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Atlantic herring on the Nova Scotia Shelf:
Results of population studies from ICNAF Subdivisions 4Vn and 4Vs

by

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1. Introduction.

Our knowledge on the different herring populations of the West Atlantic has rapidly progressed during the past few years and now, the limits of the different stocks as well as their relations one to another begin to be known. There are still many points to be clarified however ; for instance as TIBBO and ILES (1970) supposed a migration of herring in april from the Chedabucto Bay, or the Banquereau towards the southern part of the Gulf of St Lawrence, PARSONS and HODDER (1971 a and b) and PARSONS (1973) on the basis of the variations of infestation by the nematode "Anisakis" larvae according to the regions, and the different meristic characteristics, suggested that an inshore-offshore migration of the herring of the East of the Nova Scotia shelf takes place with no mixing, or nearly so, with the stocks of the Gulf of St Lawrence and of the South coast of Newfoundland.

According to MESSIEH (1974) the herring samples from the East coast of Cape Breton Island (ICNAF division 4 Vn) differ from the ones of the Chedabucto-Canso region by their age composition, average lengths of the age groups and their meristic characteristics. According to DECAMPS and BRIAND (1974), the spring spawning herrings captured in the division 4 Vn are to be considered as belonging to the stocks of the South of the Gulf of St Lawrence (division 4 T). FOREST and BRIAND (1975) came to the same conclusion, more the autumn spawning herrings of the division 4 V are different from the ones of the Gulf of St Lawrence and there seem to be some relations between the herrings of the division 4 Vn and 4 Vs, as STOBO and col. (1973) suggested. Finally, STOBO (1975, 1976 b) using the results of a tagging experiment showed that the herring population of division 4 Wa is to be attached to the ones of the divisions 4 Wb-4 X.

During the ICNAF annual meeting in 1975, the STACRES decided to consider the herring in 4 V as one unique stock, although they did not have a great deal of informations on it.

The purpose of this paper is to bring a few supplementary data on the herring of the division 4 V and its relations with the nearby stocks.

2. Methods and study areas.

From the 15 to the 31 of march 1976, micro-wave sonar prospections and trawlings were made on board the R/V CRYOS on the N-E part of the Nova Scotia banks (division 4 Vn - 4 Vs and N-E of 4 Wa, fig.1). Tows of 1/2 hour long were made using a Lofoten trawl with sweeps and carlings and a codend of 50 mm meshes.

After each tow, a thermic profil from the surface to the bottom was taken using a XBT in order to know the thermic condition of the environment. All together, 30 tows were made and 9,300 kg of herring captured.

The whole of each catch, or only a sample when the catch was too big, was weighed, then measured to the inferior centimeter. All together, 4,700 individues spread into 18 samples were measured in order to determine the length composition of the catches. 15,000 fishes spread on the whole of the study area were also measured to the millimeter and taken for biological characteristics study (weight, meristic characteristics, sex, gonadosomatic ratio (G.S.R.), etc...) in the laboratory.

The meristic characteristics counting technics has been described by DECAMPS (1971), the keeled scales counting (K2) is done starting from the insertion point of the dorsal fin to the anus ; rays of dorsal, pectoral and anal fins are counted through binoculars, so are the gill rakers (inferior limit of the first left branchial arch) ; urostyle is not taken in consideration in the counting of vertebrae.

The G.S.R. is used to determine the state of maturity of the fishes and to separate the spring spawning herrings from the autumn spawning ones. The means of the different meristic characteristics were determined for the spring spawning herrings and the autumn spawning herrings, juveniles being excluded in this analysis.

3. Results.

3.1. Yield.

Three areas can be distinguished :

- The east shores of the Banquereau were prospected but no herring detections were recorded. The southern shore of this bank was also prospected without any results. No herring was caught in any of the five tows that were made (stations 1 to 5, fig. 1).

- North of Artimon and Misaine banks and east of Canso bank, considerable concentrations of herring were detected and catches of more than 3,000 kg/half-hour were made at 170 to 180 meter depths (stations 6 to 22). Catches were of 8,935 kg representing around 63,400 individuals in this area. The most considerable catches were made at temperatures of around 1.5° C, which is definitely lower than the ones reported by SOLDAT (1976) at same depths.

