


Fig. 1. Map of division 4WX showing major locations mentioned in text.

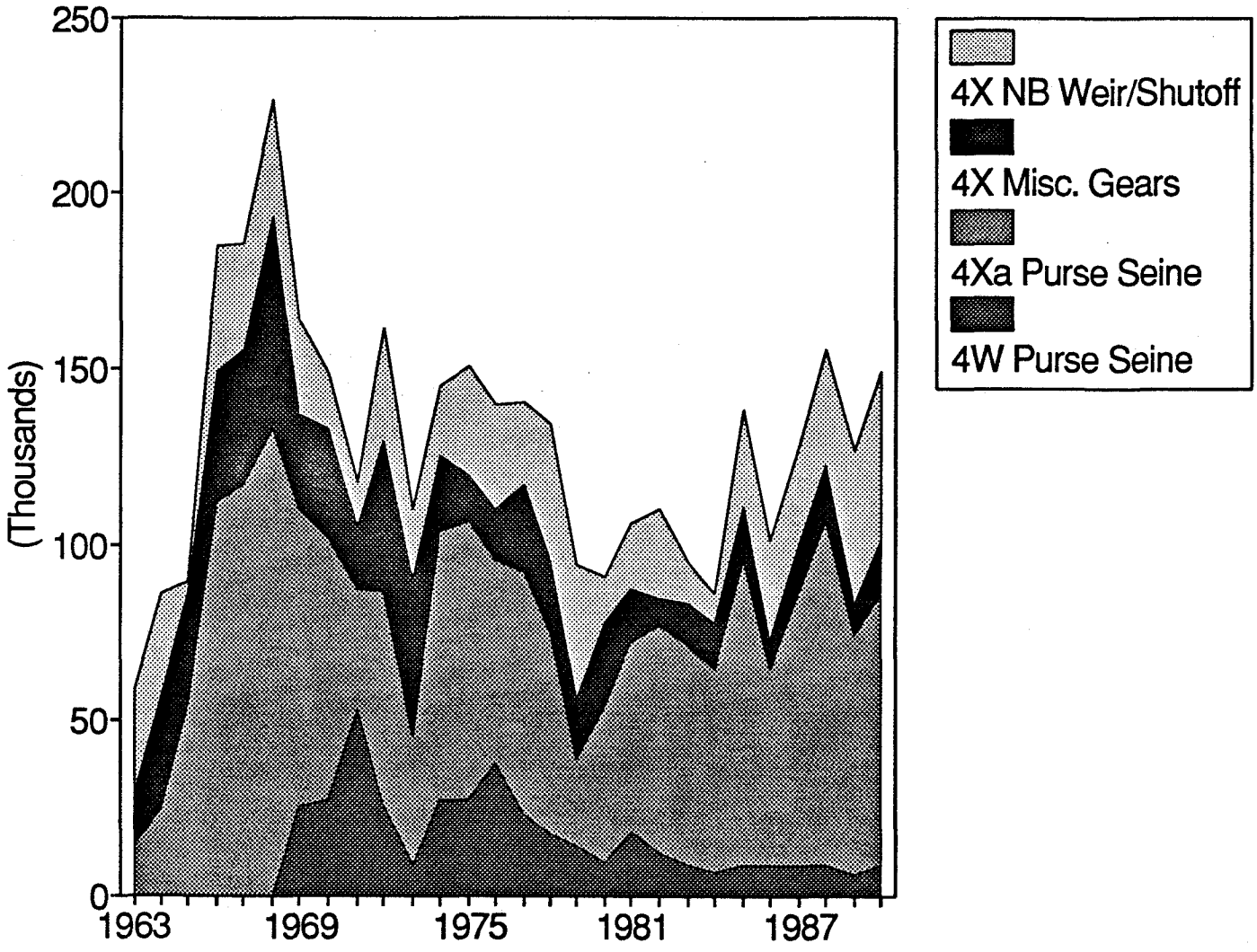


Fig. 2. Historical landings (cumulative) by gear type in the 4WX herring fishery, 1963-1990.

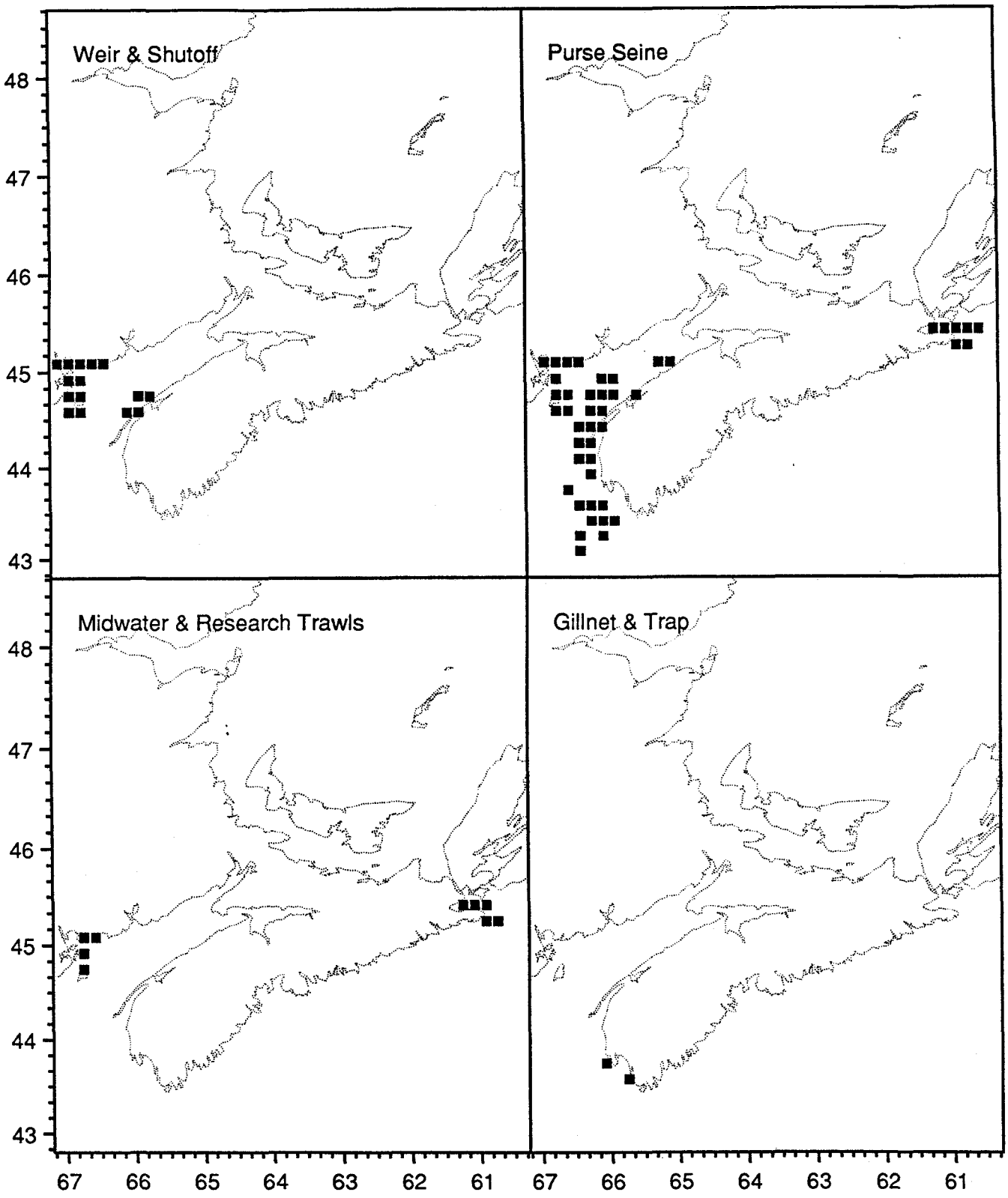


Fig. 3. Geographical distribution of biological sampling of the 1990 4WX herring fishery by gear component (resolution = 10 minutes square).

