Assessment of the 1988 4WX herring fishery

by

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ABSTRACT

The 1988 4WX herring fishery was similar in spatial and temporal composition to fisheries in recent years, and was dominated by a purse seine fishery for the Japanese roe market. Recorded landings for the 4WX stock were 124,653 t, approximately 23% higher than in 1987. The increase corresponded to an increase in sales to foreign vessels in an "over-the-side" sales program. In a change from recent years, an experimental purse seine roe fishery in the upper Bay of Fundy was opened in response to roe yield observed in test vessels. Landings by the gillnet fleet were the lowest on record.

Herring of the 1983 year-class (age 5) continued to dominate the stock fisheries in both number and weight, while the 1986 year-class (age 2) dominated non-stock (especially N.B. weir) fisheries.

The 1988 larval herring survey resulted in the highest abundance index in the 17-yr series. An acoustic survey of the overwintering aggregation in Chedabucto Bay gave a biomass estimate of 450,000 t. An analytical assessment calibrated with the larval abundance index and the acoustic information was considered unreliable and the winter acoustic survey was used as an indication of stock size.

RÉSUMÉ

Sur le plan de la composition spatiale et temporelle, la pêche au hareng de 1988 dans les divisions 4W et 4X est comparable à celles des dernières années. Elle a été dominée par les pêcheurs à la seine coulissante dont le produit était destiné au marché des oeufs, du Japon. Les débarquements enregistrés pour le stock des divisions 4W et 4X étaient de 124 653 tonnes, une hausse d'environ 23 pour 100 par rapport à 1987. Cette hausse correspondait à une augmentation de ventes aux bateaux étrangers dans le cadre du programme de ventes directes en mer. Un élément nouveau a été ajouté cette année-là. Devant les résultats obtenus par les bateaux d'essal, on a autorisé une pêche expérimentale des oeufs à la seine coulissante dans le cours supérieur de la baie de Fundy. Les débarquements de la flottille de filets maillants étaient les plus bas débarquements jamais enregistrés.

Le hareng de la classe de 1983 (5 ans) dominait encore les capture de la pêche axée sur un seul stock, tandis que la classe de 1986 (2 ans) était l'espèce prédominante dans les pêches de stocks multiples (plus particulièrement les pêches à fascines du N.-B.).

L'étude des larves de hareng de 1988 a révélé le plus gros indice d'abondance de toute la série des dix-sept ans. Un relevé acoustique de l'agrégation hivernante de la baie de Chedabucto a donné une estimation de la biomasse de 450 000 tonnes. Lorsque l'on a étalonné l'évaluation analytique sur l'indice d'abondance des larves et l'information acoustique, on a jugé que les données n'étaient pas fiables et le relevé acoustique de l'hiver a servi pour estimer la taille du stock.

INTRODUCTION

The 1988 herring fishery in NAFO Div. 4WX was similar to that in recent years. It was dominated by a purse seine fleet of 40 vessels which accounted for 72% of the (stock) landings. The remaining landings came from approximately 250 weirs, gillnetters, shutoffs, traps and a single midwater trawler (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 influenced strongly by markets, and was again dominated by the Japanese roe market, followed in importance by sardines and over-the-side sales to foreign vessels (Table 2).

1988 MANAGEMENT PLAN

The 1988 Scotia-Fundy Region Herring Management Plan (Appendix 1) established a quota for the purse seine fleet of 133,200 t. In addition, an allowance of 18,000 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.

In a change from recent years, the plan allowed a small experimental roe fishery in the upper Bay of Fundy. The opening date of this fishery was determined by roe yield observed in test sets.

In a continuing effort to decrease the fishing pressure on the Trinity Ledge spawning component, the original plan called for closure of a 100 sq mi area around the Ledge for 18 d during late August and early September. This was modified, however, in response to negative industry reaction to a series of 3- and 4-d closures per week.

DESCRIPTION OF THE FISHERIES (SEE TABLE 4)

[I] 4WX "STOCK" FISHERIES

4W (Chedabucto Bay, Winter) Purse Seine Fishery

The 1988 management plan allowed for a fishery of up to 26,240 t (30% of the summer purse seine quota) between Nov. 7, 1987 and Mar. 1, 1988. The reported landings of 8503 t (Table 4) were similar to those of recent years (Table 4) and are believed to reflect market limitation. Log records indicate that fish were readily available and that catch rates were high (Power and Stephenson, unpubl. data). The annual winter acoustic survey documented a large and persistent aggregation of herring in the area (Buerkle, 1989).

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, 1987 to Dec. 31, 1987 with a quota of 9000 t. The winter portion (Jan. 31-Mar. 31, 1988) had a quota of 3000 t. The total recorded landings (7876 t) were the highest since 1974 (Table 4), and they reflect increasing market demand and reports of high abundance of fish in the area.

4Xqr (Southwest Nova Scotia) Summer Fishery

a) Purse seine

The 1988 management plan allowed a fishery between May 1 and Oct. 14, 1988, with a quota of 87,360 t plus any uncaught quota from the fall, winter, Chedabucto Bay and upper Bay of Fundy fisheries. Recorded landings were 98,371 t - an increase of approximately 20,000 t over 1987. This increase over last year corresponds to an increase in landings to foreign vessels in the over-the-side sales (OSS) program (approx. 29,000 t in 1988 compared to 6500 t in 1987), although the fishery was again dominated by the roe market. The 1988 total for this fishery is the highest recorded since 1968, and the fourth highest in the 25-yr record.

b) Gillnet

The gillnet segment of this fishery recorded 695 t, the lowest landings on record (since 1963). This continues a steep decline in landings since 1985 which has been primarily the result of an absence of markets. The gillnet fleet has been effectively excluded from the domestic market and relies on the OSS program. Although statistics indicate a significant domestic market component, information from gillnet logbooks indicate that landings were made almost exclusively to OSS vessels. Logs also indicate a great reduction in effort in this sector to a total of less than 20 active vessels from hundreds of active vessels a few years ago.

c) Weirs

Nova Scotia weirs recorded 7518 t, a small increase over 1987, but the highest since 1979. This was the result of high catch rates combined with continued favorable market conditions.

4Xr Upper Bay of Fundy (Scots Bay) Fishery

The upper Bay of Fundy (Scots Bay fishery) was reopened to purse seining in 1987 after a closure of approximately 5 yr. The 1987 fishery was meant to allow large herring to be taken in the mid-Bay for fillets but became a roe fishery targeting early summer (July) spawners off Margaretsville, Nova Scotia. The 1988 management plan allowed an experimental roe fishery of 3000 t, with restriction on opening of the fishery according to roe yield (>8%) from test vessels (see report by Morrisey (1988)). The 1988 fishery opened mid July and resulted in a market roe yield of approximately 8% which is about 3% better than other roe fisheries in the area. Logbook analysis indicated a quota overrun (total of 3904 t) in this fishery.

[2] 4WX "NON-STOCK" FISHERIES

4Xs (New Brunswick) Weir and Shutoff Fishery

The New Brunswick weir and shutoff fisheries recorded 33,421 t (Table 4), an increase of approximately 6000 t over 1987 and the highest since 1979. 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, ending several years of very low landings in these "inner" weirs. Landings were enhanced by good market conditions for canned sardines.

CATCH STATISTICS

Reported landings for the 1988 fisheries (DFO, Scotia-Fundy Region, Statistics Div. records) are listed by month and gear segment in Table 4, and long-term trends in landings for the major gear segments are presented in Table 5 and Fig. 2. Total recorded landings for the stock in 1988 were 124,653 t, approximately 23,500 (23%) higher than 1987.

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.

Also, 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, 1987-Oct. 14, 1988). All other segments are considered for the calendar year 1988.

BIOLOGICAL SAMPLING

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

1) obtaining as many length frequencies from individual catches as possible; and

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

Sample coverage was high and resulted in 621 length frequencies (107,496 fish) and 11,927 fish analyzed in detail (including ages); however, some cells (area and gear by month) were undersampled according to the previous criteria (Table 6).

Biological samples were matched to landings by gear component on a monthly basis as in previous assessments. Numbers at age from commercial catches were generated on the St. Andrews HP 3000 in the traditional manner, using programs HERNLWO2 and HERNAGO9. For all gear components except purse seine, length-frequency samples were applied on a monthly basis.

