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1979-1980 4Vn Herring Assessment

by

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Abstract

The 4Vn winter purse seine catch in the 1979-80 fishery was 2,807 t. The fishery was stopped in early January when the quota of 3,000 t was estimated to have been caught. The catch distribution in 1979-80, in both time and space, was anomalous relative to historical patterns. The catch rates increased from 24 t per "successful night" in 1978-79 to 80 t per "successful night" in 1979-80. A large proportion of both the catch by numbers (63%) and by weight (41%) was comprised of 3, 4 and 5 year old fish. This is the first fishing season since the mid 1970's that younger ages have dominated the catch. The tagging results indicate that the winter fishery prosecutes a complex stock mixture (S.W. Nova Scotia, Gulf of St. Lawrence as well as so-called local stocks along the Nova Scotia eastern and southern shores). Due to the nature of this "overwintering" fishery (i.e. the complex stock mixture) an analytical assessment was considered inappropriate. Considering the increase in catch rates and the appearance of younger age classes in the catch a moderate increase in quota is reasonable. The increase should not however be large enough to disrupt the management of the component stocks during other phases of their annual migration.

Résumé

Pendant la campagne d'hiver 1979-1980, les prises de hareng à la senne coulissante ont été de 2,807 t. La pêche a été fermée tôt en janvier, lorsque, d'après les estimations, le quota de 3,000 t. avait été capturé. La distribution, tant spatiale que temporelle, des prises de 1979-1980 présentèrent des anomalies par rapport aux régimes historiques. Les taux de capture augmentèrent, passant de 24 t. par "nuit fructueuse" en 1978-1979 à 80 t par nuit du même genre en 1979-1980. Une forte proportion des prises, tant en nombre (63%) qu'en poids (41%), était constituée de poissons de 3, 4 et 5 ans. C'est la première campagne de pêche depuis le milieu des années 1970 que les prises sont dominées par de jeunes poissons. Les résultats de l'étiquetage indiquent que cette pêcherie exploite un mélange complexe de stocks (S.-O de la Nouvelle-Écosse, golfe Saint-Laurent, ainsi que des soi-disant stocks locaux le long des côtes orientale et méridionale de la Nouvelle-Écosse). À cause de la nature de cette pêcherie exploitant des stocks "hivernant" dans la région (i.e. le mélange complexe de

stocks), une évaluation analytique a semblé hors de propos. Si 1'on considère que les taux de capture ont augmenté et que de jeunes classes d'âge sont apparues dans les prises une augmentation modérée du quota est raisonnable. Cette augmentation ne devrait toutefois pas être de taille à perturber la gestion des stocks pendant les autres phases de leur migration annuelle.

INTRODUCTION

There are two components of the 4Vn herring fishery; a small fixed gear fishery in the spring and early summer months (500 tons per year), and a larger mobile gear fishery on overwintering stocks in the late autumn and early winter months. The "winter" fishery prosecutes predominantly fall spawning fish (Sinclair et al. 1979) but their stock identity has not been clearly identified. The spring-summer fishery has not been well sampled. It is presumed to involve local stocks of both spring and fall spawners. The relationship between the two components of the fishery, if any, has not been established.

Catch and CPUE Trends

The winter fishery, which began in 1969-70, was dominated by foreign fleets for the first two years. Subsequently it has been almost exclusively a Canadian purse-seine fishery. The temporal distribution of the 4Vn herring catches are shown in Table 1 and Figure 1. The initial sharp decrease in mobile gear catch in 1970-71 was due to a decrease in effort; catches improved in 1971-72 and 1972-73. However, the subsequent sharp decrease from 1972-73 to 1978-79 was due to a decline in the abundance of fish. In 1977-78 and 1978-79 the catch was substantially less than the quota (Figure 1). The low 1975-76 catch is believed to have been due at least in part to poor weather conditions. The 1979-80 catch was 2,807 t. The fishery was stopped in early January when the quota of 3,000 t was estimated to have been caught. The fixed gear catches do not parallel the mobile gear catch distribution.

The 1979-80 catch by month and gear type is shown in Table 2. The major portion of the purse-seine quota was taken in a few days in early January. This is anomalous in that historically the catches have almost exclusively occurred before Christmas. Further the traditional mobile fleet fishery in the winter started in the Cape Smokey area in mid-November, then quickly moved to the Bird Island area where the majority of the catch was taken. In mid- to late-December the fishery moved eastward with most catches being taken between New Waterford and Scatarie. The appearance of a substantial body of fish off Ingonish in January is a totally new development in this fishery.

Several catch per unit effort indices have been estimates from the purse-seine logs. In previous assessments only the catch per successul night of fishing has been used. This index is retained, but in addition, catch per night's fishing and catch per set over the last 6 fishing seasons are presented. Since the proportion of the total catch accounted for by the log records is relatively good, the CPUE indices shown in Table 3 and Figure 3 can be considered as representative of the overall winter fishery.

There is a good relationship between "catch per night" and "catch per successful night" but the "catch per set" values have been relatively constant except for during 1978-79. The low CPUE values during 1975-76 are at least partially due to poor weather conditions, which may have influenced the catch per night indices more than the catch per set index. Overall there has been an initial sharp decline in the early seventies followed by a levelling off from 1974-75 to 1977-78, and a sharp decrease in 1978-79. The average catch rates for 1979-80 have rebounded. The monthly breakdown in CPUE shown below indicates that the increase is due to the several days of highly successful fishing in early January.

	Catch per night (t)	Catch per successful night (t)	Catch per set (t)
November	1.3	4	4
December	27.9	39.6	21.9
January	136.3	136.3	44.0

Age Composition

The biological sampling of the purse-seine fishery has been consistently good since 1971-72. The average tons to sample ratio in the 1978-79 and 1979-80 fisheries were respectively 80 and 90. The 1979-80 age composition by month is shown in Table 4. A large proportion of both the catch by numbers (63%) and by weight (41%) was comprised of 3, 4 and 5 year old fish (the birthday is November 1st). There were however a much larger proportion of 6+ fish in January (81% by weight) than before Christmas (17% by weight). The 1975, 1976, and 1977 year-classes are all well represented in the overall catch.