- The whole of the east shores of Cape Breton Island were prospected up to the ice limit to the north, and no herring was detected ; a few catches, mostly of less than 100 kg were made through at around 170 m depth (stations 23 to 30) ; for the whole of the area they come up to 327 kg that is to say 1,737 individuals.

3.2. Length composition of catches.

In order to ease the study, the trawling stations were grouped according to geographic zone and the length composition of the catches made on the east shores of Cape Breton (stations 23 to 30) was compared to the one of the herring coming from north of the Banquereau (stations 6 to 22) (fig. 2).

The analysis of the modal lengths was eased by using CASSIE's method (1954). Three groups are found in each of the two areas. The first has an average length of around 24 cm, and represents approximately half of the catch in numbers of individuals (Cape Breton : average length 24.1 cm, 44 p.cent of total number of individuals caught ; North of Banquereau : average length 23.7 cm, 52 p.cent of the total). A second group, less considerable in number of individuals (20 p.cent in both cases) has an average length of 28.2 cm for the Cape Breton sector, and 28.0 cm for the North of Banquereau. At last, the third group represents 28 p.cent of the total number of individuals caught in Cape Breton (average length : 32.7 cm) and 21 p.cent of the ones caught North of the Banquereau (average length : 31.6 cm). A fourth mode can be noticed, well distinct

in the Cape Breton catches (average length : 37.8 cm, 5 p.cent of the total of individuals) and that, using CASSIE's method, we find in the length distribution of the catches of North Banquereau although poorly represented (average length : 38.4 cm, less than 1 p.cent of the total of individuals). Also on the North of the Banquereau small individuals (less than 20 cm total length) were found but in small quantities (less than 1 p.cent of catches in number of individuals of this area).

According to STOBO (1974, 1975, 1976 a) the 1970 age class is one of the most important among the canadian herring catches : it is probably the individuals of this class which constitute the essential of the 32 cm mode ; a second class appears to be also important in our catches : it is the 1973 class, which probably constitute the essential of the 24 cm mode. As it is shown by its average length, the 28 cm mode is constitute of a mix up of individuals of the 1971 and 1972 class, but the method used does not permit a separation between them.

Therefore the length composition of catches made on the east shores of Cape Breton Island and North of Banquereau does not show fundamental differences neither by the position of the mode nor by the relative proportions of each of them.

3.3. State of gonads development.

The G.S.R. values'frequency distribution are presented for each sex in fig. 3. The juveniles represent an important part of the captures : for both sexes, 24 p.cent of the individuals caught, in each of the sectors are juveniles (G.S.R. $< 0,5$).

For most of them, the adults caught are in state of sexual rest ($0,5 < \text{G.S.R.} < 7$). The majority of the captures is therefore constituted by autumn spawning herring, as it is for the canadian commercial catches (STOBO, 1975). However, the spring spawning herring proportion (G.S.R. > 7) is higher in the Cape Breton catches (18 p.cent) than in the ones of the North of Banquereau (2.5 p.cent). We can notice however that the majority of spring spawning herring has been caught during the trawling station 20, that is to say in the northern limit of our study area.

3.4. Meristics characteristics study.

For each station where samples were taken (11 in all) the number of individuals examined, the average and variance of the characteristics counted are given in table 1 for spring spawning and autumn spawning herring. Fig. 4 gives the population averages estimations at a 99 p.cent security rate.

The comparison of the averages was made by a variance analysis test (FISHER's F. test) and the zero hypothesis tested for $p = 0.01$.

For the whole of the characteristics studied, except the gill rakers, the test doesn't show differences among the autumn spawning herring.

The gill racker test is more complex. IREFPT (1958) showed that there was a relation between the length of the individuals and the average number of gill rakers ; this relation was computed for the stations where juveniles were presents ; the graph is given on fig. 5.

Between 25-30 cm, the number of gill rakers is again related to the length of the individuals. Therefore it is difficult to draw conclusions from the test because the variations in the average number of gill rakers could be due to variations of the length composition of the samples.

The averages of the meristics characteristics for the spring spawning herring caught in the Cape Breton area were also computed (table 2).