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

Since the purse seine fisheries involve several distinct fishing grounds and markets, including directed effort for ripe (roe) fish, a smaller spatial scale was considered necessary. As in the previous assessment, length frequencies were matched by individual 10' square and month. This was expanded this year so that all purse seine fishery components (rather than just 4X summer) were treated in this manner. Catches were partitioned by square on the basis of logbook information and where samples and catches did not coincide, length-frequency information from adjacent squares was used.

CATCH AT AGE

The age composition of landings in stock and non-stock segments of the fishery is presented in Table 7 and the proportion by age for each fishery in Table 8. The 1983 year-class continued to dominate major stock fisheries in both number and weight. Age 2 fish continued to dominate the non-stock fisheries and the 4X fall/winter purse seine on the New Brunswick side of the Bay of Fundy. The historical series of catch at age in number and weight for this fishery (1965-88) are presented in Tables 9 and 10.

LENGTH AND WEIGHT AT AGE

Average weight and length at age has been calculated by gear segment in Table 11 and by month for combined gear types in Table 12. Recent assessments (e.g. Stephenson and Power 1988) have used fishery weighted weights at age (mean for stock fish weighted by gear) and the historical weight-at-age series has been extended in Table 13. Size at age 2 in the 1988 stock calculation (Table 13) is low because of

the impact of juveniles taken in the winter purse seine fishery. Monthly mean weights calculated for combined gear (Table 12) indicate a July weight at age 2 of 53 g.

COMMERCIAL CATCH RATES

a) Purse Seine

The detailed purse seine logbook introduced in 1985 (Power and Stephenson 1986, 1987) was used for the fourth consecutive year. Coverage was again high (87% of Statistics Branch landings) as logbook submission remained a condition of license, and information was of similar quality to previous years. 1988 logbook information (Table 14) was used to document various aspects of the Div. 4VWX purse seine fishery, including catches by fishing ground, location and total effort on specific components as well as recent patterns of releases. In general, there was an increase of total effort over 1987, well distributed on all fishing grounds, in line with the increase in the TAC and market. One exception of these increases was the Trinity Ledge area which showed a slight decrease in effort while total catch remained the same. This decline in effort is thought to be partially due to the extensive spawning closures in August and September.

b) Gillnet

An experimental logbook was introduced to the gillnet fleet in 1988 as a cooperative project with the Maritime Fishermen's Union (MFU). This log was set out on a trip basis and requested detailed information on fishing location, effort, set details, catch and markets. Response was good from vessels identified - but there had been such a reduction in effort that few vessels were fishing in comparison with previous years.

c) Weir Indices

The potential use of weir indices was reviewed in an assessment of abundance indices for the 4WX assessment. Weir catch rates suffer from variability in markets and from variable behavior of juvenile herring. Use of the New Brunswick weir series is complicated further by stock mixing. Weir catch/effort series have not been used in this assessment.

RESEARCH SURVEY DATA

a) Larval Abundance

The 1988 larval herring survey was undertaken between Oct. 24 and Nov. 10 (E.E. PRINCE Cruise P377). Results of this survey were presented and compared with those of previous surveys in the review of abundance indices (Stephenson and Power, unpublished). Several modifications to the traditional larval series were compared and the most useful are considered to be:

i) an index of total larval abundance for the original larval survey area which has been surveyed each year since 1972.

ii) total larval abundance based on an extended survey area (extended to the south and east) since 1980.

These new indices are compared with the index used in the last assessment in Table 15. The 1988 survey resulted in the highest abundance index in the 17-yr series, 3.1 times that of 1987, and continues a trend of increase since 1981.

b) Acoustic Survey (see Buerkle 1989)

Another acoustic survey of overwintering herring in Chedabucto Bay, N.S. was undertaken in January 1989. The survey design was modified to conform to a random parallel design recommended by CAFSAC, and there were improvements in processing, particularly with respect to bottom echo detection. The survey estimate of biomass was 450,000 t, and is compared with previous January surveys in Table 16.

An extension of the survey to Sydney Bight, as recommended by CAFSAC, gave no indication of an additional overwintering aggregation east of Chedabucto Bay.

An additional experimental survey was undertaken in February to investigate reports of large amounts of overwintering herring in the Grand Manan area of the Bay of Fundy. This survey documented three aggregations estimated to be in the order of 100,000 t total.

ESTIMATION OF STOCK SIZE

a) Sequential Population Analysis

The catch-at-age matrix was modified for sequential population analysis to exclude a portion of 2-yr-old herring taken in the fall and winter fisheries of southwest New Brunswick and considered to be possibly of Subarea 5 stock origin.

Sequential population analysis (SPA) was undertaken using ADAPT (Gavaris 1988) and is summarized in Table 17. The formulation assumed a linear relationship between larval abundance and mature biomass as used to calibrate in previous assessments. In addition, the ADAPT formulation this year included the acoustic survey estimates of population size in 1984, 1987 and 1989. Model residuals were weighted by the inverse of the standard errors. Partial recruitment (PR) was calculated from the patterns of F's in recent years (F at age/(F ages 5-7 of the previous 3 yr)). The 1988 resulting PR (as follows) was similar to that calculated for the 1987 fishery.

Age	1	2	3	4	5	6	7	8	9	10	11+
PR	.006	.235	.339	1.012	1	1	1	1	1	1	1

The ADAPT SPA results indicated a large increase in population size and a very low F in recent years (e.g. fully recruited F = .07 in 1988). Although coefficients of variation were acceptable (21-37%), there was an unacceptably high correlation among parameters and an unbalanced pattern of residuals.

Alternate formulations, including slight modifications to PR, removal of the 1988 larval estimate and removal of the acoustic series gave similar results in all cases.

b) Acoustic Estimate

The 1989 acoustic survey gave an initial estimate of 400,000 t in the Chedabucto Bay area and an additional 102,000 t in the western Bay of Fundy. Because of the possibility of stock mixing in overwintering fish in southwestern Bay of Fundy (particularly juvenile from Div. 5Y), the Chedabucto Bay survey results were used as a minimum estimate of winter population size.

Because of the problems with the SPA based on ADAPT, it was considered unreliable as an indicator of present stock size. On the other hand, the 1989 acoustic survey of Chedabucto Bay is considered to represent a minimum estimate of stock size. Projections from the acoustic estimate were made assuming a population abundance in 1989 based upon the January 1989 acoustic survey and midwater trawl age composition, PR calculated from F's in previous 3 yr (from the ADAPT run), and 1988 fishery weights at age, as follows:

Age	Population nos. ('000)	Mean wt. (kg)	PR
1	0	.013	.006
2	171.3	.021	.235
3	461.2	.088	.339
4	513.2	.054	1.012
5	415.6	.196	1
6	690.6	.242	1
7	289.9	.281	1
8	66.9	.304	1
9	52.8	.327	1
10	19.6	.341	1
11+	41.2	.350	1

The results assuming $F_{0.1}$ = .3, TAC and 1988 catch in 1989 are:

Year of catch	1989	1990	1989	1990	1989	1990
Assumed catch level	=1988 catch	$F_{0.1}$	=1989 TAC	$F_{0.1}$	=$F_{0.1}$ catch	$F_{0.1}$
Catch (t)	124.6	86.1	151.2	79.6	113.2	88.8
2+ biomass ('000 t)	400.8	296.2	386.3	274.4	406.8	305.5
2+ number ('000)	2722	1670	2722	1558	2722	1718
Fully recruited F	.335	.3	.423	.3	.3	.3
Recruitment	1875	1875	1875	1875	1875	1875

There have been consistent general trends in the increases of the acoustic estimates (from 1984-89), the larval index and recent VPA's. All indicate a three- to five-fold increase since the early 1980's. Applying this ratio to a 1980 mature biomass of approximately 200,000 t (from the converged matrix) would indicate a stock size in the order of 600,000-1,000,000 t.

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Table 1. Landings (t) for gear types involved in the 1985-88 4WX herring fishery.