The historical % age compositions (1970-71 to 1979-80) are shown in Figure 4. From 1974 to 1978 the 1970 year-class dominated the fishery. No other year-classes (1971-75) were strongly represented in the catches. During the 1979-80 fishery however, both the 1976 and 1977 year-classes comprised a significant proportion of the catch. Whether this appearance indicates year-class dominance or the appearance of two strong year-classes cannot be yet determined. From the distribution of the 1968 and 1970 year-classes it appears that recruitment is not complete till age 4 or 5. If true the 1977 year-class may be stronger than the 1976. The catch matrix and the mean weights at age are shown respectively in Tables 5 and 6.

Mortality

A cohort analysis was attempted in the 1978-79 assessment (Sinclair et al 1979). Without inclusion of the catches during the other phases of the overall migration the analysis was fruitless and thus not repeated in this evaluation. Total mortality values for the fully recruited ages (5 to 7) were calculated from the CPUE at age data. Two points are of interest. Negative values occurred during

the two upswings of the catch rate curve (Figure 5). (Smoothing of the 1975-76 point does not produce a positive Z values). Second, the Z values (frequently high) do not reflect the effort distribution. It is probable that the major fluctuations in overwintering biomass and the high estimated mortalities are not a result of the fishing mortality in 4Vn, but rather of exploitation pressure on this group during the rest of the year in other fisheries.

Stock Identity of the Winter Fishery?

In an attempt to identify the relationships of the fish caught in the winter fishery with other herring fisheries, tagging has been carried out during the last three fishing seasons (over 18,000 fish tagged). The overall tagging operation could not have been successful without the exceptional cooperation of the purse seine fleet. The results are summarized in Tables 7 and 8.

There are some interesting differences between the three tagging operations.

1. Variable short-term rate of tag returns in the immediate vicinity of the tagging:

   1979-80 - 7.0%
   1978-79 - 1.5%
   1977-78 - 0.3%

   The very high percentage this year may be due to the fixed location of the fishery at this time. The nature of the fishery subsequent to the first part of the tagging operation in December 1979 permits the estimation of population size (N), exploitation rate (u) following the Petersen method (Ricker 1975). Between December 10th and 13th, 4,789 fish were tagged off Ingonish Bay. However, almost immediately 78 tags were recaptured by the purse seiners fishing in that regions. Therefore M (number of fish tagged) equals 4,711. The fishery closed down shortly after the tagging operation for the traditional Christmas Break. This permitted considerable mixing of the tagged fish within the "population" prior to the reopening of the fishery in early January. Three hundred and twelve tags were recaptured (R) prior to the closure of the fishery in mid-January during which time 8,721 million fish were caught (C). Following the Petersen method:

   $N = 131.68$ million fish (± 7.45)
   $u = 0.0662$ (± 0.0038)

   where N is the population abundance and u is the exploitation rate. The mean weight of the fish caught in January was 0.251 kg. Therefore the estimated biomass was 33.05 thousand tonnes ($\pm$ 3.74 x 10^3 t, 95% confidence limits).

2. Higher proportion of tags caught in 4Wa during the same fishing season from the first (1977-78) operation relative to the second (1978-79). These differences could be related to the area of tagging. In the 1977-78 operation, most of the tags were applied in the area between New Waterford and Scatarie, from small catches made close inshore. In the 1978-79 operation, the majority of the tags were applied in the Bird Islands area, the location of the earlier large catches in the 'traditional' mobile fleet fishery. In the 1979-80 operation, the majority of the tags were applied in the Bird Island to Ingonish Bay area. Only 2 tags from the 1979-80 tagging operation were caught in 4Wa (one only 7 days after tagging in 4Vn).

   1977-78 - 69/3063/17274 t (1.30×10^{-6})
   1978-79 - 9/3993/14073 t (1.6×10^{-7})

   Returns to 4Wa a year later were also proportionally different from the two operations.

   1977-79 - 9/3063/14073 t (2.10×10^{-7})
   1978-79 - 2/3993/8000 t (6.86×10^{-8})

3. Long distance returns during the following year were different for the first two operations. From the first operation 15 tags were caught in 4WX from spring to autumn, and only a single tag from the Gulf of St. Lawrence (Souris, PEI). From the second operation 8 tags were caught in 4VWX during the subsequent spring to autumn period, whereas 13 were caught in the Gulf (predominantly the edge). The long distance returns from these operations are shown in Figures 6 and 7.

4. A total of 24 fish tagged in other locations have been caught in 4Vn during the past three seasons; 16 from tagging operations in 4WX and 8 from operations in the Gulf. There has however been significantly more tagging over this period in 4WX. The results are shown in Figure 8 and Table 8.

Several general conclusions can be drawn from the overall tagging results.

1. There is some intermixing of the overwintering fish in 4Wa and 4Vn. This mixing however is not sufficiently important to "homogenize" the weights, since a striking difference in weights-at-age for the two fisheries has been consistently observed (Sinclair *et al*. 1979).

2. There is mixing of Gulf of St. Lawrence and Atlantic coast stocks during overwintering in 4Vn. The proportional respresentation is perhaps variable with time.

3. The winter 4Vn purse seine fishery does prosecute what have been defined as small local stocks in 4VWX.

Management considerations

1. The component stocks, or at least some of them, are being managed in their respective management units without consideration of the fishing mortality incurred in 4Vn. In that the catches have been historically as high as 17,000 t this is of some signficiance.

2. The fishery puts some undefinable pressure on "local stocks" in 4VWX. This might be expected to be more important when the overwintering component from the "major stocks" is low.