Although their number is low (36) we can notice that the computed values are close to those considered as characteristics by MESSIEH (1975) for the spring spawning herring of the Gulf of St Lawrence and which he uses in his discriminant function (Pectorale : 17.301 - Dorsal : 19.203 - Gill rakers : 46.102). On the other hand, they are distinctly different from the values obtained by DECAMPS and BRIAND (1973) on the south of Banquereau, particularly for the K2 value (13.900 to 14.075), the pectoral (18.000 to 18.100), the anal (17.950) and the gill rakers (48.974 to 49.000).

4. Conclusion.

It seems that the samples that we studied, caught in march in the divisions 4 Vn and 4 Vs, can be split into two groups :

- on one hand, the autumn spawning herring, largely dominant in the captures, and which don't seem to show differences neither in the length composition nor in their meristic characteristics and of which large concentrations were found north of the Artimon and Misaine banks, but that we also find north of the division 4 Vn.

- on the other hand, the spring spawning herring, in very small number, caught in north of division 4 Vn, which seem to be clearly distinguished from the spring spawning herring of the Banquereau and can be attached to the stocks of the South of Gulf of St Lawrence.

References

- CASSIE (R.-H.), 1954.- Some uses of probability paper in analysis of size frequency distributions. Austr. J. Mar. Freshw. Res., 3 (2) : 170-198.
- DECAMPS (Ph.), 1971.- Study of the biological characteristics of spring and autumn herring taken off Cape Breton Island and Burgeo Bank. Ann. Meet. Int. Comm. Northw. Atlant. Fish., Res. Doc. n° 71/40 : 6 p. (mimeographed).
- DECAMPS (Ph.) and BRIAND (D.), 1974.- Results of studies on herring of the Gulf of St Lawrence and Banquereau and Georges banks. Ann. Meet. Int. Comm. Northw. Atlant. Fish., Res. Doc. n° 74/58 : 12 p. (mimeographed).
- FOREST (A.) and BRIAND (D.), 1975.- Supplementary data on meristic characteristics of herring (Clupea harengus harengus L.) stocks of the southern part of the Gulf of St Lawrence, the southern coast of Newfoundland and Banquereau Bank. Ann. Meet. Int. Comm. Northw. Atlant. Fish., Res. Doc. n° 75/30 : 13 p. (mimeographed).
- HODDER (V.M.) and PARSONS (L.S.), 1971 (a).- Some biological Features of Southwest Newfoundland and Northern Scotian Shelf Herring stocks. Res; Bull. Int. Comm. Northw. Atlant. Fish. n° 8 : 67-73.
- ILES (T.D.) and TIBBO (M.S.), 1970.- Recent events in canadian Atlantic herring fisheries. Int. Comm. Northw. Atlant. Fish., Redbook 1970, part III : 134-147.

- KREFFT (G.), 1958.- Counting of gill rakers as a method of morphological herring investigations, in contributions to special herring meetings 1956 on herrings "races". Cons. int. Explor. Mer, Rapp. et P.V., 143 part II : 22-25.
- MESSIEH (S.N.), 1974.- The structure of Herring populations on the Atlantic coast of Cape Breton Island, ICNAF division 4 Vn and division 4 Wa. Ann. Meet. Int. Comm. Northw. Atlant. Fish., Res. Doc. n° 74/62 : 14 p (mimeographed).
- MESSIEH (S.N.), 1975.- Delineating spring and autumn Herring populations in the Gulf of St Lawrence by discriminant function analysis. J. Fish. Res. Bd Canada, 32 (4) : 471-477.
- PARSONS (L.S.), 1973.- Meristics characteristics of Atlantic Herring, Clupea harengus harengus L., stocks in Newfoundland and adjacent waters. Res. Bull. Int. Comm. Northw. Atlant. Fish., n° 10 : 37-52.
- PARSONS (L.S.) and HODDER (V.M.), 1971 b.- Variation in the incidence of larval nematodes in herring from canadian Atlantic waters. Res. Bull. Int. Comm. Northw. Atlant. Fish., n° 8 : 5-14.
- SOLDAT (V.T.), 1976.- Distribution of herring from the Nova Scotia Shelf. Ann. Meet. Int. Comm. Northw. Atlant. Fish. Res. Doc. n° 76/I/1 : 13 p (mimeographed).
- STOBO (W.T.), 1974.- The Canadian 4 Vwa herring fishery : analysis of the 1973-74 catch, and the distribution of fishing activity and catch per unit effort from 1971-74. Ann. Meet. Int. Comm. Northw. Atlant. Fish., Res. Doc. n° 74/95 : 17 p (mimeographed).
- STOBO (W.T.), 1975.- The 1974-75 Canadian Cape Breton (4 Vwa) herring fishery. Ann. Meet. Int. Comm. Northw. Atlant. Fish., Res. Doc. n° 75/39 (Revised) : 12 p (mimeographed).
- STOBO (W.T.), 1976 a.- Canadian herring fishery in division 4 V. Ann. Meet. Int. Comm. Northw. Atlant. Fish., Res. Doc. n° 76/VI/22 : 2 P (mimeographed).