Gear	1985	1986	1987	1988
Purse seine	101337	67918	91625	114750
Weirs	30786	29470	33408	40072
Gillnet	5584	4318	2919	1151
Traps	1304	296	440	1284
Shutoffs	1139	371	698	867
Midwater trawl	98	28	17	423
Miscellaneous	1612	103	74	1329
Total	141860	102504	129181	159876

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

Market	Landings t (logged t)	%
Roe	32,509	38
Adult shore[1]	29,361	34
Over-the-side	21,755	25
Bait	449	1
Fillet	410	1
Sardine[2]	99	0
U.S. buyers	23	0
Unspecified	1,135	1

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

[2]Sardine market (of approx. 30,000 t) 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
TAC	-	-	-	-	109.0	110.0	99.0	65.0[1]	100.0	80.2	82.0	80.0	125.0	97.6[2]	126.5	151.2
Reported stock[3] 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
Adjusted stock[4] catch						114.0	77.5	107.0	137.0	105.8	117.4	135.9	-	-	-	-
Reported total catch	142.6	170.3	174.7	143.9	150.7	134.7	96.2	93.1	106.8	110.7	94.1	88.7	141.9	101.8	130.2	159.9

[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 wier + 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 1988 4WX herring fishery (data from DFO, Scotia-Fundy Region, Tape MFD 00389).

Gear component	1987			1988											1987	1988	1987/88	Quota Totals
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec				
4W Purse Seine		3420	1177	3330	576									1917	1218	4597	7041	11638	8503[1]
4Xqr P.Seine Domestic	6968							158	8004	17054	14693	27555	1594			6968	69058	76026	69058[2]
4Xqr P.Seine O.S.S.									3572	6753	7334	11027	627			0	29313	29313	29313[2]
4Xs (NB) Purse	1438	854	140	2752	1644	1048							288			2432	5732	8164	7876[1]
4X Gillnet Domestic								15	55	30	316	256				0	672	672	672[3]
4X Gillnet O.S.S.										23						0	23	23	23[3]
4X NS Weirs								1256	2976	1696	1204	386				0	7518	7518	7518[3]
4X Traps	16	1						760	398	24	10	36	56			17	1284	1301	1284[3]
4Xs (NB) Midwater			17	66	101	239										17	406	423	406[3]
Stock Totals	8422	4275	1334	6148	2321	1287		2189	15005	25580	23557	39260	2565	1917	1218	14031	121047	135078	124653
4Xs (NB) weirs	5362	703	122		12	1	90	657	287	4943	10664	6802	6918	2137	43	6187	32554	38741	
4Xs (NB) Shutoff	459								1	19	147	161	414	125		459	867	1326	
4X Misc.	3	2						1	120	414	427	142	62		1	5	1167	1172	
4W Gillnet	7	0	1				129	93	71	150	9	4				8	456	464	
4W Misc.	6	3					134	17		7	3	1				9	162	171	
Non-stock totals	5837	708	123		12	1	353	768	479	5533	11250	7110	7394	2262	44	6668	35206	41874	
4WX Total all Gears	14259	4983	1457	6148	2333	1288	353	2957	15484	31113	34807	46370	9959	4179	1262	20699	156253	176952	
4Vn Purse Seine		1873	499											1088	1484	2372	2572	4944	
4Vn Gillnet							9	12	5	203	1					0	230	230	
4Vn Trap/Misc.		1						77	13	20						1	110	111	
4VN Totals	0	1874	499				9	89	18	223	1			1088	1484	2373	2912	5285	
4VWX Overall	14259	6857	1956	6148	2333	1288	362	3046	15502	31336	34808	46370	9959	5267	2746	23072	159165	182237	

[1]October 1987-March 1988.
[2]January-October 1988.
[3]January-December 1988.

Table 5. Historical series of annual landings (t) for major components of the 4WX herring fishery (1963-87 from Stephenson and Power 1988).

Year	4Wa P.seine	4Xa P.seine	4Xa Gillnet	4Xa Weir	4Xb P.seine	4Xb Shutoff & Weirs	Stock Total *
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
1978	17274	57973	6059	8057	6519	38842	95882
1979	14073	25265	4363	9307	3839	37828	59021
1980	8958	44986	19804	2383	1443	13525	79584
1981	18588	53799	11985	1966	1368	19080	87706
1982	12275	64344	6799	1212	103	25963	84733
1983	8226	63379	8762	918	2157	11383	84385
1984	6336	58354	4490	2684	5683	8698	78083
1985	8751	87167	5584	4062	5419	27863	112385
1986	8414	56139	3533	1958	3365	27883	73733
1987	8780	77706	2289	6786	5139	27320	101157
1988	8503	98371	695	7518	7876	33421	124670

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

Table 6. Distribution of Biological Samples from the 4WX Commercial Herring Fishery by Area and Month. ‡

Area	Gear Component	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
4W	Purse Seine - Detail Fish		606	355	793	221											1975
	- L.F. Samples		15	8	34	8											65
	- Catch		2803	1578	6623	1562											12566
	- Catch/Detail Fish		4.6	4.4	8.4	7.1											6.4
	- Catch/L.F. Sample		186.9	197.3	194.8	195.3											193.3
4Xa	Purse Seine - Detail Fish							-	300	832	745	419	131				2427
	- L.F. Samples							-	26	69	60	14	3				172
	- Catch							(158)->	11734	23807	22027	38582	2221				98371
	- Catch/Detail Fish								39.1	28.6	29.6	92.1	17.0				40.5
	- Catch/L.F. Sample								451.3	345.0	367.1	2755.9	740.3				571.9
4Xb	Purse Seine - Detail Fish	780	261	-	401	197	-										1639
	- L.F. Samples	26	9	-	17	6	-										58
	- Catch	1438	994	<-(140)	2752	2692	<-(1048)										7876
	- Catch/Detail Fish	1.8	3.8		6.9	13.7											4.8
	- Catch/L.F. Sample	55.3	110.4		161.9	448.7											135.8
4Xa	Gillnet - Detail Fish							-	(32)->		139	<-(52)	-				139
	- L.F. Samples							-	1		8	15	-				24
	- Catch							(15)->	(55)->		123	572	<-(256)				695
	- Catch/Detail Fish										.9						5
	- Catch/L.F. Sample										15.4	38.1					29.0
4Xa	N.S. Weir - Detail Fish								526	699	278	224	139				1866
	- L.F. Samples								14	22	8	6	3				53
	- Catch								1256	2976	1696	1204	386				7518
	- Catch/Detail Fish								2.4	4.3	6.1	5.4	2.8				4.0
	- Catch/L.F. Sample								89.7	135.3	212	200.7	128.7				141.8
4X	Traps - Detail Fish	/ All 4WX except 4XS (N.B.) \							700	768	328	281	139	-			2216
	- L.F. Samples	\All gears except purse seine /							2	2	8	15	3	-			30
	- Catch	\All trap & gillnet gears /							760	398	24	10	92	<-(56)			1284
	- Catch/Detail Fish								1.1	.5	.1	.0	.7				.6
	- Catch/L.F. Sample								380	199	3	.7	30.7				42.8
4X	Midwater - Detail Fish				122	146	<-(26)										268
	- L.F. Samples				10	9	<-(1)										19
	- Catch				66	340	<-(239)										406
	- Catch/Detail Fish				.5	2.3											1.5
	- Catch/L.F. Sample				6.6	37.8											21.4
4Xb	N.B. Weirs - Detail Fish			(25)->	(24)->	182			500	199	589	952	540	249	374	<-(20)	3585
	- L.F. Samples			(1)->	(1)->	6			28	10	31	45	41	38	11	<-(1)	210
	- Catch			(12)->	(1)->	103			657	287	4943	10664	6802	6918	2180	<-(43)	32554
	- Catch/Detail Fish					.6			1.3	1.4	8.4	11.2	12.6	27.8	5.8		9.1
	- Catch/L.F. Sample					17.2			23.5	28.7	159.5	237.0	165.9	182.1	198.2		155.0
4Xb	N.B. Shutoffs- Detail Fish	< Combined weir & shutoff >								-	-	952	540	249	-		1741
	- L.F. Samples	< Shutoff only except Aug. with weir >								-	-	45	1	3	-		49
	- Catch									(1)->	(19)->	167	161	539	<-(125)		867
	- Catch/Detail Fish											.2	.3	2.2			.5
	- Catch/L.F. Sample											3.7	161	179.7			17.7
4WX	Misc. - Detail Fish	/ All areas except 4XS (N.B.) \							759	768	328	281	139				2275
	- L.F. Samples	\ & all gears except purse seine /							18	24	16	21	3				82
	- Catch						(263)->		374	191	571	439	209	<-(62)			1784
	- Catch/Detail Fish								.5	.2	1.7	1.6	1.5				.8
	- Catch/L.F. Sample								20.8	8.0	35.7	20.9	69.7				21.8
4VN	Purse Seine - Detail Fish														(-)->	493	493
	- L.F. Samples														1	9	10
	- Catch														1088	1484	2572
	- Catch/Detail Fish															3.0	5.2
	- Catch/L.F. Sample														1088	164.9	257.2
4VN	Misc. - Detail Fish	/ All gears \						(-)->	(-)->	1827	2131	-					3958
	- L.F. Samples	\ and all areas except 4XS /						(-)->	(-)->	68	164	-					232
	- Catch							(9)->	(12)->	103	237	<-(21)					340
	- Catch/Detail Fish									.1	.1						.1
	- Catch/L.F. Sample									1.5	1.4						1.5

‡Note: Values in "directed" parentheses are included in the indicated adjacent month's total;
i.e. "(nn)->" and "<-(nn)" are included in the adjacent right and left month, respectively.