3. The fishery generally prosecutes relatively older fish (fully recruited at about age 5) in good market conditions.

4. There are no rigorous biological methods for estimating an appropriate TAC for a fishery such as this.

5. Even though the distributional aspects of the 1979-80 fishery, in both time and space, were somewhat anomalous; the catch rates did rise sharply, the 1976 and 1977 year-classes were prominent, and the quota was caught.

Taking these points into consideration a moderate increase in quota is reasonable but difficult to quantify. It should not be large enough to potentially disrupt the management of the component "major stocks" during other phases of their migration or the continuing catches from the "local stocks". In any case, an improved understanding of the degree of mixing is needed before the degree of disruption can be evaluated. The 4WX herring stock is being managed cautiously in 1980 due to the uncertainty over the 1976 and 1977 year-classes. The same caution should be considered for the 1980-81 4Vn fishery. It is biologically reasonable, taking into consideration points 1 and 2 above, that the TAC for this fishery should be kept at a minimal level (say 5,000 t) even during periods of high catch rates. In time an alternate biologically acceptable approach may be to allow the TAC to follow the catch rate trends but this yield will be lost (and accounted for) from the other management units.

REFERENCES

Ricker, W.E. 1975. Computation and interception of biological statistics of fish populations. Bull. Fish. Res. Board Can. 91, 382 p.

Sinclair, M., W. Stobo and A. Sinclair. Status of 4Vn herring fishery 1978-79. CAFSAC Research Document 79/40.

Table 1. Annual (Oct-Oct) herring landings (t) in 4Vn

	1962-63	63-64	64-65	65-66	66-67	67-68	68-69	69-70	70-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80
Canadian Fixed Gear	503	408	200	94	298	235	235	82	138	164	126	213	226	74	110	307	329	
Canadian Mobile Gear							2044	5342	2917	10036	17537	16285	14298	7947	12831	7879	3332	2807
Foreign Mobile Gear			18		17		11465	11050	344	1	10	588	270	188				
Total Mobile Gear			18		17		13509	16392	3261	10037	17547	16873	14568	8135	12831	7879	3332	2807

Table 2. Seasonal distribution of herring catch by gear type in 4Vn

	1978						1979									1980
	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	
Purse Seine	241	3091											6.6	621.2	2179	
Trap						10.8	15.2	19.8	6.8							
Drift Gillnet						88.7	78.0	31.2	3.6				2.3			
Set Gillnet							51.7	12.6								
Unspecified						8.8										

Table 3. CPUE Indices for the 4Vn Herring Purse Seine Fishery

Year	Catch (t) per successful night	Catch (t) per night	Catch (t) per set	% Catch accounted for by logs
71-72	115[1]			
72-73	94[1]			
73-74	79[1]			
74-75	76[1]	70[2]	38[2]	74[2]
75-76	55[2]	35[2]	36[2]	51
76-77	77[2]	61[2]	38[2]	80
77-78	70[2]	39[2]	35[2]	65
78-79	24[2]	11[2]	10[2]	38
79-80	80[2]	61[2]	36[2]	65

[1]From previous assessments

[2]From re-analysis of logs

Table 4. 4Vn Herring Catch-at-age ($x10^{-3}$) for the 1979-80 Purse Seine Fishery

	Age[1]								
	2	3	4	5	6	7	8	9	10	11+
December	--	1346	1929	496	126	54	45	21	49	75
% numbers	--	33	47	12	3	1	1	<1	1	2
% weight	--	22	46	15	4	2	2	1	3	5
January	--	1763	1425	1140	600	931	551	836	814	661
% numbers	--	20	16	13	7	11	6	10	9	6
% weight	--	8	10	11	7	12	8	14	15	13
Total	--	3109	3354	1636	726	985	596	857	863	736
% numbers	--	24	26	13	6	8	5	7	7	6
% weight	--	11	18	12	7	10	7	11	12	11

[1]Birthday November 1st

Table 6. 4Vn Herring weights-at-age from Purse Seine Fishery

	Weight (gm)	
Age	1978-79	1979-80
3	99	103
4	175	152
5	220	207
6	243	255
7	273	289
8	307	324
9	346	366
10	378	400

Table 5. Catch-at-age Matrix.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
2	0	0	10	41	151	1	0	0	0	0
3	295	1994	8372	308	6190	667	16	7	23	3109
4	201	4288	6117	40206	4935	1544	2986	110	441	3354
5	3169	3283	10745	13100	39265	1846	5103	2377	1415	1636
6	2253	5062	4727	4078	7582	7840	4136	2800	1444	726
7	2049	3659	8855	2721	2785	2570	17602	1442	879	985
8	2712	6530	6067	2921	2711	1122	8379	7623	848	596
9	570	4214	8490	2617	2735	892	3401	4056	1703	857
10	913	4027	8418	3546	3599	1005	2431	1202	1840	863
11+	877	9783	8071	4582	6531	3411	5451	3098	1889	736

Table 7. Tagging Recapture Summary for 4Vn Fishery

Recaptures from 4789 herring tagged in Subdiv. 4Vn Dec 10 - 13, 1979

Recapture Location	Dec. 11 - 13, 1979	Jan 1 - 9, 1980
Subdiv 4Vn	78	312

Recaptures from 6312 herring tagged in Subdiv. 4Vn Jan 3 - 7, 1980

	Jan. 3-9, 1980	Jan. 14, 1980
Subdiv 4Vn	359	-
Subdiv 4W	-	2

Recaptures from 3993 herring tagged in Subdiv. 4Vn Nov 9 - Dec 2, 1978

Recapture Location	Nov 9 - Dec 31/78	Jan 1 - Mar 30/79	Apr 1 - July 31/79	Aug 1 - Oct 31/79	Nov. 1 - Feb 5/80
Subdiv 4Vn	62	-	2	-	67
Subdiv 4Wa	4	5	5	-	2
Hfx. St. Marys	-	-	-	1	1
N.S. Fundy Shore	-	-	1	1	-
Shippegan	-	-	-	1	1
Edge (4TF)	-	-	10	-	-
P.E.I., Souris (4TG)	-	-	-	1	-
St. Georges Bay (4RD)	-	-	1	-	-