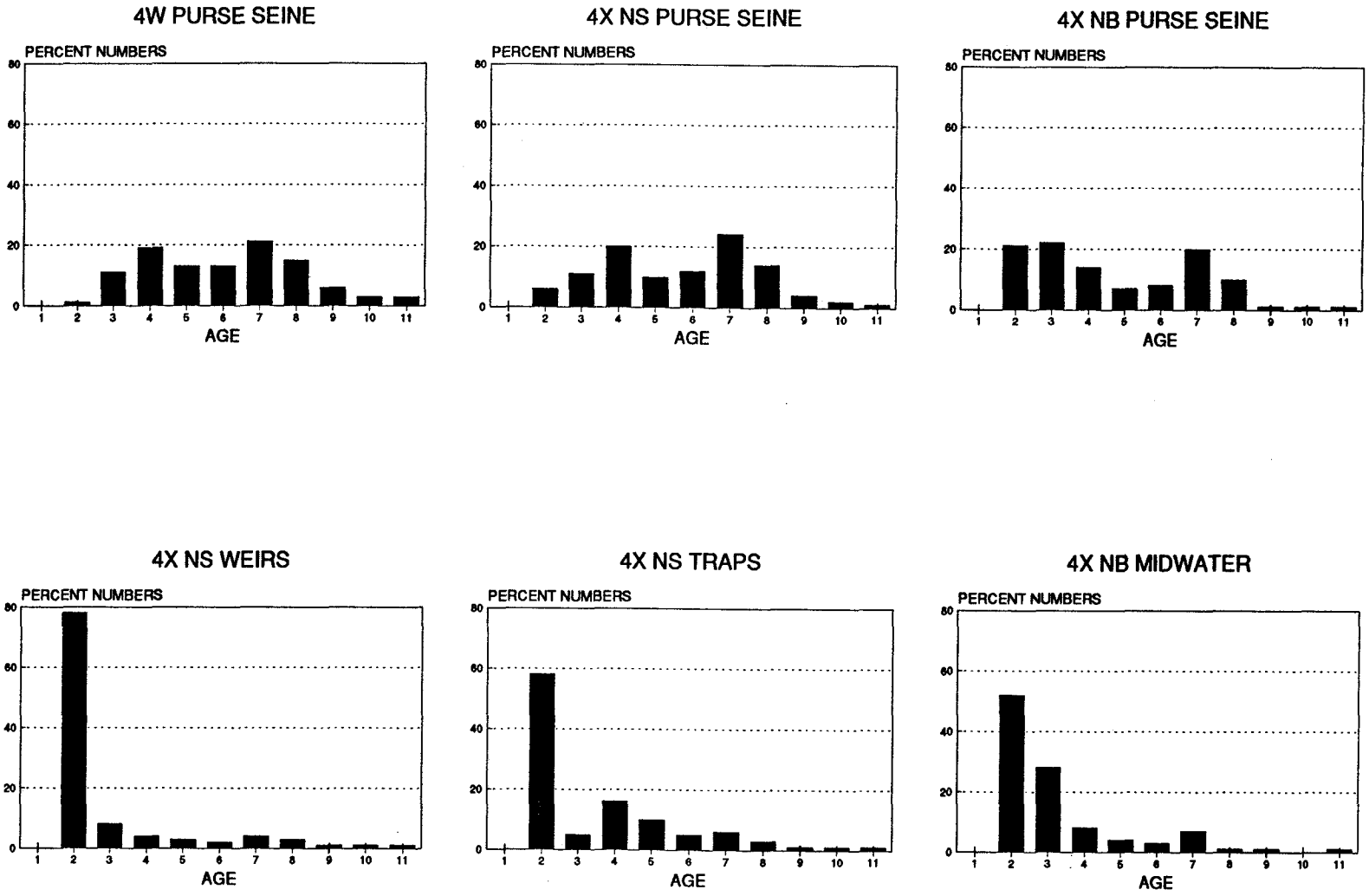


Fig. 4a. Catch at age (% numbers) for stock gear components of the 1990 4WX herring fishery.

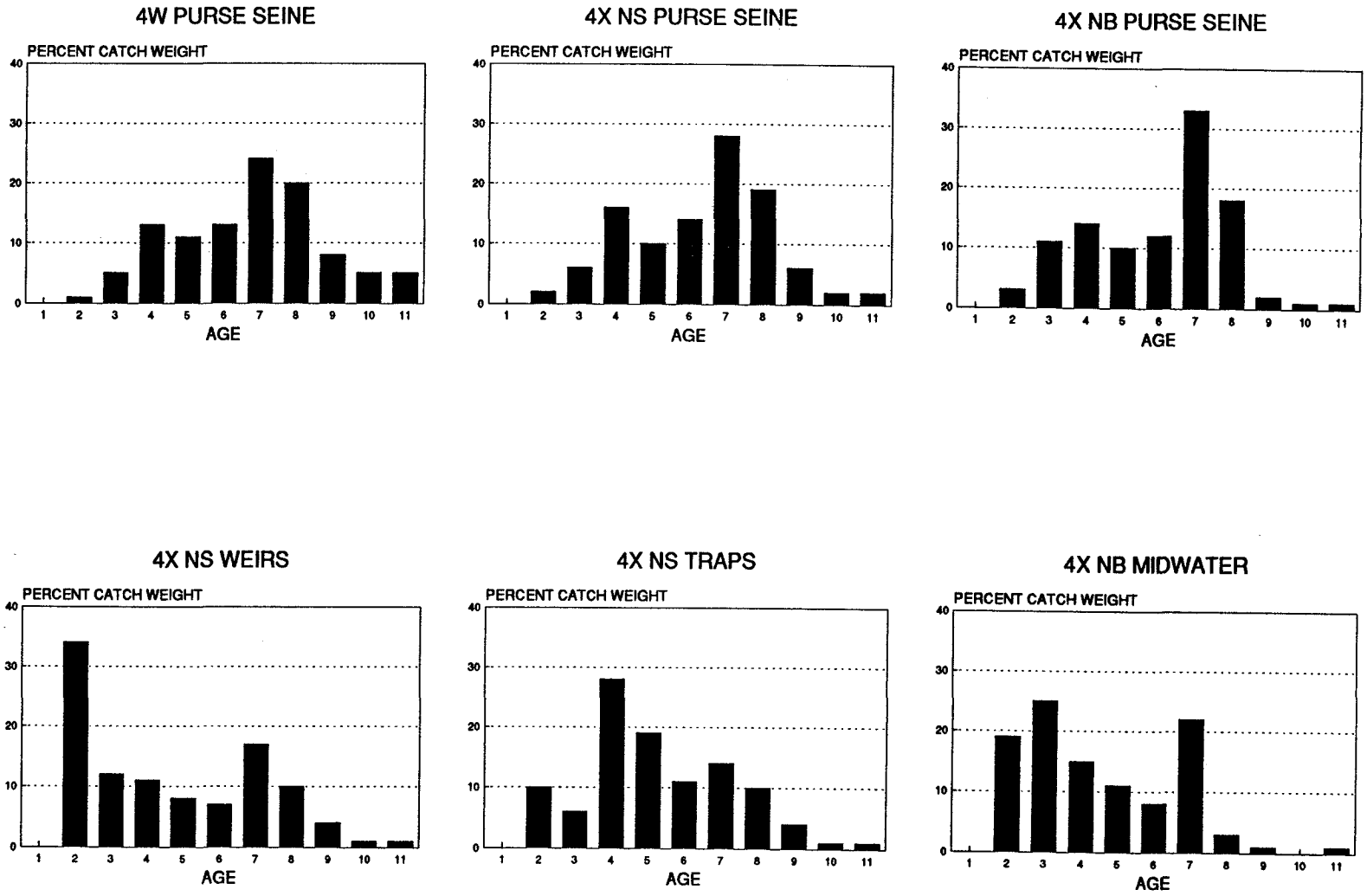


Fig. 4b. Catch at age (%catch weight) for stock gear components of the 1990 4WX herring fishery.