STOBO (W.T.), 1976 b.- Movements of herring tagged in the Bay of Fundy. Update. Ann. Meet. Int. Comm. Northw. Atlant. Fish., Res. Doc. n° 76/VI/48 : 16 p (mimeographed).

STOBO (W.T.), HUNT (J.J.) and ILES (T.D.), 1973.- A preliminary report on the herring fisheries in ICNAF Divisions 4 V and 4 Wa. Ann. Meet. Int. Comm. Northw. Atlant. Fish., Res. Doc. n° 73/94 : 20 p (mimeographed).

Tabl. 1 - Numbers of examined fishes (N), means (m) and standard deviations (S.D.) for meristic characteristics of autumn spawning Atlantic herring from various areas.
 K2 - Keeled Scales D = Dorsal fin rays P = Pectoral fin rays A = Anal fin rays V = Vertebrae G = Gill rakers

	9	10	13	15	16	17	21	22	24	25	29	F
N	141	28	85	68	98	150	96	96	70	68	72	
m	14.163	13.929	14.082	14.074	13.980	13.947	13.948	14.042	14.229	13.897	14.014	1.31
S.D.	0.803	0.566	0.617	0.539	0.571	0.757	0.716	0.707	0.748	0.622	0.625	
N	142	29	85	68	100	150	95	96	70	68	72	
m	19.444	19.621	19.376	19.544	19.520	19.533	19.495	19.552	19.557	19.603	19.694	1.46
S.D.	0.303	0.511	0.399	0.336	0.370	0.382	0.460	0.435	0.390	0.357	0.518	
N	142	29	85	68	99	150	96	96	70	67	72	
m	18.430	18.517	18.529	18.603	18.768	18.627	18.583	18.583	18.471	18.582	18.556	1.19
S.D.	0.752	0.870	0.673	0.563	0.805	0.607	0.618	0.618	0.735	0.721	0.636	
N	138	27	85	68	98	150	95	96	70	68	72	
m	18.123	18.074	18.176	18.162	18.245	18.180	18.105	18.146	18.071	18.279	18.278	0.58
S.D.	0.760	0.513	0.804	0.665	0.654	0.641	0.599	0.541	0.809	0.584	0.673	
N	141	29	85	68	99	150	95	95	70	67	72	
m	55.539	55.172	55.518	55.397	55.475	55.380	55.537	55.505	55.514	55.473	55.694	1.66
S.D.	0.504	0.419	0.579	0.534	0.431	0.516	0.628	0.482	0.507	0.667	0.657	
N	142	29	81	68	99	149	96	96	70	68	71	
m	49.211	48.897	48.753	49.147	49.343	49.691	49.146	48.823	49.057	48.926	48.563	3.31
S.D.	3.082	2.989	2.902	2.008	2.670	2.482	2.750	2.896	3.625	4.156	4.274	

Tabl. 2 - Numbers of examined fishes (N) means (m) and standard deviations (S.D.) for meristic characteristics of spring spawning Atlantic herring from station 28.

K2 = Keeled Scales D = Dorsal fin rays P = Pectoral fin rays
 A = Anal fin rays V = Vertebrae G = Gill rakers.