Recaptures from 3063 herring tagged in Subdiv 4Vn Nov 26 - Dec 15, 1977

	Nov 26 - Dec/77	Jan 1 - Mar 31/78	Apr 1 - July 31/78	Aug 1 - Oct 31/78	Nov 1 - Mar 31/79	Apr 1 - July 31/79

Recaptures from 3063 herring tagged in Subdiv 4Vn Nov 26 - Dec 15, 1977

Recapture Location	Nov 26 - Dec /77	Jan 1 - Mar 31/78	Apr 1 - July 31/78	Aug 1 - Oct 31/78	Nov 1 - Mar 31/79	Apr 1 - July 31/79	Aug 1 - Oct 31/79	Nov 1 - Mar 31/80
Subdiv 4V	8	2	-	-	14	-	-	1
Subdiv 4Wa	-	69	-	-	9	-	-	-
Hfx-St. Marys Bay	-	-	10	3	-	-	-	-
N. S. Fundy Shore	-	-	2	-	-	-	-	-
Edge (4TF)	-	-	-	-	-	1	-	-
Souris P.E.I. (4TG)	-	-	-	1	-	-	-	-
St. Georges Bay (4RD)	-	-	-	-	-	1	-	-

Table 8. Recaptures within 4Vn of Herring Tagged in other Areas

Tagging Location	Date	Winter 77-78	Summer 78	Winter 78-79	Summer 79	Winter 79-80
Campobello Island	July/74	-	1	-	-	-
Southwest N.S.	Aug/74	-	-	-	-	1
Magdalen Islands	May/76	-	-	-	-	1
Gaspe Coast	Aug-Sept/76	2	-	2	-	-
Southwest N.S.	Aug-Sept/77	-	-	4	-	1
Subdiv 4Wa	Jan/78	-	-	1	-	-
Souris PEI	Oct/78	-	-	1	-	2
Subdiv. 4Wa	Dec/78	-	-	-	-	8

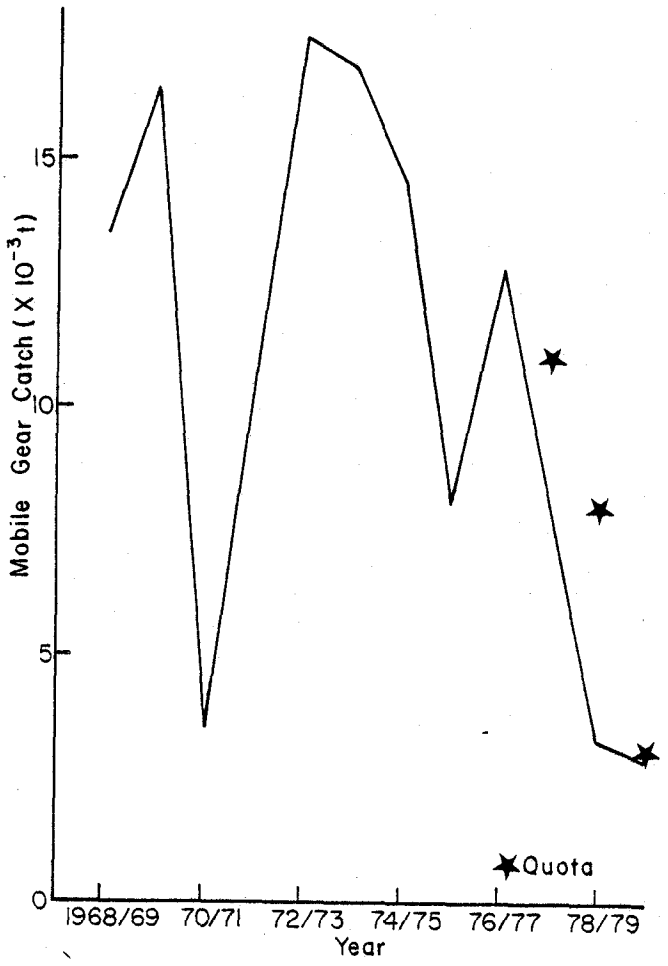

Figure 1. 4Vn mobile gear winter herring catch.