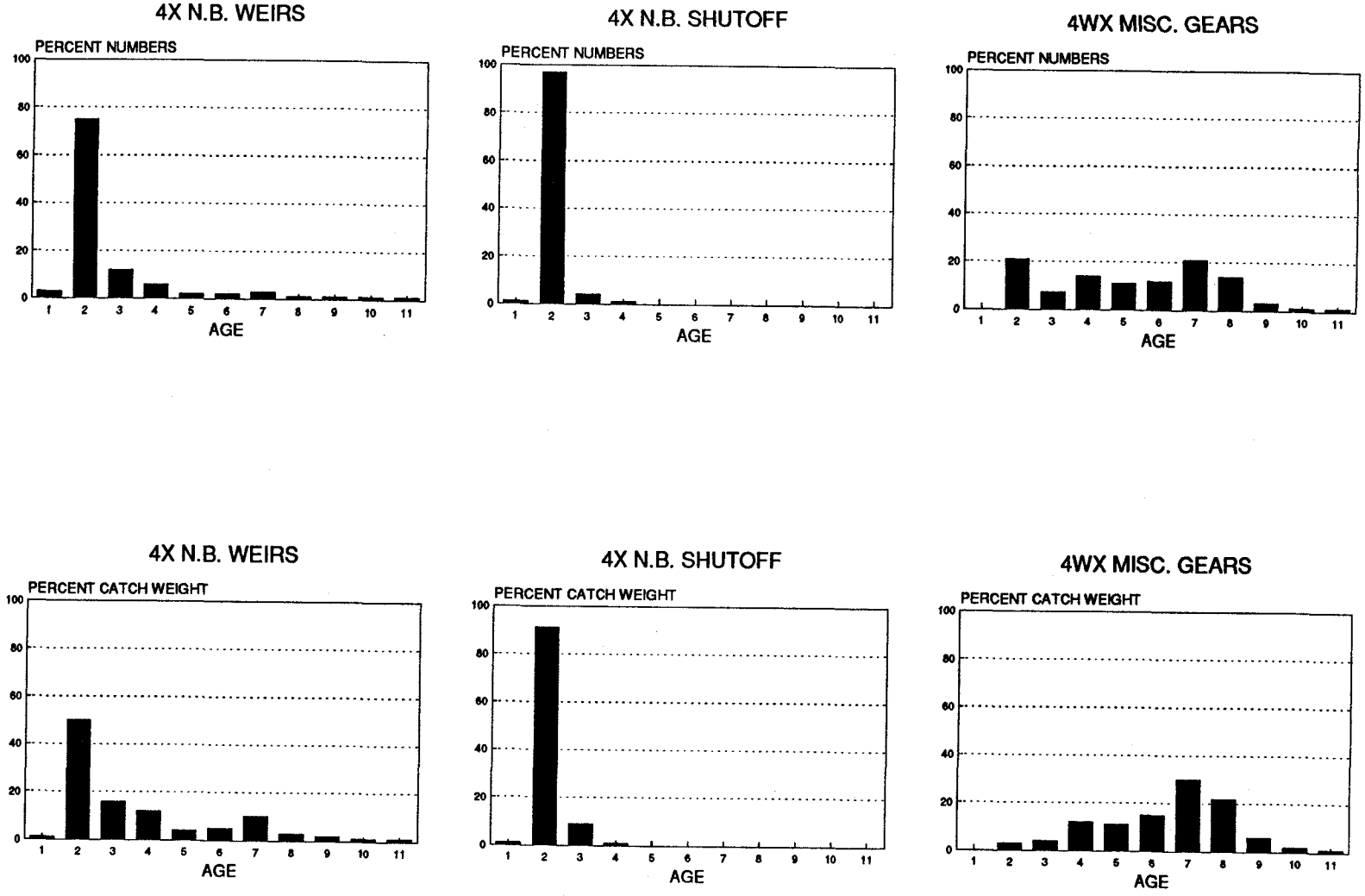


Fig. 4c. Catch at age in number (upper) and catch weight (lower) for non-stock gear components of the 1990 4WX herring fishery.

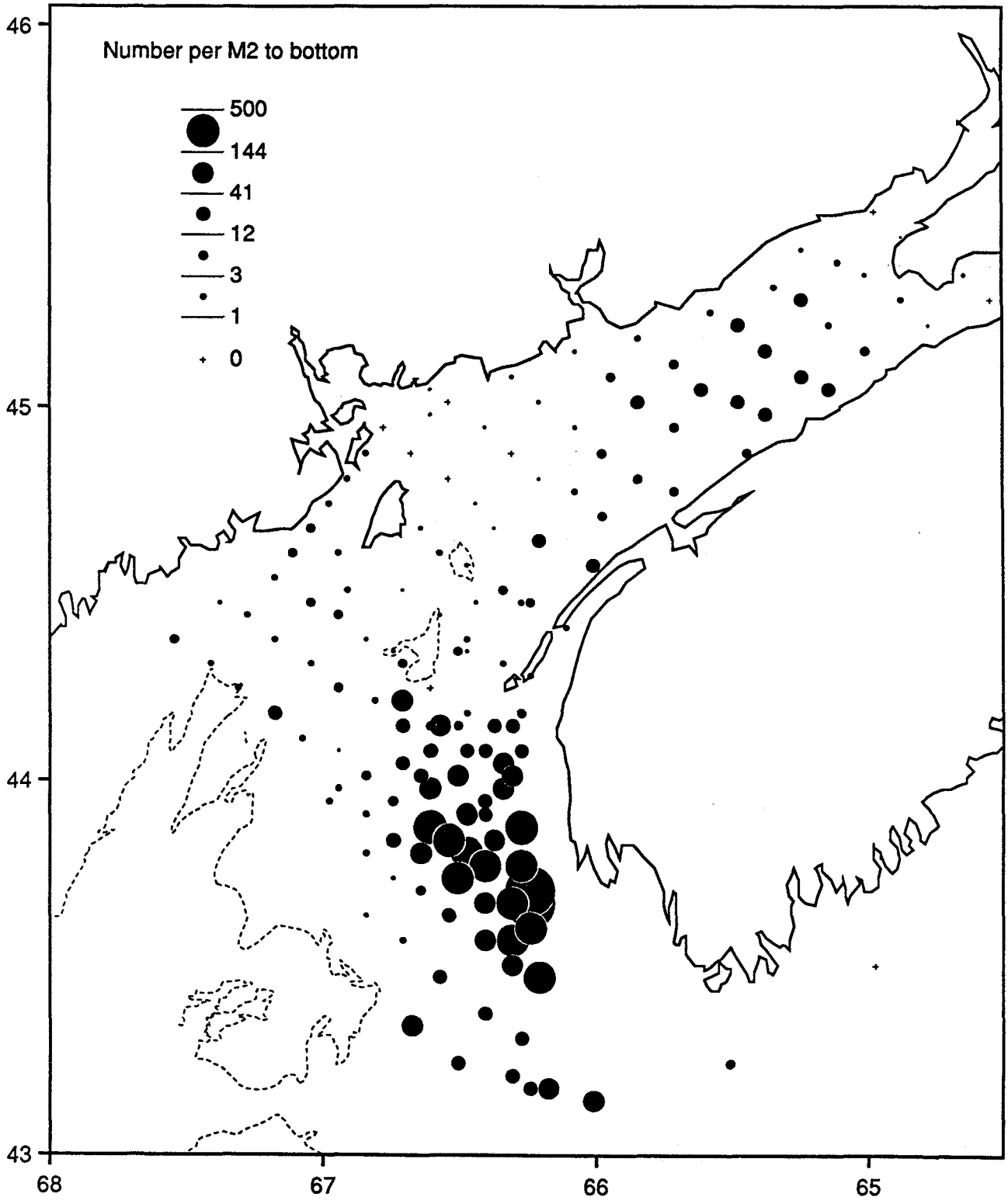


Fig. 5. Larval herring abundance (numbers per m^2 to bottom) by station for E. E. Prince cruise P408, Oct. 26 to Nov. 6, 1990.