Table 7. Catch at age in number and weight for stock and non-stock gear components of the 1988 4WX herring fishery.

Stock

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	74	5945	10843	21688	10987	2634	1748	707	522	695	55843
4X Summer P.Seine	0	6269	28993	83726	204340	113856	19266	9882	1426	1526	773	470057
4X Fall/Winter P.Seine	0	48452	24302	14465	18380	6710	800	186	6	17	5	113323
4X Gillnet	0	0	9	75	370	676	573	404	121	63	62	2353
4X N.S. Weirs	0	14809	8201	7392	13799	7932	1720	314	111	80	78	54436
4X Traps	0	239	278	590	2194	1782	598	228	148	77	99	6233
4X Midwater Trawl	91	19455	394	307	501	122	3	0	0	0	0	20873
Total Nos. by Age	91	89298	68122	117398	261272	142065	25594	12762	2519	2285	1712	723118
Catch Weight (t.)												
4W Purse Seine	0	2	412	1233	3284	1993	575	438	193	154	218	8503
4X Summer P.Seine	0	342	3380	13986	41953	28621	5638	3096	500	538	318	98372
4X Fall/Winter P.Seine	0	677	1455	1616	2683	1215	174	47	2	5	2	7876
4X Gillnet	0	0	1	13	84	187	183	133	42	25	26	695
4X N.S. Weirs	0	568	708	1059	2633	1894	467	93	30	36	31	7518
4X Traps	0	14	30	84	398	409	162	70	49	27	41	1284
4X Midwater Trawl	1	254	20	36	73	22	1	0	0	0	0	407
Totals Catch t. by Age	1	1857	6006	18027	51108	34340	7201	3878	817	785	635	124654

Nonstock

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	72623	329681	44902	22233	38548	14110	1665	97	247	0	9	524115
4X N.B. Shutoffs	3430	18084	176	133	295	102	15	4	0	1	0	22240
4WX Misc. Gears	0	1408	1133	1062	2320	1848	882	547	143	96	62	9501
Total Nos. by Age	76053	349173	46211	23428	41163	16060	2562	648	390	97	71	555856
Catch Weight (t.)												
4X N.B. Weirs	778	11660	4725	3592	7780	3419	482	30	84	0	4	32554
4X N.B. Shutoffs	44	689	18	23	62	26	4	1	0	0	0	867
4WX Misc. Gears	0	62	108	150	445	458	263	183	52	37	26	1784
Totals Catch t. by Age	822	12411	4851	3765	8287	3904	749	214	136	37	30	35205

Table 8. Proportion (%) catch at age in number and weight for each gear segment of the 1988 4WX (stock) herring fishery.

% Numbers at Age	1 Age1	2 Age 2	3 Age 3	4 Age 4	5 Age 5	6 Age6	7 Age 7	8 Age 8	9 Age 9	10 Age10	11 Age11+	Totals
4W Purse Seine	0	1	11	20	39	20	5	4	2	1	2	100
4X Summer P.Seine	0	2	7	18	44	25	5	3	1	1	1	100
4X Fall/Winter P.Seine	0	43	22	13	17	6	1	1	1	1	1	100
4X Gillnet	0	0	1	4	16	29	25	18	6	3	3	100
4X N.S. Weirs	0	28	16	14	26	15	4	1	1	1	1	100
4X Traps	0	4	5	10	36	29	10	4	3	2	2	100
4X Midwater Trawl	1	94	2	2	3	1	1	0	0	0	0	100
Overall % by Age	1	15	10	16	35	19	4	2	1	1	1	100
% Catch Weight at Age												
4W Purse Seine	0	1	5	15	39	24	7	6	3	2	3	100
4X Summer P.Seine	0	1	4	15	43	30	6	4	1	1	1	100
4X Fall/Winter P.Seine	0	9	19	21	35	16	3	1	1	1	1	100
4X Gillnet	0	0	1	2	13	27	27	20	7	4	4	100
4X N.S. Weirs	0	8	10	15	36	26	7	2	1	1	1	100
4X Traps	0	2	3	7	31	32	13	6	4	3	4	100
4X Midwater Trawl	1	63	5	9	18	6	1	0	0	0	0	100
Overall % by Age	1	2	6	15	41	28	6	4	1	1	1	100

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

	1981	1982	1983	1984	1985	1986	1987	1988
1	0	3589	3367	0	5762	40	1398	91
2	75713	72591	128378	72301	138419	80019	50422	89298
3	33174	122380	101017	141067	215599	176197	76865	68122
4	68816	17756	168379	131251	193369	186983	320651	117398
5	306716	73025	16946	84920	94308	36361	147483	261272
6	21728	154542	41607	13633	27081	20180	27924	142065
7	1631	10910	63468	13803	8989	6878	11843	25594
8	1914	1535	7334	16299	11609	2759	4433	12762
9	1366	977	1351	5418	5107	1879	2043	2519
10	361	886	434	1263	767	866	1897	2285
11	1442	719	895	5207	300	223	395	1712
1+	512861	458910	533176	485162	701310	512385	645354	723118
2+	512861	455321	529809	485162	695548	512345	643956	723027
3+	437148	382730	401431	412861	557129	432326	593534	633729

Table 10. 4WX Herring Catch Weight (mt) at Age.

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

	1973	1974	1975	1976	1977	1978	1979	1980
1	0	0	0	0	0	0	3	16
2	3641	28436	5501	1585	9160	9812	6991	392
3	62996	7976	17059	20107	3247	4055	25362	6783
4	15696	108155	16555	20778	33613	2050	8118	61831
5	7731	10938	82930	16883	22665	24604	1011	4787
6	6429	3659	12124	54815	15099	15627	5003	910
7	5404	2251	2503	5256	44122	8243	4439	1003
8	5830	1711	1079	1576	4055	31944	3224	1599
9	7139	3754	1246	1360	943	3453	12527	711
10	3757	2037	1077	742	521	861	1491	3182
11	4325	2590	1743	1241	1433	595	794	819
1+	122948	171509	141816	124343	134859	101245	68964	82033
2+	122948	171509	141816	124343	134859	101245	68960	82017
3+	119307	143073	136315	122758	125699	91433	61969	81625

	1981	1982	1983	1984	1985	1986	1987	1988
1	0	36	34	0	0	0	17	1
2	3104	2976	5263	2713	7313	4400	2539	1856
3	3715	13707	11314	18630	25442	21781	7501	6006
4	11836	3054	28961	25122	39432	34032	48975	18026
5	66864	15919	3694	19418	23516	8704	29294	51108
6	5519	39254	10568	3533	7536	5469	6843	34340
7	466	3120	18152	3863	2833	2102	3245	7201
8	618	496	2369	4828	3879	907	1287	3878
9	484	346	478	1674	1757	677	650	817
10	140	345	169	460	337	346	664	785
11	561	280	348	1895	132	89	138	635
1+	93309	79532	81351	82135	112177	78507	101153	124654
2+	93309	79496	81317	82135	112177	78507	101136	124652
3+	90204	76520	76053	79422	104864	74107	98597	122796

Table 11. Average weight (g) and length (cm) at age for stock and non-stock gear components of the 1988 4WX herring fishery.