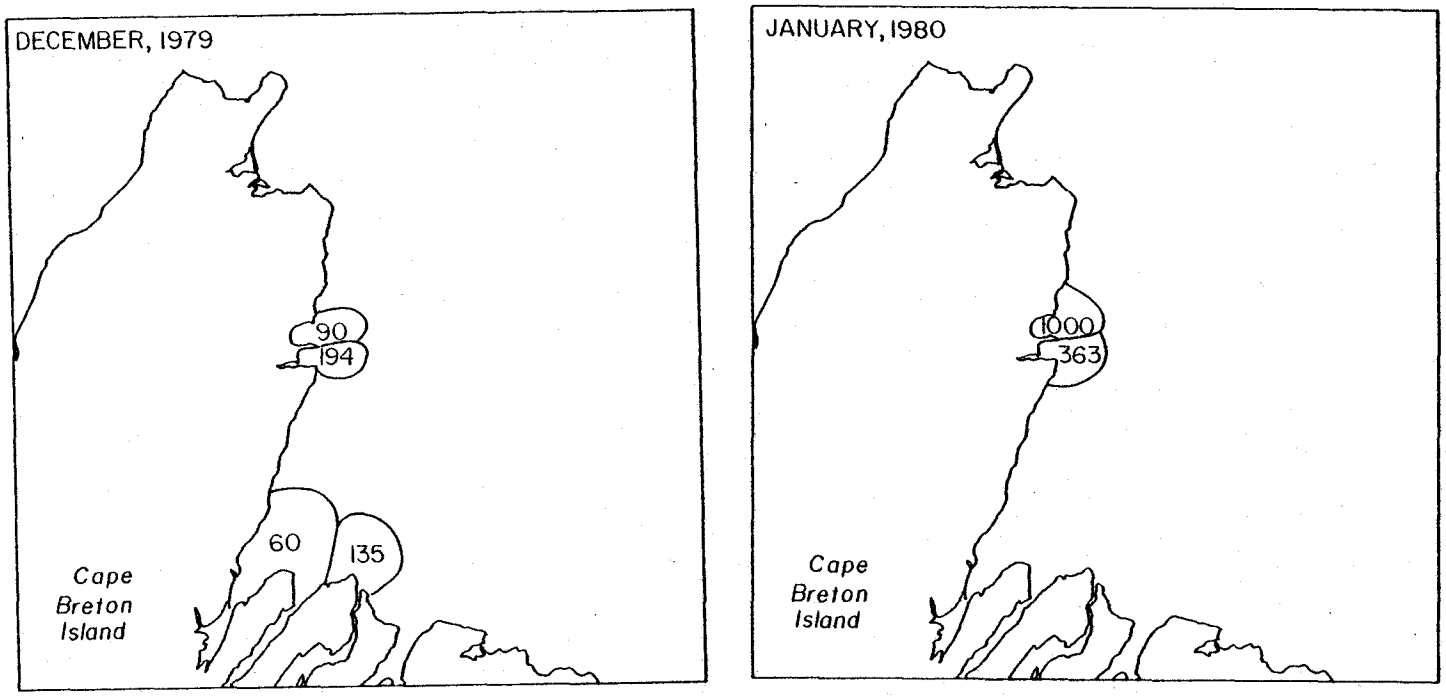

Figure 2. Geographical distribution of 1979/80 winter herring catch (numbers indicate catch in metric tons).

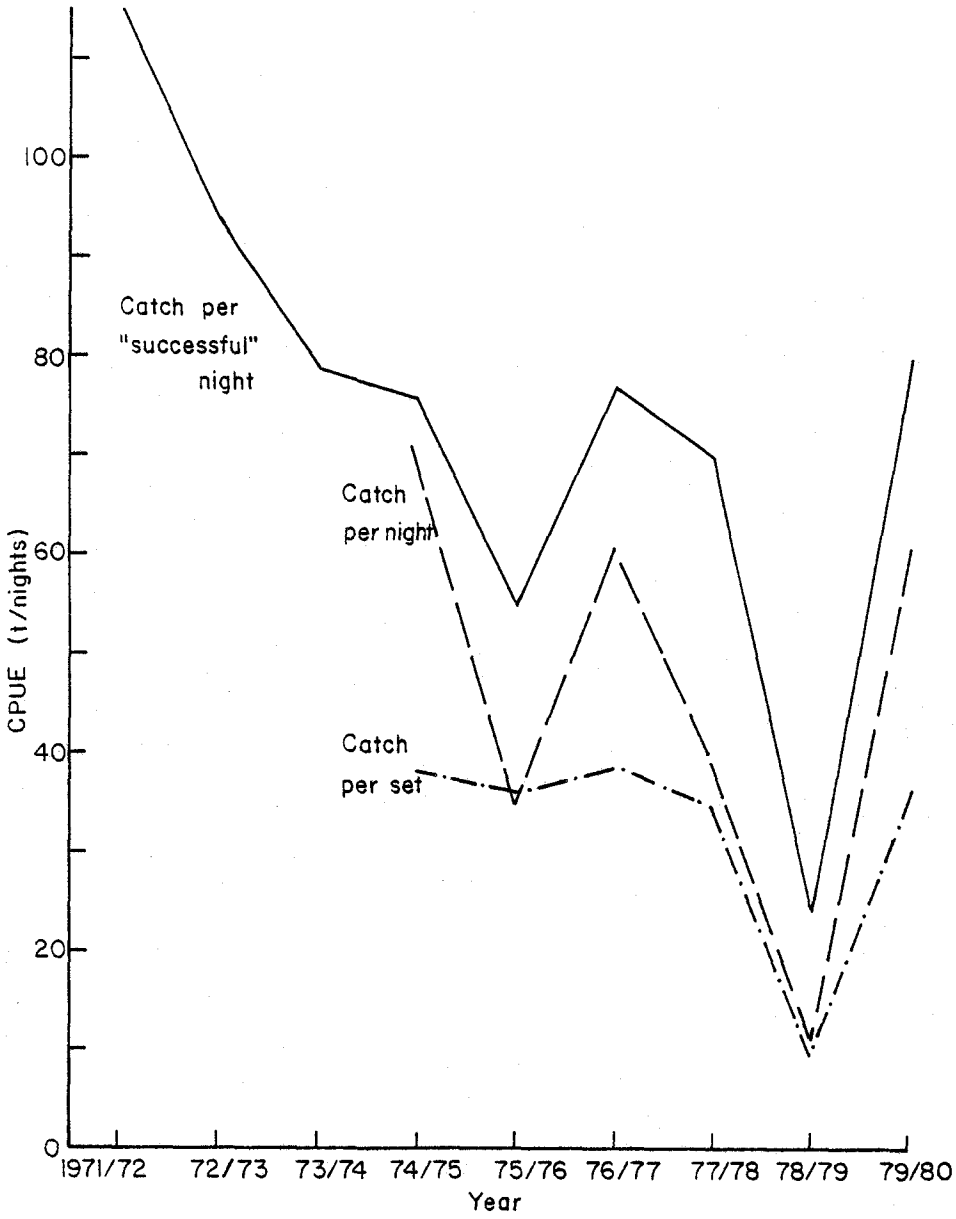

Figure 3. Catch per unit effort trends for the 4Vn winter herring fishery.