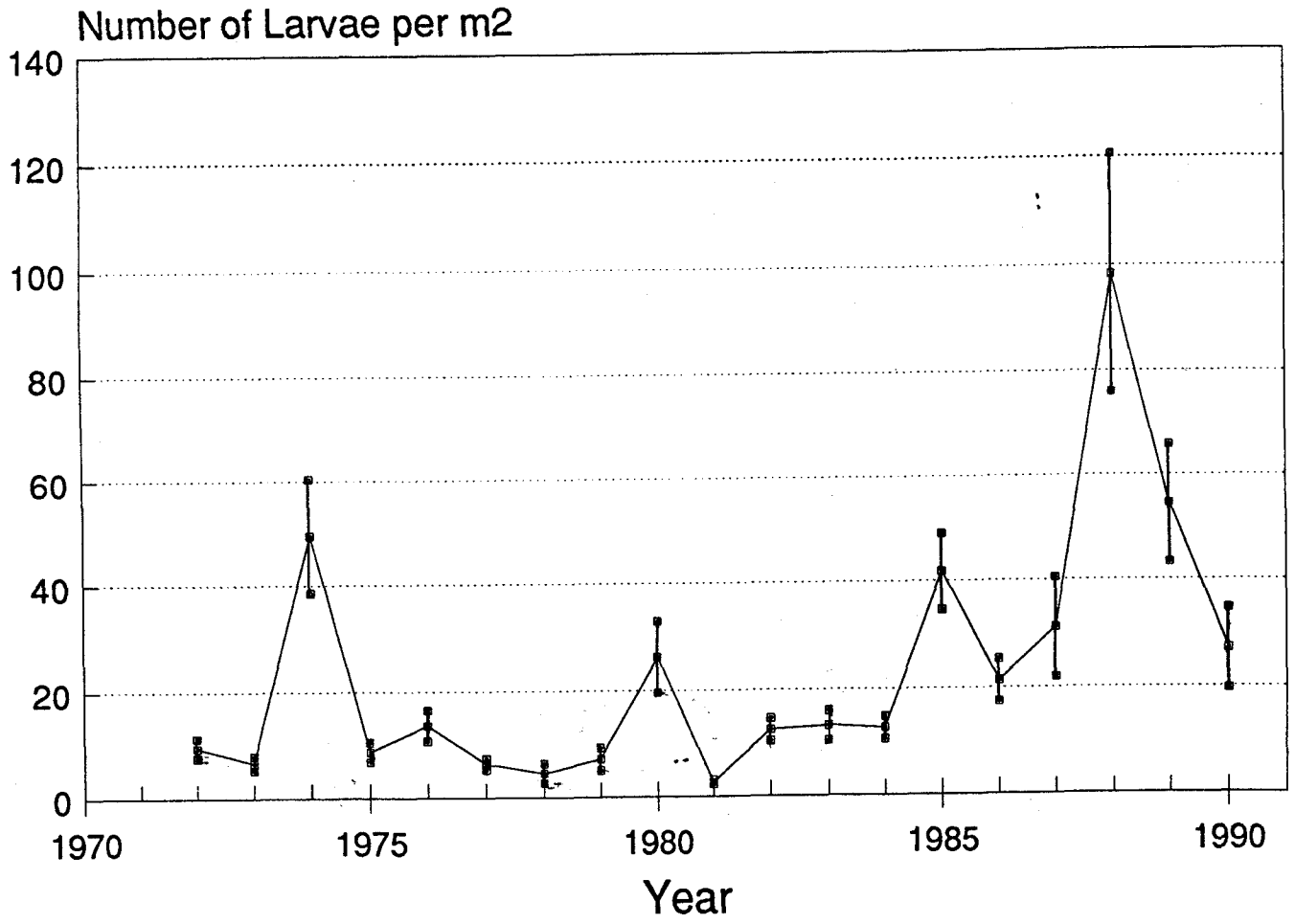


Fig. 6. Larval herring abundance index for 4WX herring assessment (Mean number of larvae per m2 to bottom for the 79 index stations. Sampled using bongo gear on Oct./Nov. Bay of Fundy E. E. Prince research surveys).

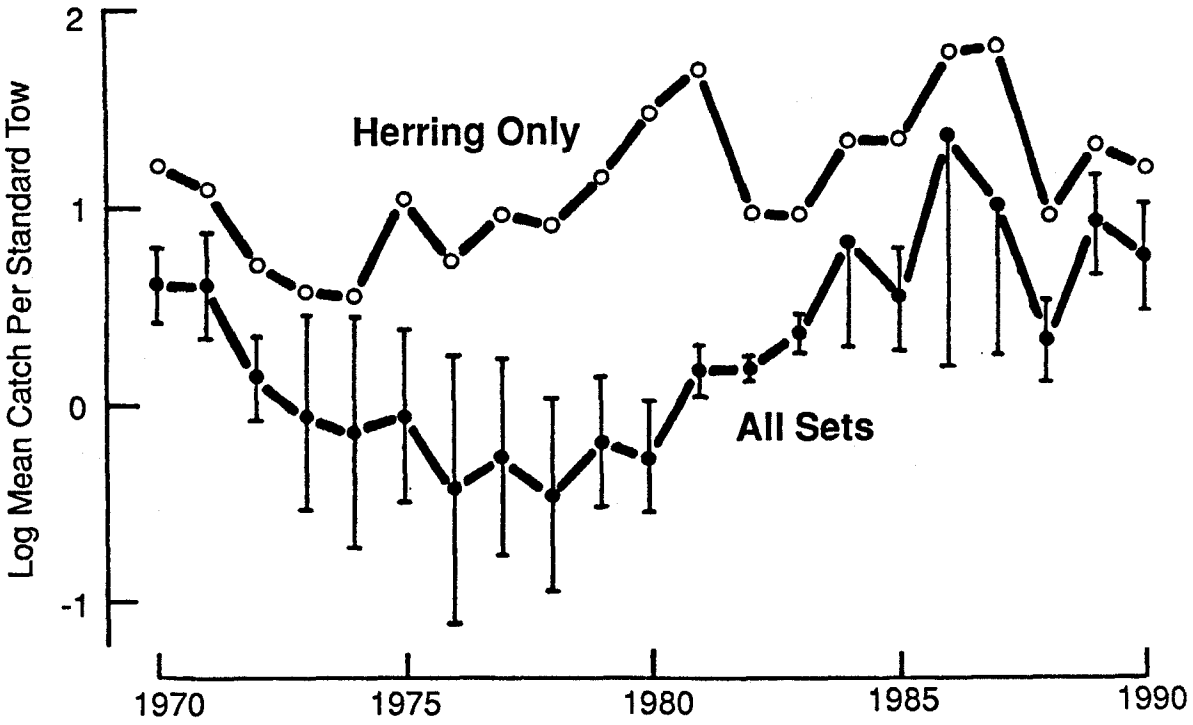


Fig. 7. Time series comparison of herring by catch in 4WX groundfish surveys using 1) sets containing herring only (standard mean) versus 2) all sets (stratified mean $\pm$ SE.