	K2	D	P	A	V	G
N	36	36	36	36	36	36
m	13.444	19.278	17.167	17.639	55.139	45.639
S.D.	0.525	0.256	0.583	0.508	0.508	2.286

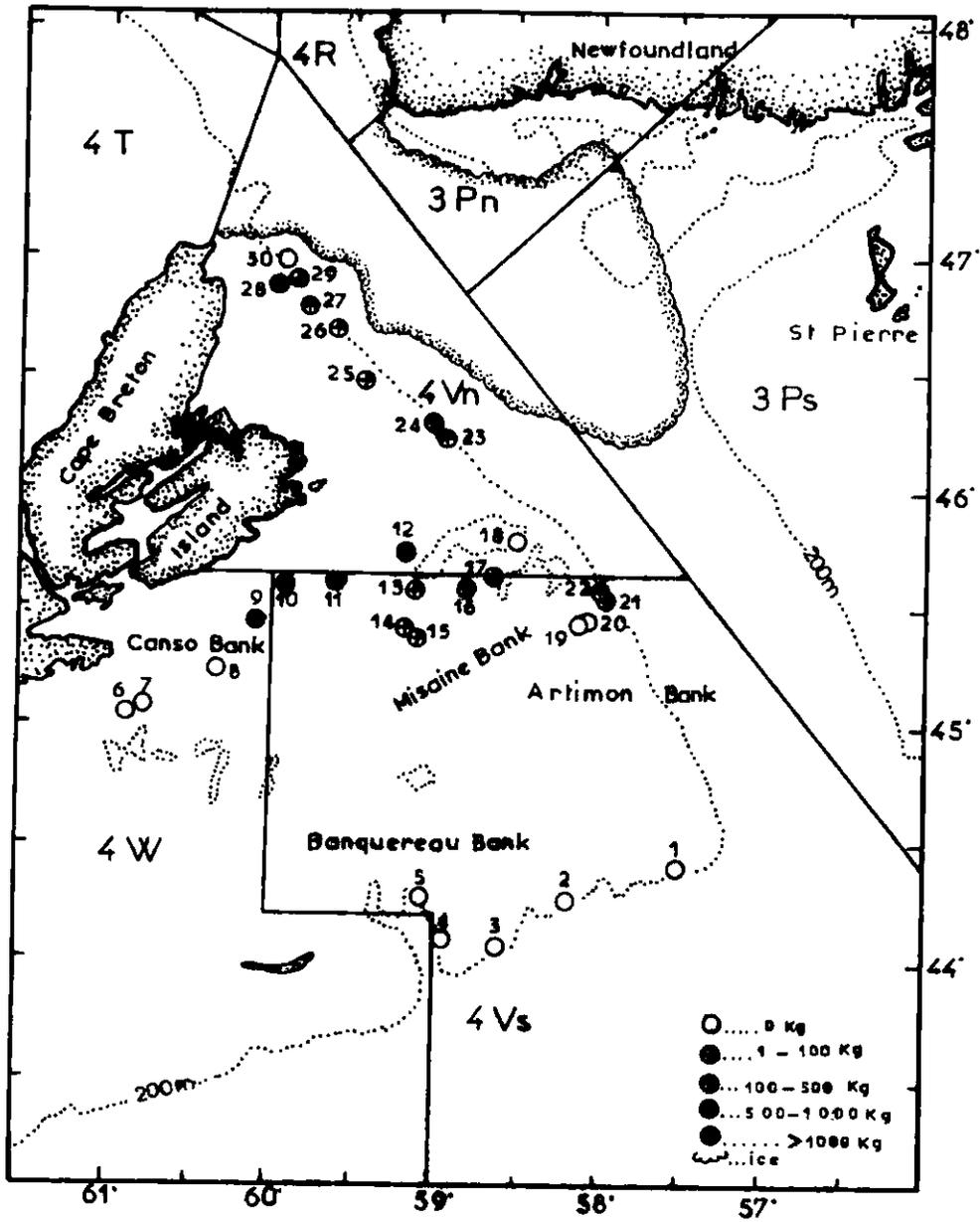


Fig. 1.— Map showing location of stations during the cruise of R/V 'CRYOS' (march 15 to 31 1976)