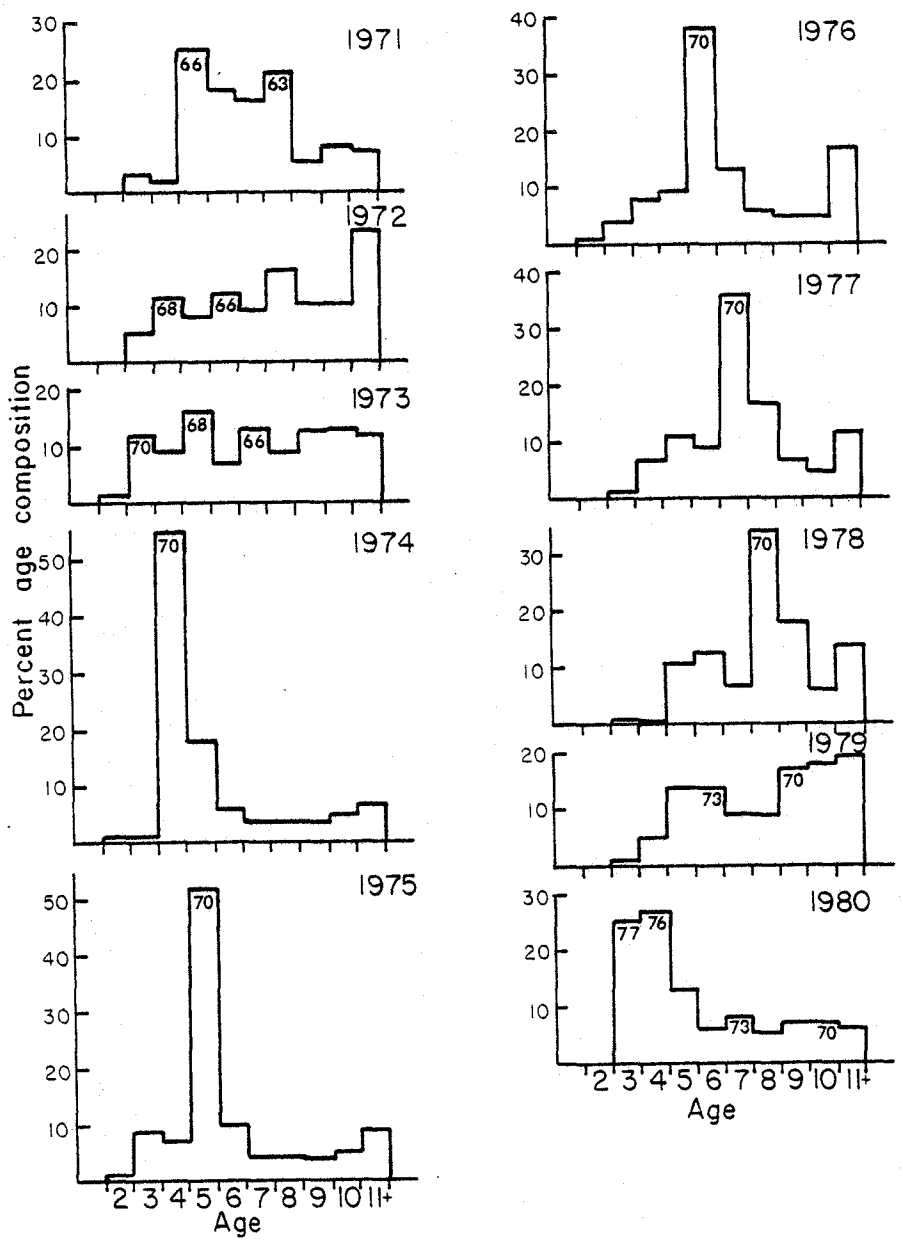

Figure 4. Age composition (%) of the 4Vn winter herring fishery, 1970-71 to 1979-80.