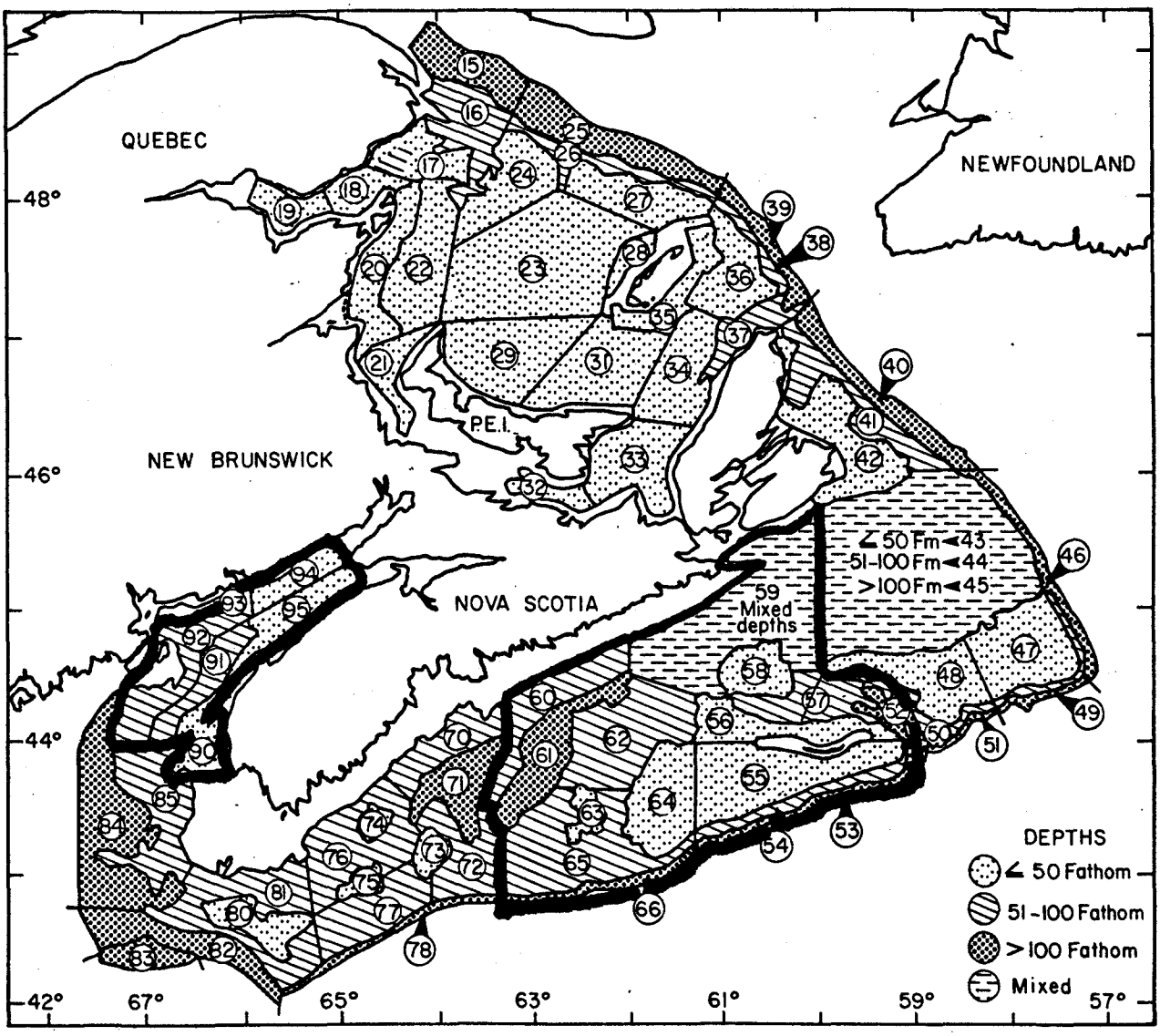


Fig. 8. Strata in NAFO Division 4WX outlining two areas where herring by catch predominantly occurred.

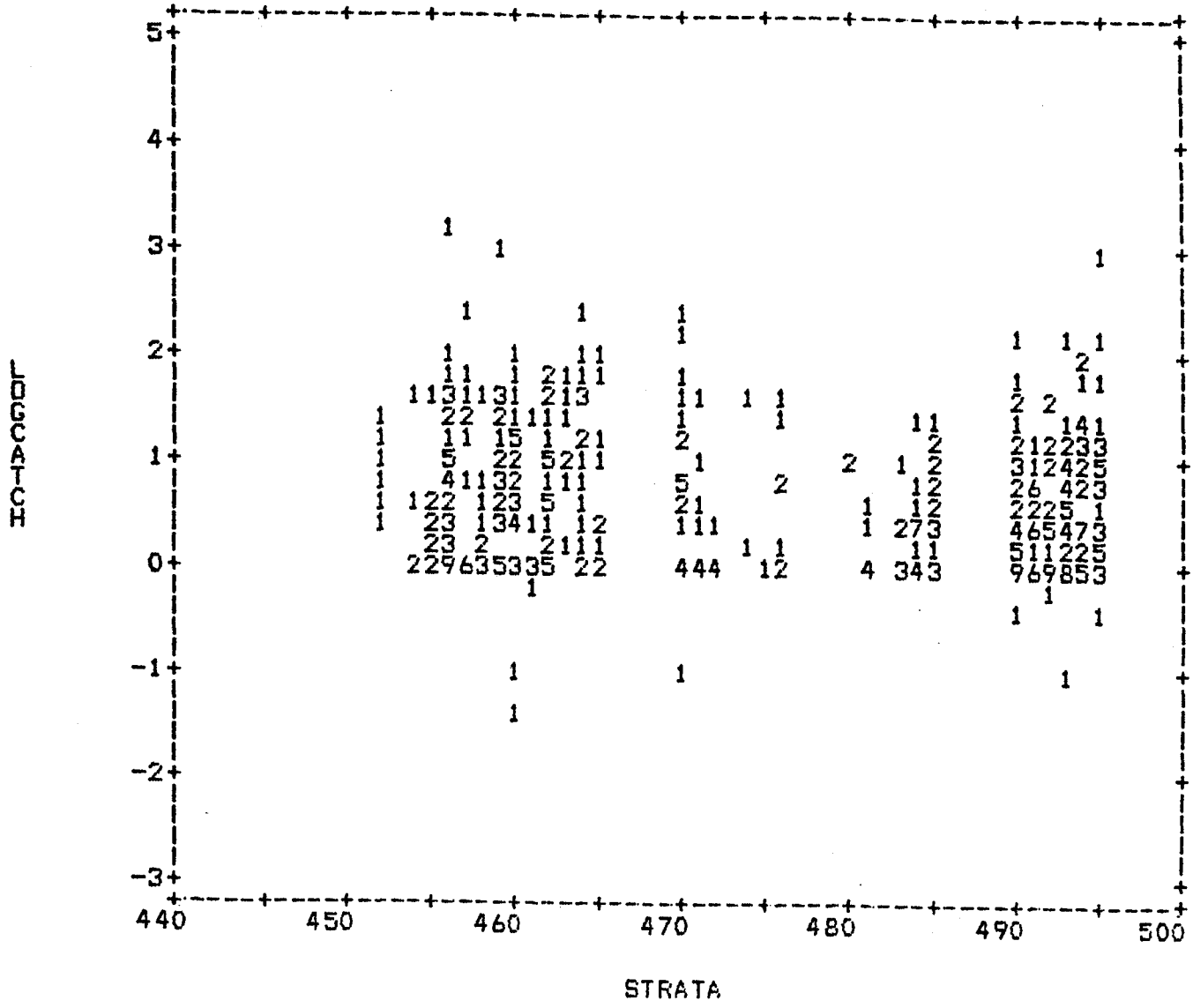


Fig. 9. Plot of log standardized herring by catch on strata for summer groundfish surveys (4WX) 1970-1990.

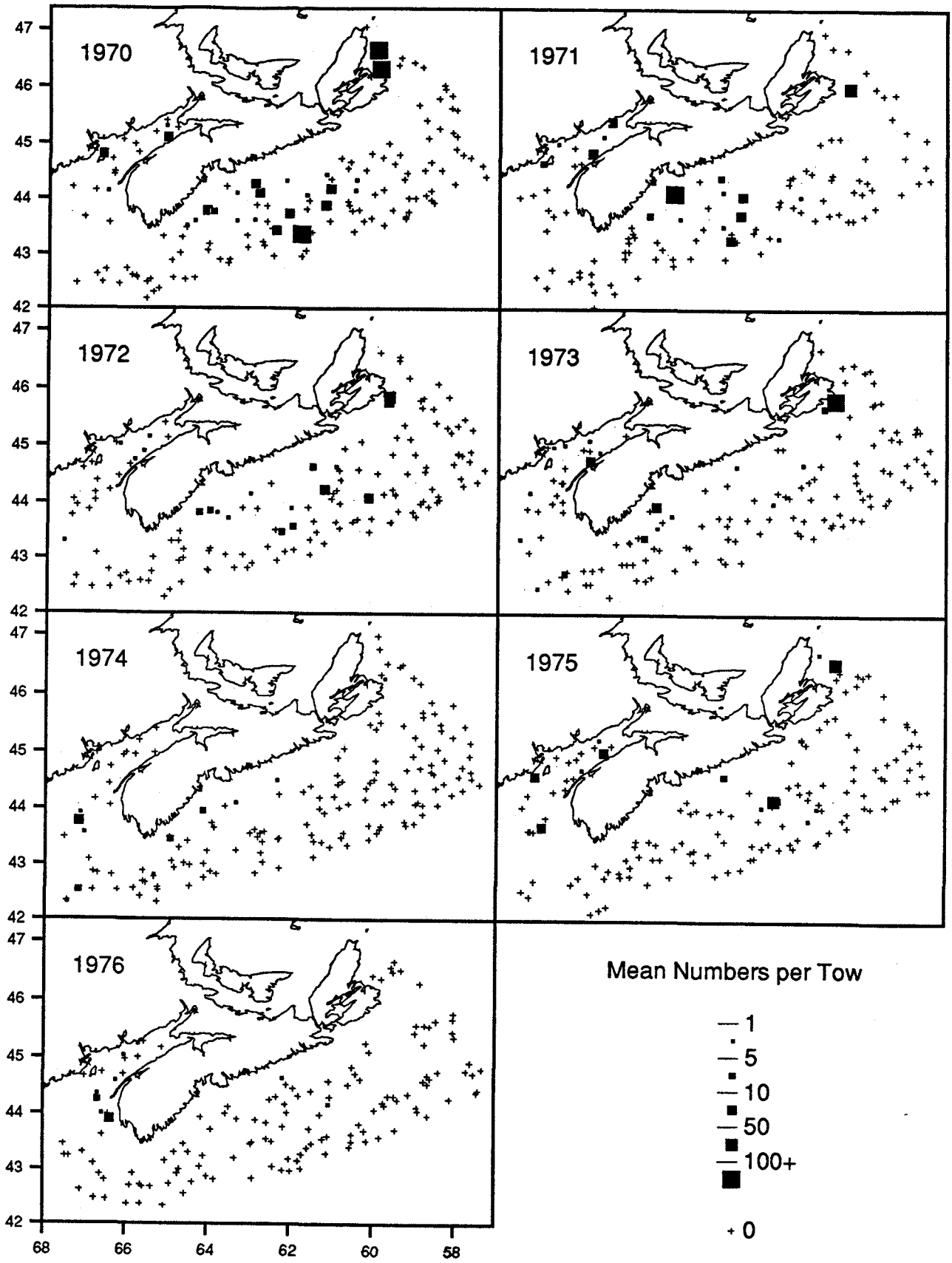


Fig. 10. Occurance of herring (number per tow) in summer research groundfish survey (bottom trawl) sets, 1970-1990.