Stock

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	26	69	114	151	181	218	251	274	295	314
4X Summer P.Seine	0	55	117	167	205	251	293	313	351	353	411
4X Fall/Winter P.Seine	0	14	60	112	146	181	218	255	276	291	307
4X Gillnet	0	0	128	177	228	277	320	330	350	398	412
4X N.S. Weirs	0	38	86	143	191	239	272	295	334	363	395
4X Traps	0	57	107	142	181	230	271	307	334	349	415
4X Midwater Trawl	13	13	50	116	145	182	224	0	0	0	0
Average for Stock Gears	13	21	88	154	196	242	281	304	327	341	371

Average Length at Age											
4W Purse Seine	0	16	22	26	29	30	32	34	35	35	36
4X Summer P.Seine	0	20	25	28	30	31	33	34	35	35	37
4X Fall/Winter P.Seine	0	13	21	26	28	30	31	33	34	34	35
4X Gillnet	0	0	25	28	30	32	34	34	35	36	36
4X N.S. Weirs	0	18	23	27	29	31	32	33	35	35	36
4X Traps	0	21	25	27	29	31	33	34	35	35	37
4X Midwater Trawl	13	13	20	26	28	30	32	0	0	0	0
Average for Stock Gears	13	14	23	27	29	31	33	34	35	35	36

Nonstock

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	11	35	105	162	202	242	290	308	342	0	411
4X N.B. Shutoffs	13	38	103	172	210	254	291	319	0	407	0
4WX Misc. Gears	0	44	95	142	192	248	298	334	362	383	427
Average for non-stock	11	36	105	161	201	243	292	330	349	383	425

Average length											
4X N.B. Weirs	12	17	24	28	29	31	33	34	35	0	36
4X N.B. Shutoffs	13	18	24	28	30	31	33	33	0	36	0
4WX Misc. Gears	0	19	24	27	29	31	33	34	35	35	37
Average for non-stock	12	17	24	28	29	31	33	34	35	35	37

Table 12. Mean weights at age (g) by month for 1988 4WX herring stock and non-stock fisheries (combined gear).

Stock Gears Combined by Month

Age	1987								1988							
	Oct	Nov	Dec	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Year Avg
1	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	14
2	0	26	0	14	13	0	0	25	32	53	49	57	44	0	0	21
3	60	57	83	64	64	0	0	73	92	111	119	125	138	0	0	88
4	103	118	124	111	115	0	0	130	161	163	171	168	166	0	0	154
5	144	159	163	143	147	0	0	173	196	208	207	205	200	0	0	196
6	181	186	185	171	185	0	0	214	242	256	256	249	237	0	0	242
7	223	220	224	211	212	0	0	253	281	297	304	289	272	0	0	281
8	253	254	247	245	255	0	0	274	285	328	317	316	272	0	0	304
9	278	275	283	264	253	0	0	308	325	314	367	349	0	0	0	324
10	273	294	300	293	297	0	0	276	374	468	381	349	0	0	0	343
11+	0	313	320	306	260	0	0	376	410	421	402	416	358	0	0	371

Non-stock gears combined by month

Age	1987								1988							
	Oct	Nov	Dec	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Year Avg
1	0	0	0	0	0	0	0	0	0	0	9	7	10	13	0	11
2	0	0	0	0	0	0	12	12	15	36	45	36	42	37	0	36
3	0	0	0	0	0	0	50	56	73	103	113	109	109	116	0	105
4	0	0	0	0	0	0	101	118	147	165	174	138	173	169	0	161
5	0	0	0	0	0	0	138	165	190	208	213	185	191	184	0	201
6	0	0	0	0	0	0	0	204	245	260	258	225	224	222	0	243
7	0	0	0	0	0	0	0	241	285	313	305	269	279	263	0	292
8	0	0	0	0	0	0	0	265	312	343	332	0	308	0	0	329
9	0	0	0	0	0	0	0	312	362	380	357	335	304	0	0	349
10	0	0	0	0	0	0	0	232	352	407	394	0	0	0	0	379
11+	0	0	0	0	0	0	0	0	421	423	433	0	0	0	0	425

Table 13. Average weights at age for the 4WX herring fishery (stock portion) 1965-88.

	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

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0	10	10	10	10	10	0	0	0	12	13
2	28	41	41	41	41	41	38	53	55	50	21
3	112	112	112	112	112	112	132	118	124	98	88
4	181	172	172	172	172	172	191	204	182	153	154
5	229	218	218	218	218	218	229	249	239	199	196
6	259	254	254	254	254	254	259	278	271	245	242
7	302	286	286	286	286	286	280	315	306	274	281
8	330	323	323	323	323	323	296	334	329	290	304
9	351	354	354	354	354	354	309	344	360	318	327
10	397	389	389	389	389	389	364	440	400	350	341

Table 14a. 4WX herring catch (t); 1985 - 1988 and total effort (sonar search hours) by fishery and grounds.

Fishery	Grounds	1985 Catch	1986 Catch	1987 Catch	1988 Catch	1985 Search	1986 Search	1987 Search	1988 Search
4W	Chedabucto Bay	4216	6871	4468	7319	135	164	181	385
4W	Unknown Areas	746	959	1893		17	32	66	
4W	Total	4962	7830	6361	7319	152	196	247	385
4Xa	Grand Manan	3584	2984	2217	301	184	284	220	27
4Xa	Long Island	857	3060	7309	10892	149	292	771	827
4Xa	Trinity	35800	13419	18851	18586	2110	1650	1700	1506
4Xa	Lurcher	308			2928	39	8		162
4Xa	Gannet, Dry Ledge	5675	2187	1474	14901	526	203	162	1187
4Xa	Seal Island	13745	8894	11560	18947	718	542	1086	1133
4Xa	German Bank	15502	13346	16434	17692	679	873	985	789
4Xa	Scots Bay		36	3649	3949		5	256	184
4Xa	S.W. Grounds	558	1839	184	181	47	175	28	11
4Xa	N.B. Coastal		621	138	126		33	9	33
4Xa	Unknown Area	7294	5240	6443		709	452	561	
4Xa	Total	83323	51626	68259	88503	5161	4517	5778	5859
4Xb	Grand Manan	1332	2814	2135	4197	26	169	125	162
4Xb	Long Island		252	215	18		32	10	3
4Xb	Trinity	94							
4Xb	Seal Island	123							
4Xb	German Bank			66				8	
4Xb	N.B. Coastal	188		966	692			74	27
4Xb	Unknown Areas	36	44	16				6	
4Xb	Totals	1773	3110	3398	4907	26	201	223	192
4VN	Sydney Bight	3511	4250	1751	2100		26	29	1
4VN	Unknown Area		236		68				
4VN	Total	3511	4486	1751	2168		26	29	1

Table 14b. 1985-1988 4VWX Herring Purse Seine CPUE by Fishery and Grounds. April 29, 1989

Fishery	Grounds	1985 Catch/hr	1986 Catch/hr	1987 Catch/hr	1988 Catch/hr	1985 Set/hr	1986 Set/hr	1987 Set/hr	1988 Set/hr
4W	Chedabucto Bay	42.01	70.76	39.49	33.70	.82	1.05	.92	.66
4W	Unknown Areas	143.27	60.29	79.98		2.11	1.19	1.38	
4W	Average	68.10	68.90	51.50	33.70	1.14	1.08	1.07	.66
4Xa	Grand Manan	27.83	22.42	18.70	8.66	.73	.81	.56	.30
4Xa	Long Island	15.83	22.82	13.72	21.31	.44	.88	.48	.64
4Xa	Trinity	28.51	11.09	13.46	18.18	.70	.41	.45	.48
4Xa	Lurcher	10.46			28.98	.18			.73
4Xa	Gannet, Dry Ledge	16.71	31.32	17.39	22.72	.46	.85	.59	.54
4Xa	Seal Island	29.38	19.93	15.51	16.80	.60	.61	.54	.48
4Xa	German Bank	30.32	20.95	32.34	34.85	.62	.60	.69	.74
4Xa	Scots Bay		8.07	24.58	28.26		.22	.51	.62
4Xa	S.W. Grounds	33.82	14.73	12.17	13.08	.75	.47	.29	.42
4Xa	N.B. Coastal		33.19	26.32	4.66		.47	.64	.18
4Xa	Unknown Area	17.68	17.60	25.55		.42	.56	.68	
4Xa	Average	26.60	18.10	19.50	22.59	.62	.59	.55	.57
4Xb	Grand Manan	43.02	22.34	30.76	28.53	1.28	.97	.85	.90
4Xb	Long Island		8.31	54.25	6.03		.46	2.97	.33
4Xb	Trinity								
4Xb	Seal Island								
4Xb	German Bank			8.77				.27	
4Xb	N.B. Coastal			11.48	5.61			.43	.49
4Xb	Unknown Area			2.89				.18	
4Xb	Average	43.02	20.30	25.90	25.82	1.28	.89	.91	.85
4VN	Sydney Bight		54.76	30.32	45.40		1.13	.69	1
4VN	Unknown Area								
4VN	Average		54.76	30.32	45.40		1.13	.69	1

Table 15. Larval abundance indices for the 1988 4WX herring assessment.