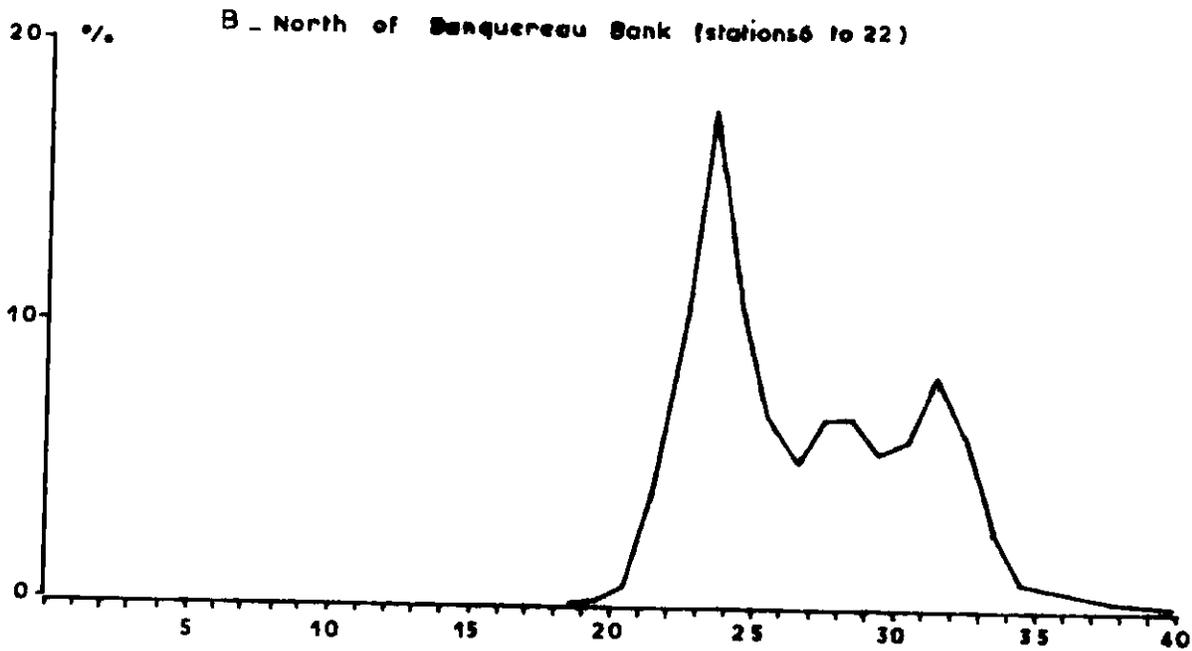
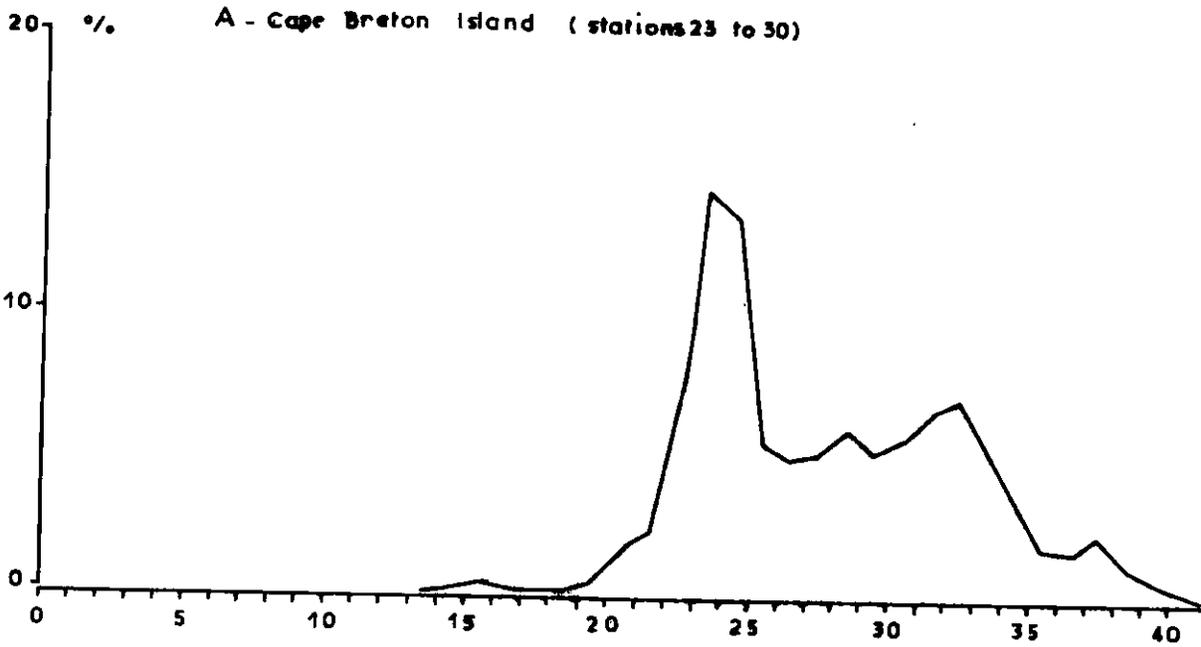