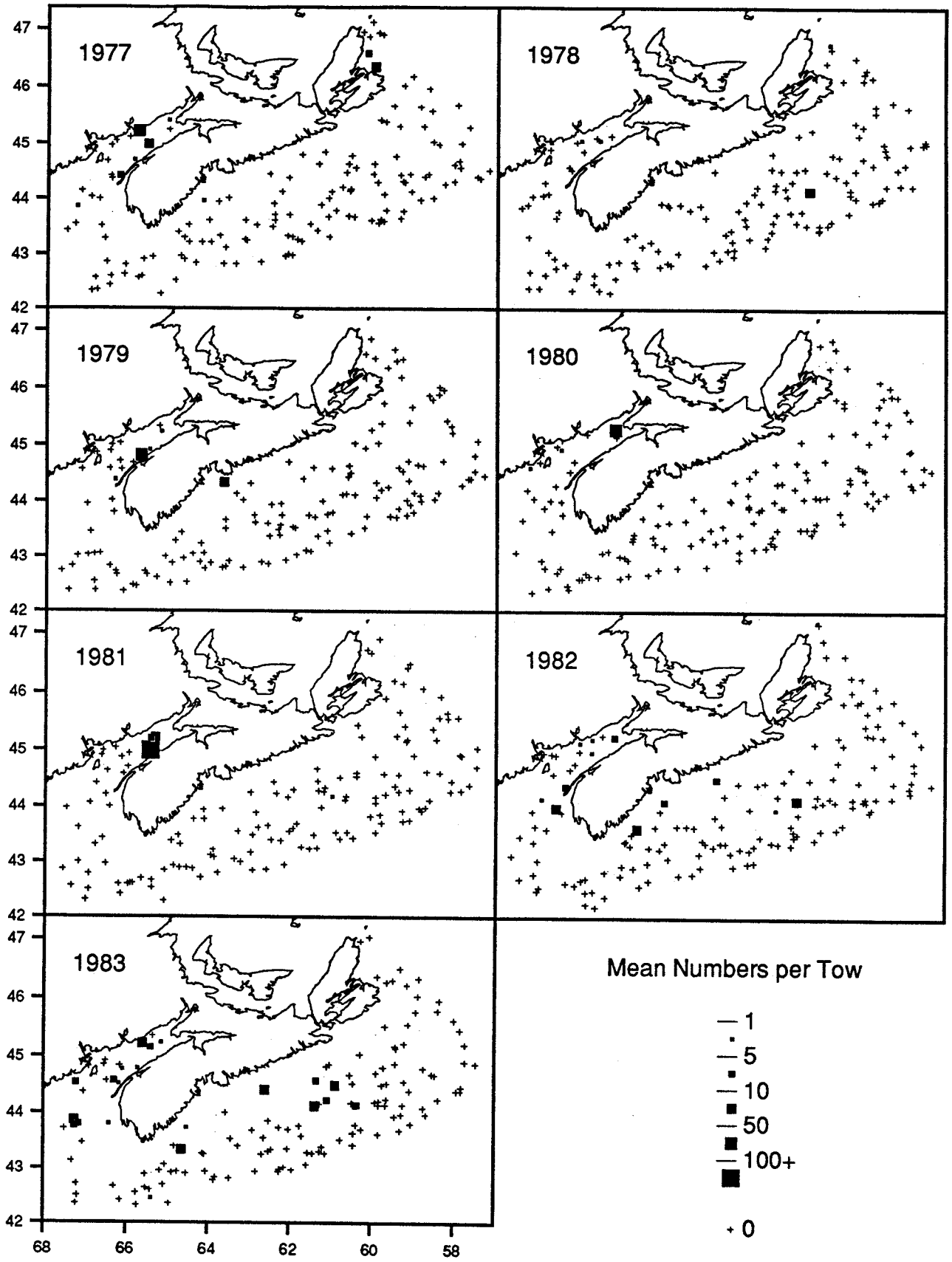
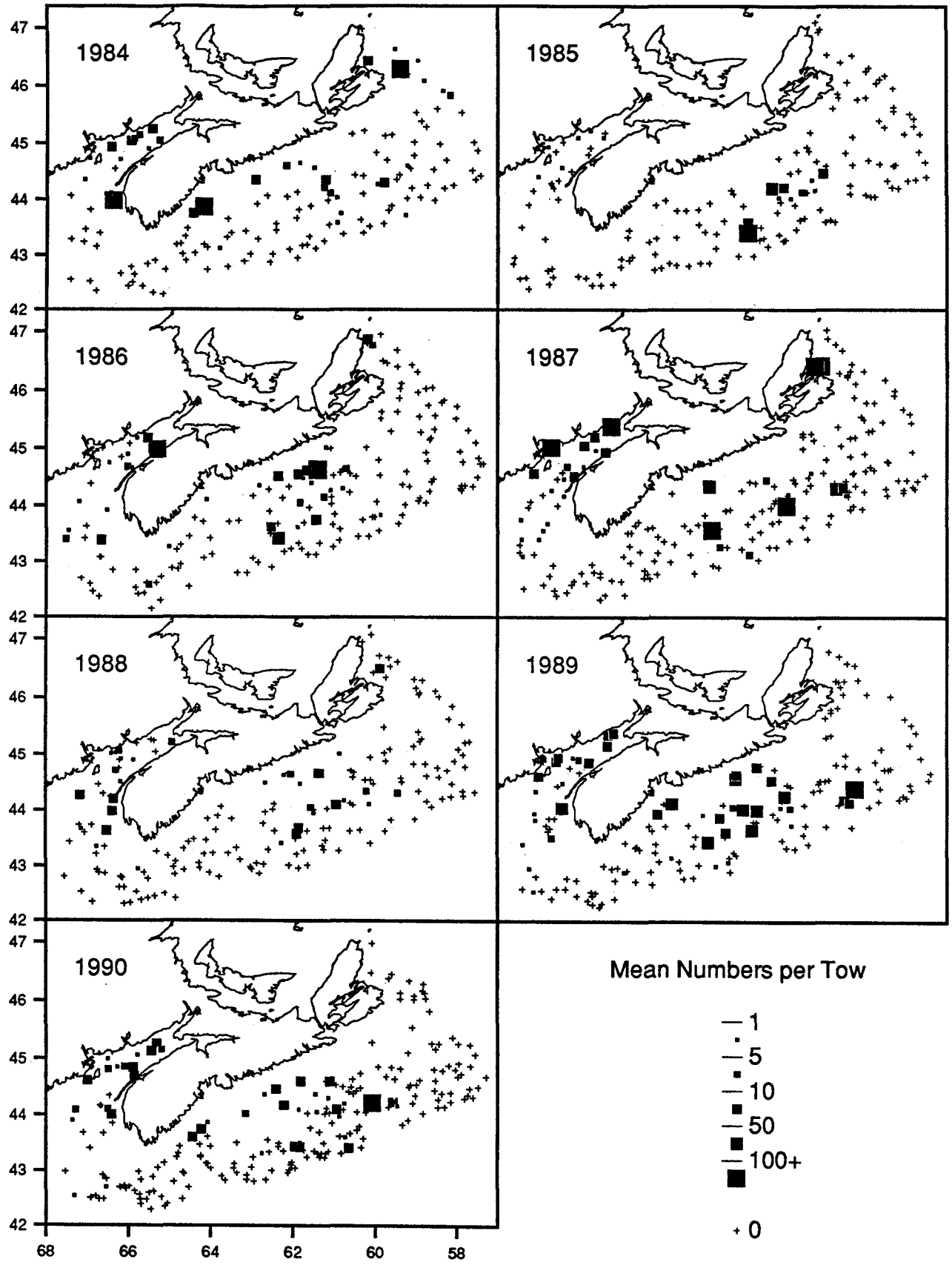

1977
1978
1979
1980
1981
1982
1983
47
46
45
44
43
42
68
66
64
62
60
58
Mean Numbers per Tow
1
5
10
50
100+
0

Fig. 10. con't.