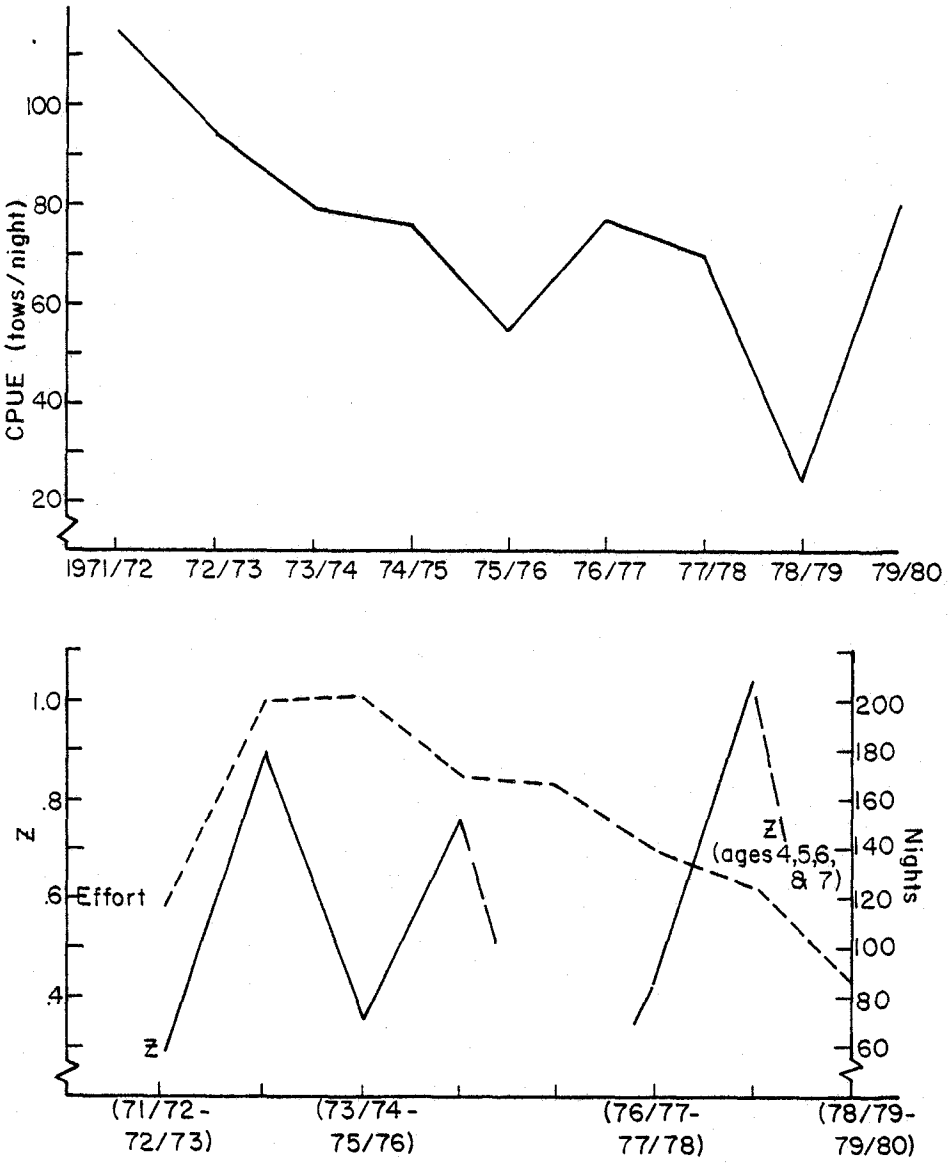

Figure 5. Total mortality estimates (Z) for the 4Vn winter herring fishery.