Year	LAI[1] (old)	TLA-1[2] (traditional area)	TLA-2 (expanded area)
1972	9.4	22.26	
1973	6.6	15.54	
1974	49.5	104.59	
1975	8.6	21.60	
1976	13.5	32.73	
1977	6.3	17.30	
1978	4.5	9.44	
1979	7.1	17.30	
1980	26.2	57.32	66.00
1981	2.7	5.33	5.54
1982	12.4	31.40	46.47
1983	13.1	28.74	63.59
1984	12.6	29.93	48.03
1985	41.8	83.72	228.04
1986	21.3	53.11	75.62
1987	31.2	65.50	N/A
1988	98.19	194.07	336.75

[1]Arith. mean of 79 stations as used in the last assessment (Stephenson and Power 1988).

[2]Total larval abundance from contoured plots of density.

Table 16. Summary of results from January acoustic surveys of Chedabucto Bay (from Buerkle 1989).

Year	Mean total scattering (m^2 sr^{-1})	SE	Estimated biomass[a] ('000 t)	SE
1984	64,429		208	
1985				
1986	129,306		391	
1987	170,658		491	
1988				
1989	159,741	25,214	450[b]	71

[a]Calculated according to Foote (1987).

[b]Revised from initial estimate of 400,000 t presented in May 1989.

Table 17. Summary of input for assessment of the 1988 4WX herring fishery using the ADAPT method (Gavaris 1988).

Parameters:

- year-class strength; age 4 in 1989
- calibration constants (slopes) of relationships:
  i) larval abundance yr t vs mature biomass yr t+1
  ii) acoustic biomass vs population biomass

Structure:

- PR calculated from average F's in previous 3 yr (assuming ages 5-7 = 1) based on preliminary ADAPT run.

Input:

- Larval abundance index (17 yr 1972-88 related to Jan. 1 mature biomass 1973-89)
- Acoustic survey biomass (Jan. 1984, 1987, 1989 related to Jan. 1 population)

Objective Function:

- Weighting by inverse of standard error

Summary:

- Number of observations = 20
- Number of parameters estimated = 3

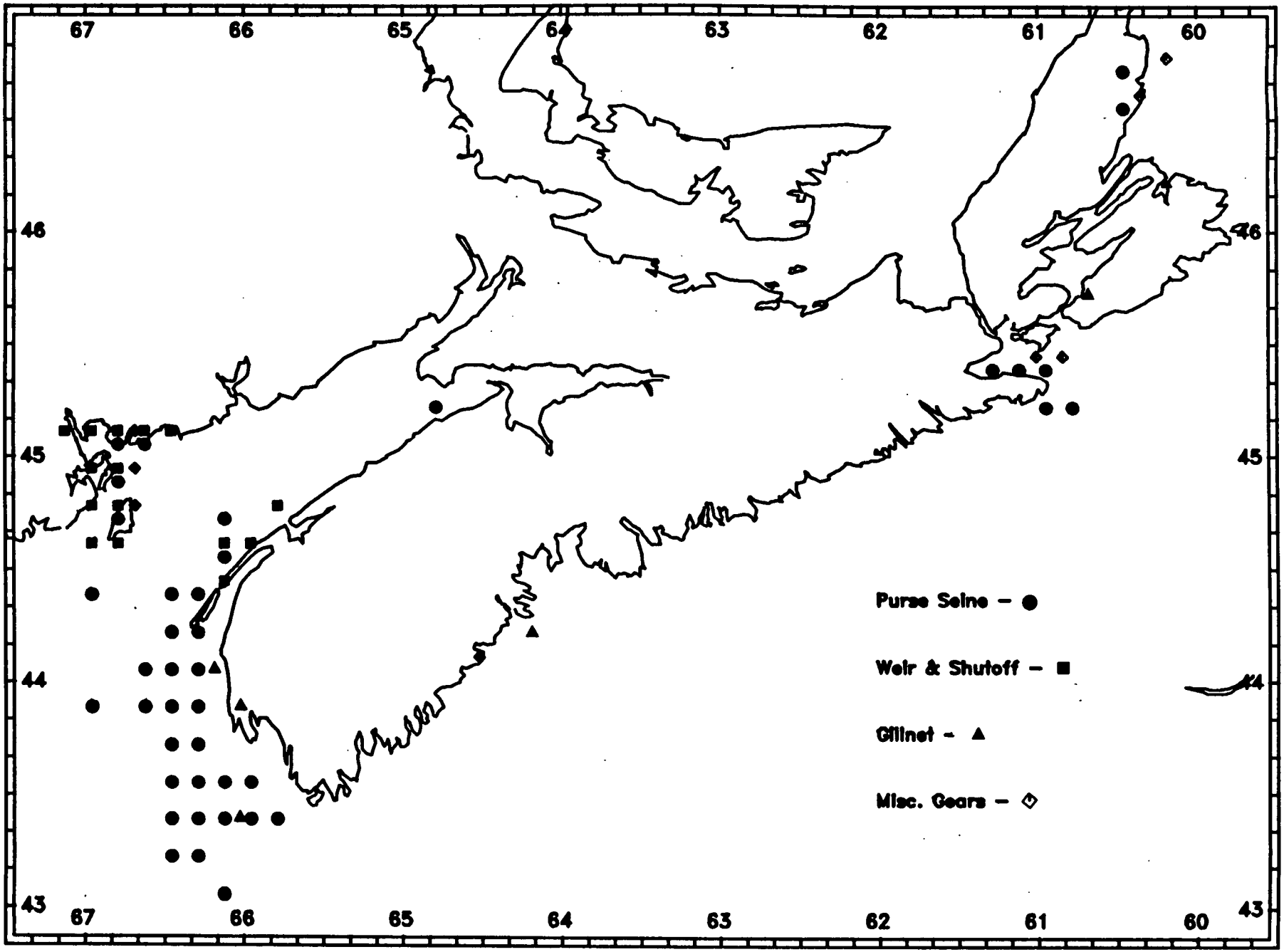


Fig. 1. Geographical distribution of gear components of the 1987 4WX (and 4VN purse seine) herring fishery (from biological sample data; resolution - 10' square).