1984
1985
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68
66
64
62
60
58
Mean Numbers per Tow
1
5
10
50
100+
0

Fig. 10. Con't.

APPENDIX 1.

1

THE 1990 SCOTIA-FUNDY HERRING MANAGEMENT PLAN

1990 HERRING MANAGEMENT PLAN OBJECTIVES

Although herring stocks in the Scotia-Fundy Region are in fairly good shape, stocks have been threatened by overfishing in the past. Weak stocks make it more difficult to achieve economic stability. Participants in the Scotia-Fundy herring fishery want long-term conservation and restoration measures. The 1990 Herring Management Plan stresses the following objectives:

1. Conservation and Restoration

   Currently, three good year classes are in the fishery which, under proper management restrictions on catch, will permit sustained TAC's of 125,000 t. Given the lack of predictability in pelagic recruitment, the Department of Fisheries and Oceans (DFO) stresses that effective conservation and restoration requires the full cooperation of all industry members. Stability in harvesting patterns will set the stage for long-term economic viability.

2. Fleet Rationalization and Economic Viability

   Economic viability for the herring purse seine fleet is a function of markets, quota, price per tonne, and the ability to fish the available harvest efficiently. When the ten-year Fleet Reduction Program was introduced in 1983, the purse seine fleet was in a weak state. Many vessels were not cost efficient and many were old and in need of replacement. Currently, several vessels do not have adequate fish holding systems, thereby reducing the quality of landed material. The high cost of financing new vessels has inhibited, in part, the modernization of the large vessel fleet. The small vessel fleet has been modernized more quickly.

   The Fleet Reduction Program, through the transfer of quotas, has led to the removal of nine vessels from the fleet. The transfer of quotas has not been fully exhausted; the process of fleet reduction continues. The acquisition of quotas has made some vessels more profitable.

   DFO and industry remain committed to the 1983 Herring Purse Seine Management Plan and anticipate that the continuous process of fleet rationalization will lead to greater economic viability in coming years. Economic stability should set the stage for reasonable rates of returns on capital investments and on optimal distribution of benefits for participants in the herring fisheries.

3. Resource Utilization

The primary demand for raw herring continues to be for the production of roe for the Japanese market. Strong demand also comes from the canned products sector, and to a lesser extent, frozen fillets and cured herring products. The current over-the-side sales program provides an opportunity for an alternate use of the herring catch. The development and use of fish silage as feed may enhance the use of the resource as well.

For the gill net fleet, efforts will continue to improve quality and to develop domestic markets. Until domestic processors again purchase gill net fish, OSS proposals will be supported by the Advisory Committee to provide markets for the gill net sector of the herring fishery.

4. Elimination of Non-Reported Landings

In recent years, misreporting of landings has been estimated at a lower percentage than traditional levels. The new legislation regarding the reporting of herring catches will contribute to the resolution of this problem. (See pages 16-17 for more details.)

5. Improved Utilization of the Resource over the Calendar Year

The herring purse seine fisheries operate in the fall 4X and 4W fisheries, the winter 4X and 4W fisheries and the summer 4X fishery. Herring landed during the different seasons vary in size and type.Such fishing patterns supply most processors with sufficient quantities of raw material on a year round basis so that distinct markets can be filled. Different herring products coming out of these seasons can be used to target specific markets.

1990 HERRING FISHING PLAN

Part I

This Plan has been developed in consultation with representatives of the herring fishing industry, the two provincial governments and the Department of Fisheries and Oceans through the Scotia-Fundy Herring Advisory Committee. The Plan will apply to the 1990 herring fishery which begins on October 15, 1989, and ends on October 14, 1990.

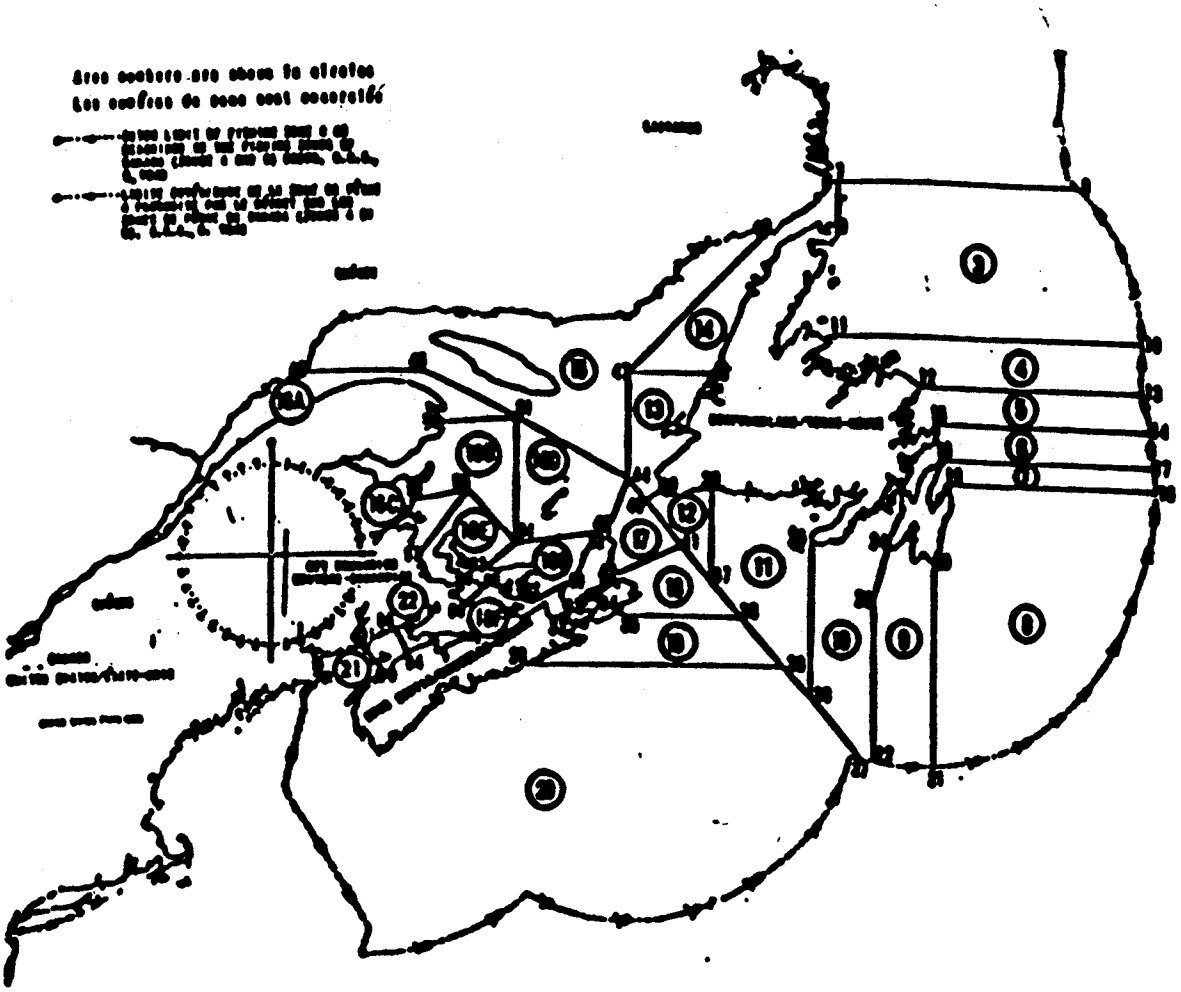
Monitoring of all herring landings will be carried out under the provisions of Section 61 of the Fisheries Act, in accordance with existing regulations and subject to any new regulations which may come into effect in 1990.

1989/1990 SCOTIA-FUNDY HERRING MANAGEMENT PLAN

PART I

The total allowable catch (TAC) will be 4,200 t in Herring Fishing Area 17 for Gulf purse seine vessels and 151,200t in Herring Fishing Areas 19 to 21 for Scotia-Fundy herring fishermen which will be allocated as set out in Table I.