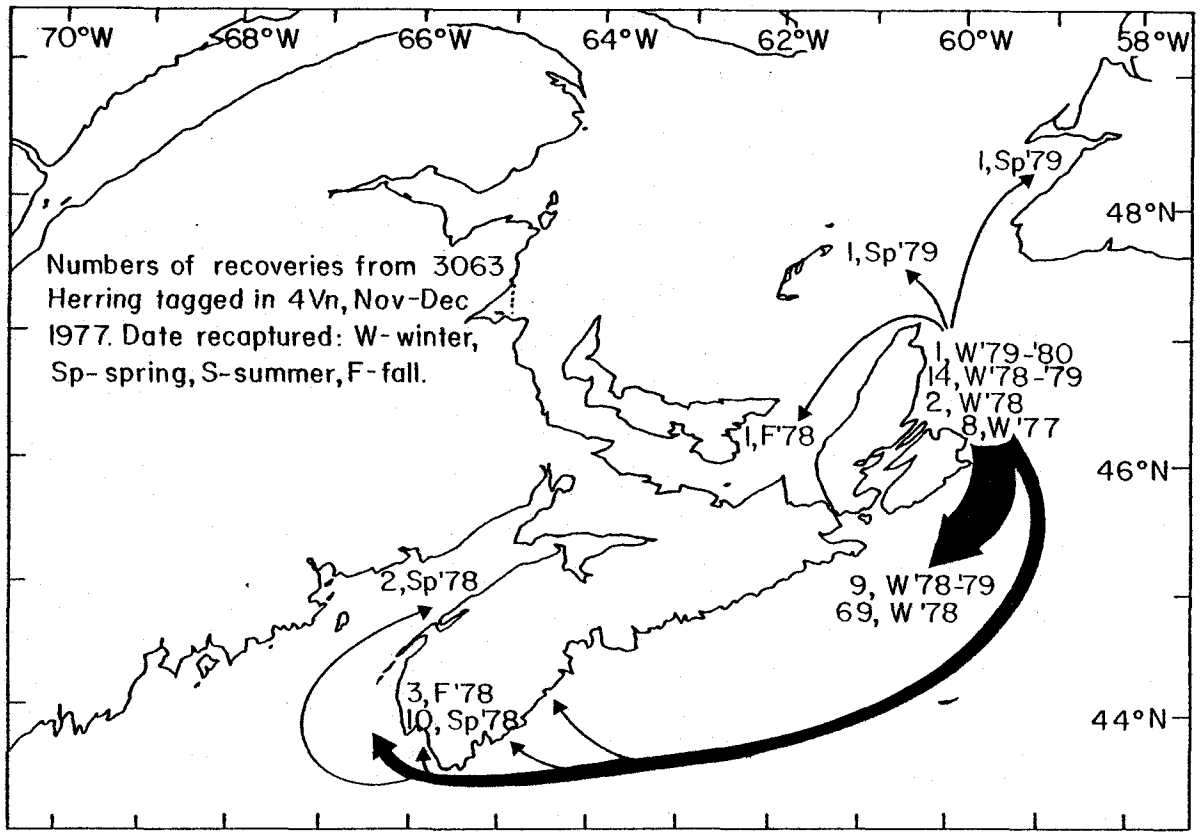

Figure 6. Recaptures from 3063 herring tagged in 4Vn, Nov-Dec 77

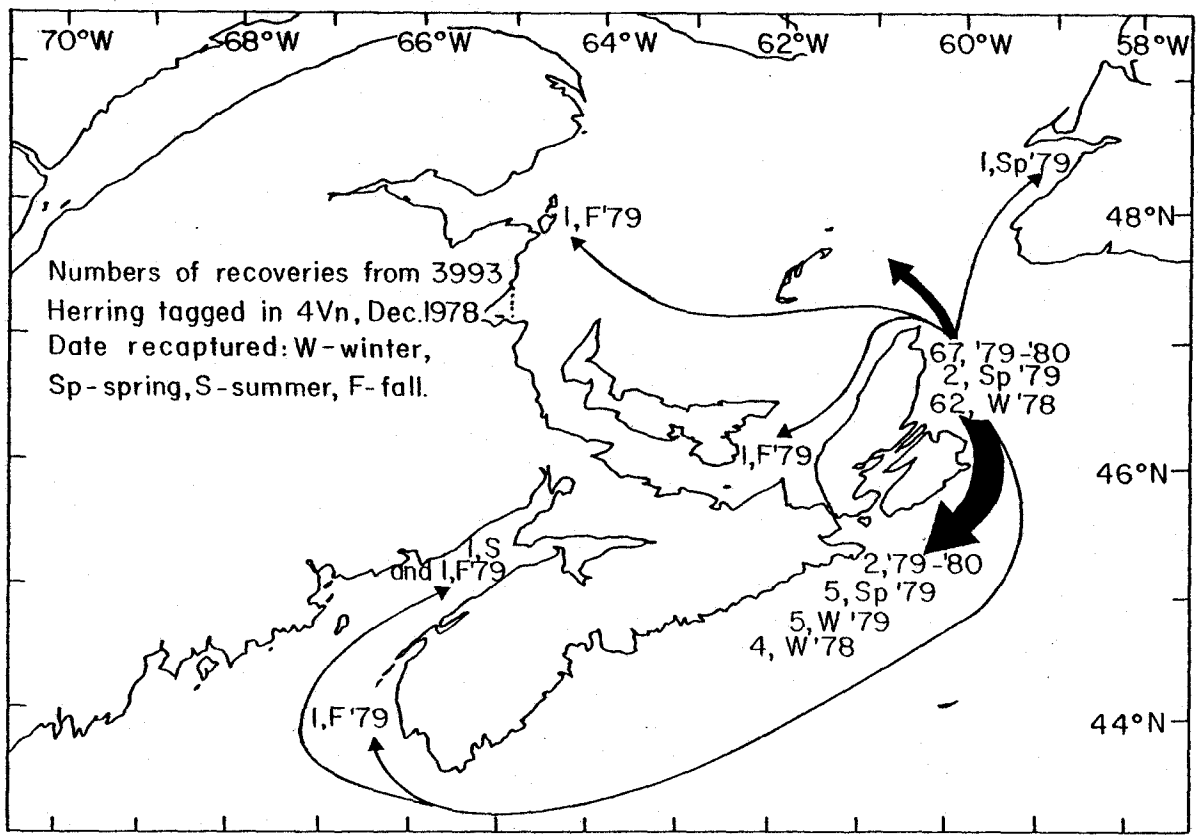

Figure 7. Recaptures from 3993 herring tagged in 4Vn December 1978

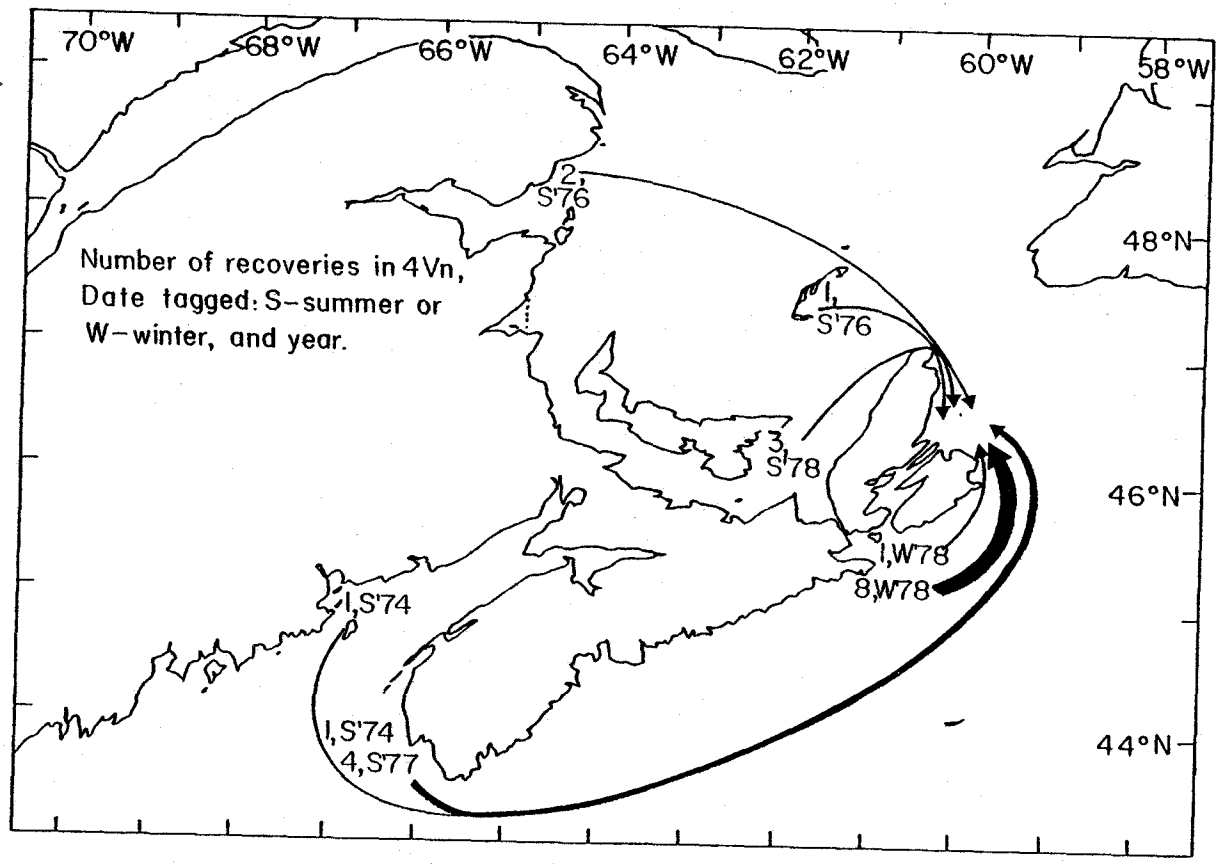

Figure 8. Recaptures within 4Vn of herring tagged in other areas