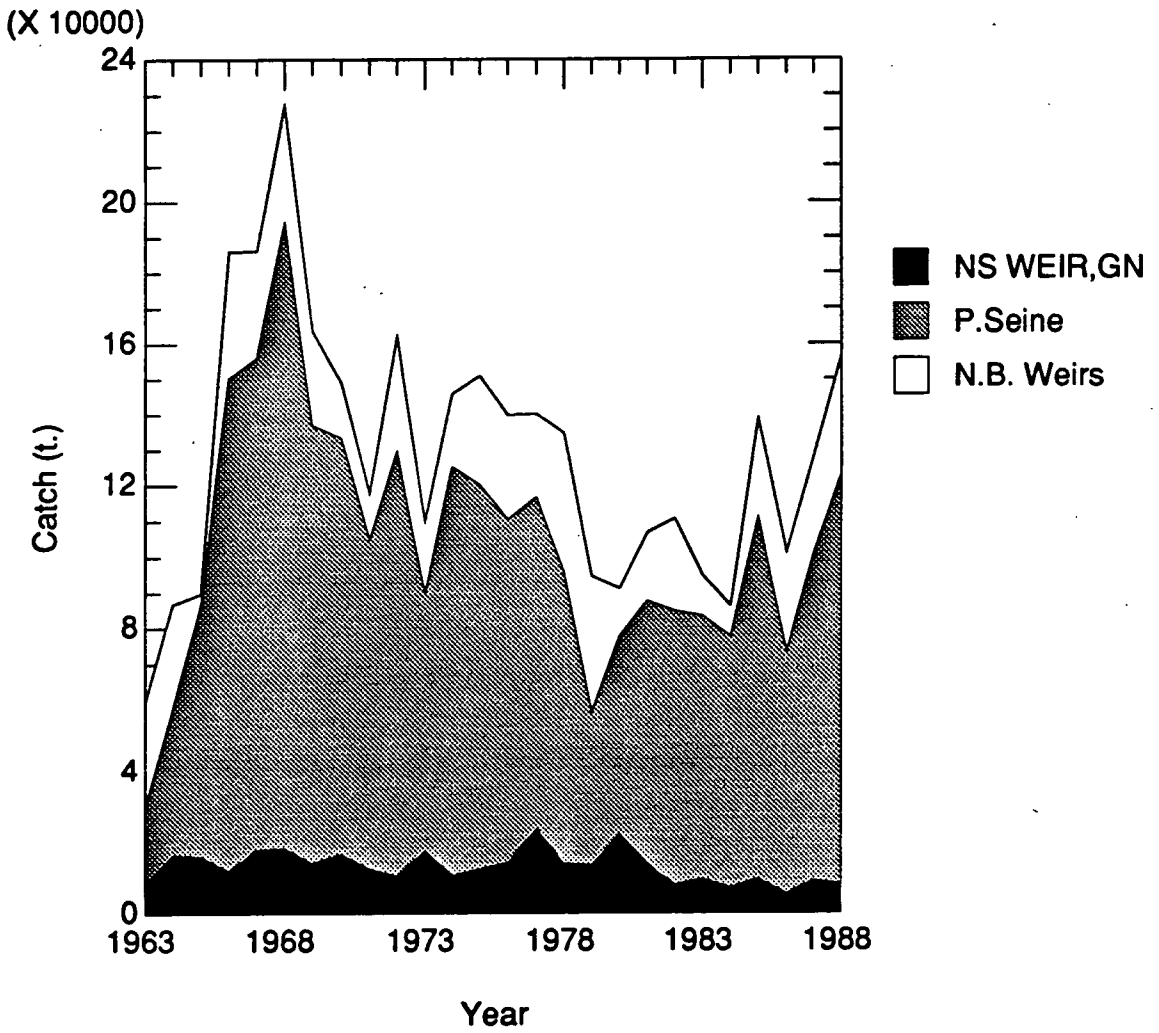


Fig. 2. 1963 to 1988 4WX cumulative catches by major gear components.

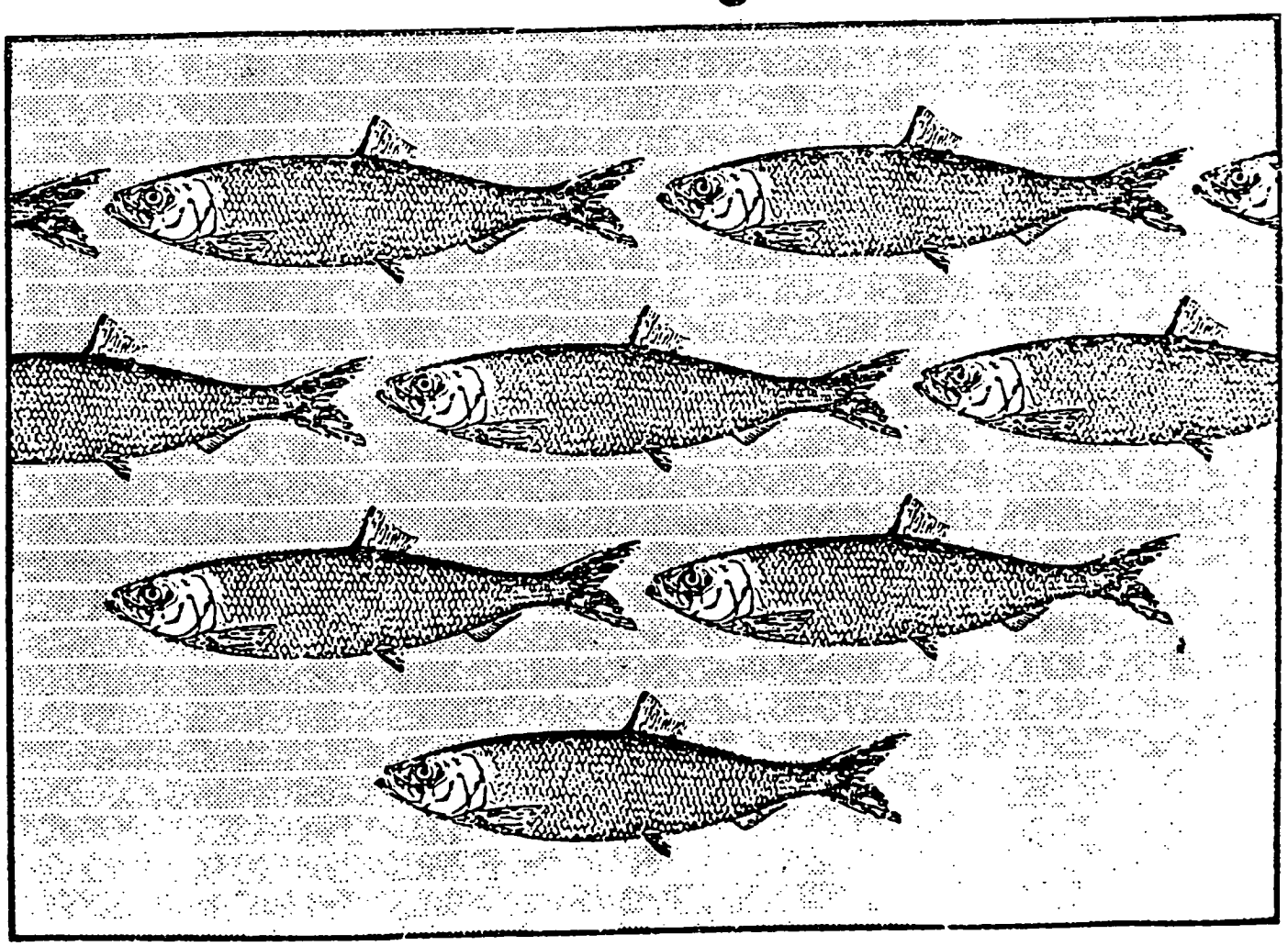
Appendix 1

Fisheries and Oceans / Pêches et Océans

Fisheries Management Plan: 1988

Scotia - Fundy Region

Herring



Canada

1988 SCOTIA-FUNDY HERRING MANAGEMENT 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. This Plan will apply to the 1988 herring fishery which begins on October 15, 1987, and ends on October 14, 1988.

Monitoring of all herring landings will be carried out under the provisions of Section 48 of the Fisheries Act, in accordance with existing regulations and subject to any new regulations which may come into effect in 1988.