HERRING FISHING AREAS



1989/90 HERRING FISHING PLAN

Table I

GEAR TYPE	FISHERY	AREA	SEASON	QUOTA	FOOT NOTES
PURSE SEINE	FALL	20 & 21	OCT 15 TO DEC 31	9000	
	WINTER	20 & 21	JAN 1 TO FEB 28	6000	1,2
	CHEDABUCTO	AREA 19	NOV 1 TO MAR 1	28470	
	SUMMER	20 & 21 & 22	APR 1 TO OCT 14	96280	3,4
TOTAL PURSE SEINE VESSEL QUOTAS				139750	
	BAIT	19 & 20 & 21		2600	5
TOTAL PURSE SEINE VESSEL QUOTA				142350	
MID-WATER TRAWL	WINTER	20 & 21	JAN 1 TO MAR 31	850	
GILLNETS, TRAPS AND WEIRS		17,18,19,20,21,22		8000	6
TOTAL ALLOWABLE CATCH				151200	
PURSE SEINE	FALL	17	NOV 1 TO MAR 1	4200	7
	FALL	18	CLOSED ALL YEAR	0	

5

FOOTNOTES TO THE 1989/90 HERRING FISHING PLAN

Not more than 500 t of the winter fishery quota will be taken north of a straight line drawn due east from Bliss Island Light, Charlotte County, New Brunswick.

The winter reference figure of 6000 t may be increased by transfer from the summer fishery. Similarly, any unused quota would be transferred to the summer quota.

The quota for the summer fishery will be the balance of any uncaught quotas and over runs from the Fall, Winter, Chedabucto Bay and Upper Bay Fundy fisheries within the 1990 fishery year only.

The division of this quota between the three areas will be resolved at the spring meeting of the Scotia-Fundy Herring Advisory Committee.

The 2600 t bait quota will be allocated to each purse seiner based on their existing percentage share of the purse seine quota, i.e. 1.6%, 2.7%, etc.

Allowances are applied only to the inshore gear licensed for waters adjacent to Nova Scotia. Fixed gear catch by the New Brunswick inshore sector is not considered to be part of the 4VW stock but rather related to NAFO area 5. Therefore, no quotas or allowances are applied by this Plan to inshore gear licensed for the waters adjacent to New Brunswick.

To be fished by Gulf purse seiners only, the 4200 t does not count toward the 151,200 t TAC for the Herring Fishing Area 19 to 21.

6

PART II

Part II applies to the purse seine fleet.

1. Participation

Any Scotia-Fundy purse seine vessel may participate in any or all of Herring Fishing Areas 19, 20, 21 and 22 subject to season, area quota and vessel quota restrictions.

2. Vessel Quotas

a) All purse seine vessels shall operate on an annual vessel quota. This quota is determined on the basis of a 1.6% share of the TAC for Class A vessels and a 2.7% share of the TAC for Class B vessels.

These percentage shares also apply to processor-owned vessels (Class C) but do not account for quota purchases. Subject to additional authorized quota purchases for the 1990 fishery, individual vessel quotas will be allocated as set out in Table II and issued as a licence condition.

b) All documented individual vessel quota overruns in the 1989 fishery will be deducted from the 1990 individual vessel quotas.

3. Trinity Ledge Closure / Continuous 18 d closure, Aug 15 - Sept 2.

The terms of the closure on Trinity Ledge will be reviewed by the Scotia-Fundy Herring Advisory Committee in the spring of 1990. The closure involves that area of Trinity Ledge bounded on the north by latitude 44°05', on the south by latitude 43°55' and on the west by longitude 66°25'.

4. Upper Bay of Fundy / 7500 t opening July 22 - No test fishery.

Due to a late agreement within the industry on the price fishermen received for roe fish during the 1989 season, no herring purse seine fishery took place in the Upper Bay of Fundy. It has yet to be resolved whether or not there should be a purse seine fishery on the Upper Bay of Fundy in 1990. The matter will be discussed at the Spring meeting for resolution.

5. Georges Bank

Scientific advice suggests the herring stock on Georges Bank is showing signs of rebuilding but it is too early to recommend a commercial fishery in the area. For the 1990 herring fishing season, Georges Bank will be closed to herring fishing.

6. Over-the-Side Sales (OSS)

Subject to Ministerial approval of the individual arrangements, an over-the-side sales program for 25,000 t of herring may occur for purse seiners. Within this approval, projects have been approved for the Fall fishery and the Chedabucto Bay fishery and it is anticipated other proposals will be submitted for the 1990 summer fishery.

7. Over-the-Wharf Sales (OTW)

Ministerial approval in principle may be sought, with industry consensus, for an over-the-wharf sales program consistent with government policy, at a later date.

PART III

Part III applies to inshore gear which is comprised of weirs, trap nets and gill nets.

1. General

Effort limitations in all inshore fisheries will be governed by current regulations and licensing policy.

2. Weir Fishery

(a) The Split Rock to Gannet Rock Light closure will be in effect from April 15, 1990, to September 30, 1990. An extension of this closure may be granted up to October 15 after consultation with the affected industry groups, i.e., Connors Brothers, Comeau's Seafoods, South West Seiners, Grand Manan Fishermen's Association, Fundy Weir Fishermen's Association and Atlantic Herring Fishermen's Marketing Co-op.

(b) Subject to Ministerial approval of individual arrangements, an OSS of 10,000 t of herring may occur for New Brunswick weirs. This may be increased if necessary. Nova Scotia weirs subject to Ministerial approval will have a 1,000 t OSS which may be adjusted after consultation with the Advisory Committee.

3. Herring Drift Net Fishery

a) To date, no proposals have been presented by the gill net sector for OSS during the 1990 season.

b) Ministerial approval in principle may be sought for an OTW program, consistent with government policy, at a later date.

TABLE II

1990 SCOTIA-FUNDY PURSE SEINE VESSEL QUOTA ALLOCATIONS

CLASS A (NON-MOBILE)	(% SHARE)	CLASS B (MOBILE)	(% SHARE)	CLASS C (PROCESSOR-OWNED)	(% SHARE)
1. CAPE SHOAL	1.6%	25. CANADA 100	4.0%	37. NOVA STAR - non-mobile	1.9%
2 CHELTOM	1.6%	26. CENTENNIAL III	3.0%	38. EASTERN PHOENIX	4.0%
3. CLELAND G.	1.6%	27. DUAL VENTURE	4.0%	39. LADY MELISSA	4.0%
4. CRAIG & DIANE	1.6%	28. EASTERN FISHER	2.7%	40. MATTUNA MARINER	4.0%
5. DAUGHTERS THREE	1.6%	29. ISLAND PRIDE #1	4.0%		
6. FIVE LADIES	3.2%	30. LEROY AND BARRY NO. II	4.0%		
7. FLYING SWAN VI	1.6%	31. MARGARET ELIZABETH #1	4.0%		
8. FUNDY MISTRESS	1.6%	32. MARI-LYNNE ANITA	4.0%		
9. GAIL & TROY	1.6%	33. LADY NOREEN	4.0%		
10. GOLDEN DAWN	1.6%	34. PUBNICO GEMINI	2.7%		
11. INGALLS SANDS	1.6%	35. SEALIFE II	4.0%		
12. LISA ANNE	3.2%	36. SEALIFE NO. III	2.8%		
13. ARON & KATE	1.6%				
14. NORCHA	1.6%				
15. POLLY B.	1.6%				
16. PUBNICO VIRGO	1.6%				
17. RICHARD B.	1.6%				
18. SARAH & STEWART	1.6%				
19. SEACO	1.6%				
20. SEA FOAM I	1.6%				
21. 7 L'S	1.7%				
22. SEVEN SONS	1.6%				
23. TODD AND CARLA	1.6%				
24. TOMMIE & ARNIE	3.2%				

For 1990, the percentage share of the purse seine TAC and the separate bait quota equates to the following tonnages:

1.6% = 2,236 t and 41.6 t bait
1.7% = 2,376 t and 44.2 t bait
1.9% = 2,655 t and 49.4 t bait
2.7% = 3,773 t and 70.2 t bait
2.8% = 3,913 t and 72.8 t bait
3.0% = 4,193 t and 78.0 t bait
3.2% = 4,472 t and 83.2 t bait
4.0% = 5,590 t and 104.0 t bait