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

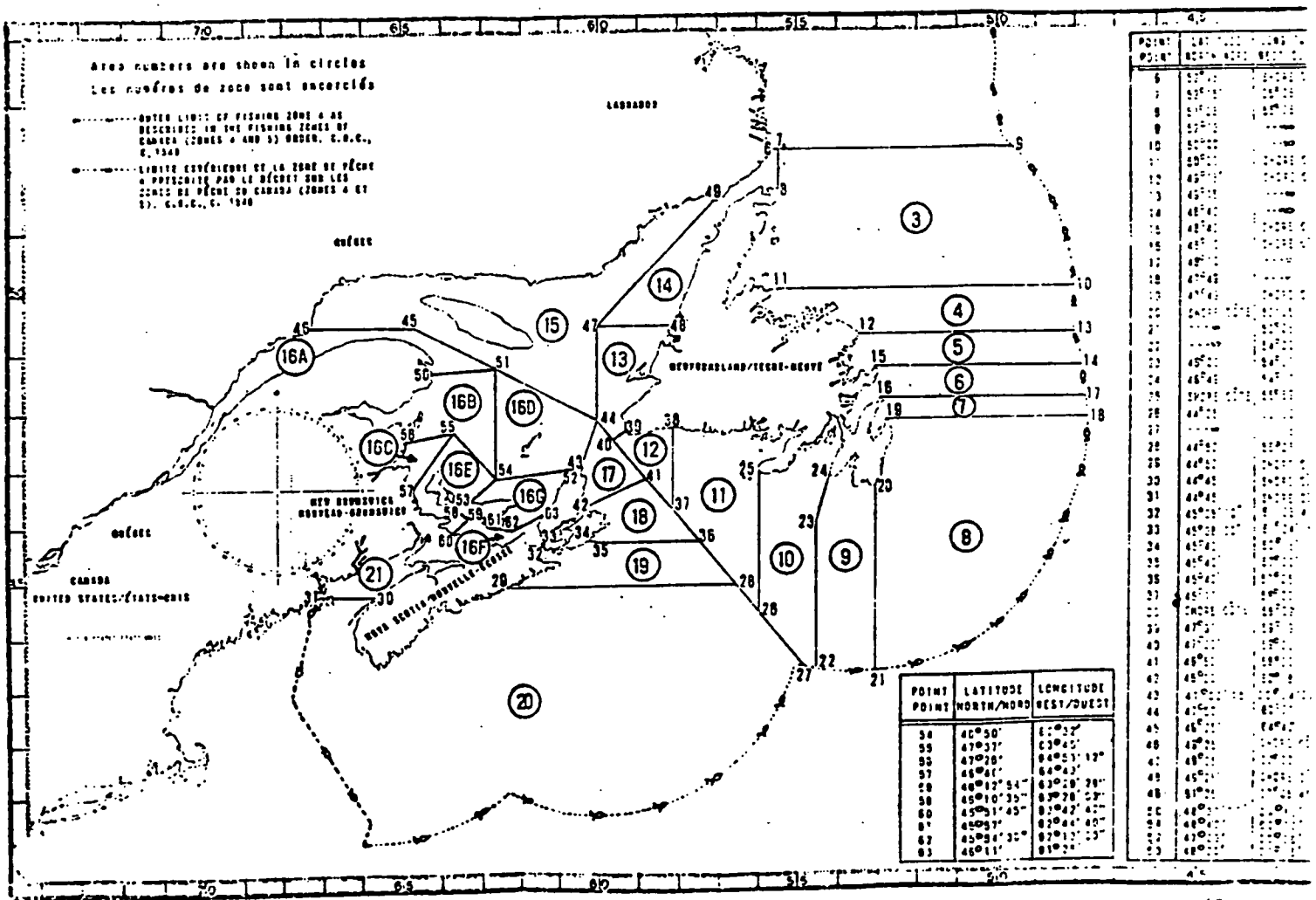


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TABLE I

GEAR TYPE	HERRING FISHING AREA	SEASON	QUOTA(t)	ALLOWANCE(t)
Purse Seine	Area 17	Nov.07/87-Mar.01/88	4,200[1]	
Purse Seine	Area 18	Closed All Year	N/A	
Purse Seine	Area 20 and 21 (Fall Fishery)	Oct.15/87-Dec.31/87	9,000	
	Area 20 and 21 (Winter Fishery)	Jan.01/88-Mar.31/88	3,000[2]	
	Area 19 (Chedabucto Bay)	Nov.07/87-Mar.01/88	26,240	
	Area 20 and 21 (Summer Fishery)	May 01/88-Oct.14/88	87,360[3]	
	Area 21 (Upper Bay of Fundy)	To be established	2,700[4]	
	Purse Seine Vessel Quotas		128,300	
	Area 21 (Upper Bay of Fundy Reserve)	To be established	300[5]	
	Area 20 and 21 (OSS Reserve)	To be established	2,000[6]	
	Area 19, 20 & 21 (Bait Fishery)	N/A	2,600[7]	
	Total Purse Seine Quota		133,200	
Drift Gill Nets	Area 20 (OSS)	N/A	5,000	13,000
Set Gill Nets	Areas 17, 18, 19, 20 and 21	N/A		
Weirs	Areas 20 and 21	N/A		
Trap Nets	Areas 19, 20 and 21	N/A		
	Total Inshore Allowance			18,000[8]
	Total Allowable Catch		151,200	

1. To be fished by Gulf purse seine vessels only, the 4,200 t does not count toward the 151,200 t TAC for Herring Fishing Areas 19 to 21.

2. Not more than 500 t of the 3,000 t winter fishery quota will be taken north of a straight line drawn due east from Bliss Island Light, Saint John County, New Brunswick.

3. Uncaught quotas from the fall, winter, Chedabucto Bay and Upper Bay of Fundy fisheries will be made available to the summer fishery within the 1988 fishing year only.

.../3

4. The 2,700 t Upper Bay of Fundy fishery quota will be taken north of a straight line drawn between Parker's Cove, Annapolis County, Nova Scotia and Cape Spencer, Saint John County, New Brunswick. The open season for this fishery will be established after roe quality has been sampled by selected herring purse seine vessels and the Department.

5. A special reserve of 300 t has been set aside for the Upper Bay of Fundy fishery and will be allocated to selected vessel(s) to test roe quality prior to the opening of the area. The 300 t allowance, from the purse seine quota, will not count against individual vessel quotas.

6. The 2,000 t over-the-side sales reserve will not be counted against individual vessel quotas.

7. The 2,600 t bait quota will be allocated to each purse seine vessel based on their existing percentage share of the purse seine quota, i.e. 1.6%, 2.7% etc.

8. Allowances are applied only to inshore gear licensed for waters adjacent to Nova Scotia. No quotas or allowances are applied to inshore gear licensed for the waters adjacent to New Brunswick.

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 and 21 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 1988 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 1987 fishery will be deducted from the 1988 individual vessel quotas.

3. Trinity Ledge Closure

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' will be closed to purse seine vessels during the following times:

From:	To:
12 noon August 19, 1988	12 noon August 21, 1988
12 noon August 26, 1988	12 noon September 11, 1988

4. Upper Bay of Fundy

No fishing of herring is permitted north of a straight line drawn between Parker's Cove, Annapolis County, Nova Scotia (Latitude 44°49' and Longitude 65°32') to Cape Spencer, Saint John County, New Brunswick (Latitude 45°12', Longitude 65°55'), until the herring have been sampled by selected purse seine vessels under the supervision of the Department and the area is opened. A special reserve of 300 t has been allocated for the sampling and will

not count towards individual vessel quotas or be considered part of the 2,700 t quota for the area. The area will be open to fishing when it is determined that the herring roe sampled is of an acceptable quality.

5. Georges Bank

For the 1988 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 15,000 t of herring for purse seine vessels may occur with an additional 5,000 t if required. A special 2,000 t reserve has been established to encourage purse seine vessels to deliver herring to ensure the program is extended for the benefit of drift net fishermen. The 2,000 t reserve will not count against individual vessel quotas. The reserve will be controlled by the purse seine groups in consultation with the drift gill net group. (See also Part III, 3 c) on page 7.)

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.

TABLE II

1988 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. MISS JENNIFER	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	1.6%				
22. SEVEN SONS	1.6%				
23. TODD AND CARLA	1.6%				
24. TOMMIE & ARNIE	3.2%				

For 1988, the percentage share of the purse seine TAC and the separate bait quota equates to the following tonnages:

1.6% = 2,053 t and 41.6 t bait
1.9% = 2,438 t and 49.4 t bait
2.7% = 3,464 t and 70.2 t bait
2.8% = 3,592 t and 72.8 t bait
3.0% = 3,849 t and 78.0 t bait
3.2% = 4,106 t and 83.2 t bait
4.0% = 5,132 t and 104.0 t bait

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

The Split Rock to Gannet Rock Light closure will be in effect from April 15, 1988, to September 30, 1988. 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.

3. Herring Drift Net Fishery

a) Subject to Ministerial approval of individual arrangements, an OSS program for 5,000 t may occur. This program will be made up of gill net herring only and no portion of this allowance can be transferred to a purse seine OSS program.

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

c) Given the approval of an 1988 OSS program in the Bay of Fundy, the Maritime Fishermen's Union, representing drift gill netters, and participating seiner groups agree to cooperate to ensure a viable gill net OSS program by jointly negotiating an OSS contract(s) and entering into a cooperative agreement to ensure daily OSS capacities are filled. (See also Part II, item 6 on page 5.)

PART IV

Regulatory Requirements

1. Until such time as new regulations can be promulgated to control:

   a) the Trinity Ledge area closure;
   b) the Upper Bay of Fundy closure; and
   c) the 500t limit on herring to be caught north of a line drawn due east from Bliss Island Light in the winter fishery.

   these restrictions can be implemented and legally enforced as licence conditions pursuant to section 33 of the Atlantic Fishery Regulations, 1985.