Fig. 2. Length frequencies of herring from Cape Breton Island area and North Banquereau Bank (March 1976).

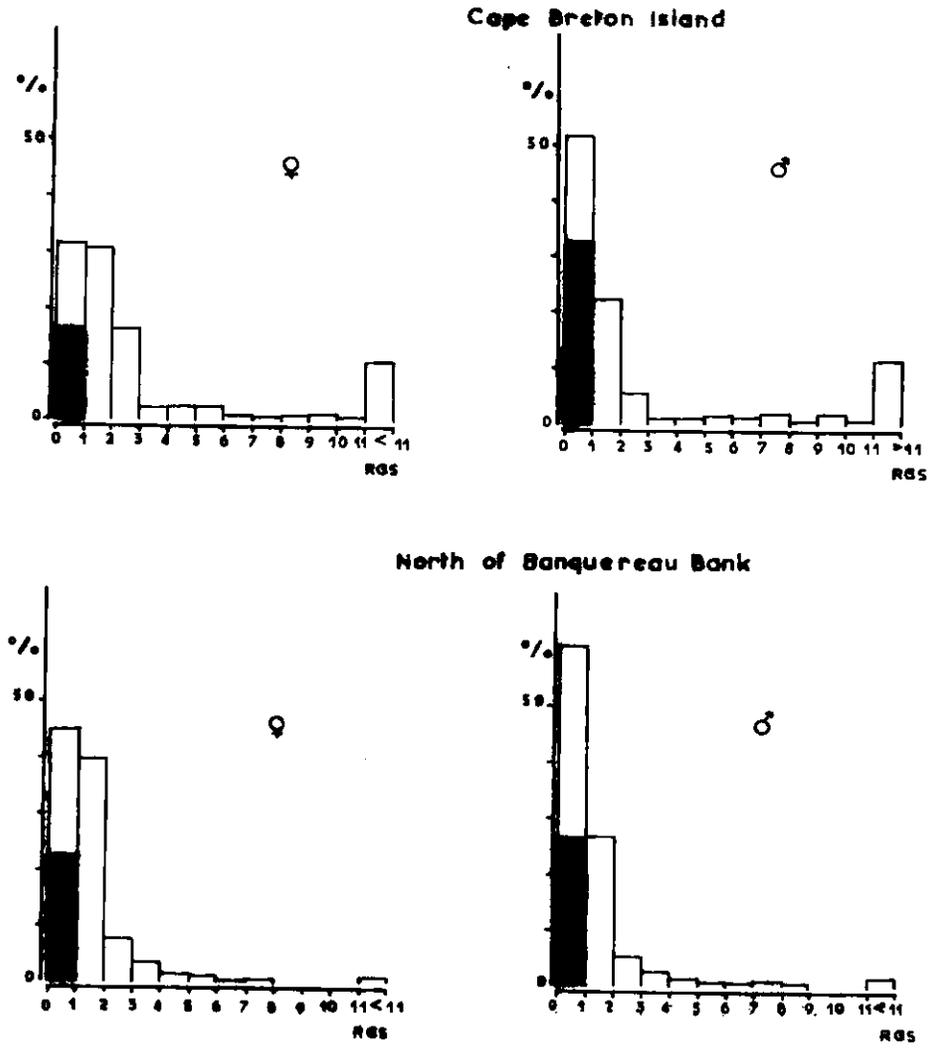


Fig. 3. Gonadal development of herring from Cape Breton Island area and North Banquereau Bank (March 1976).

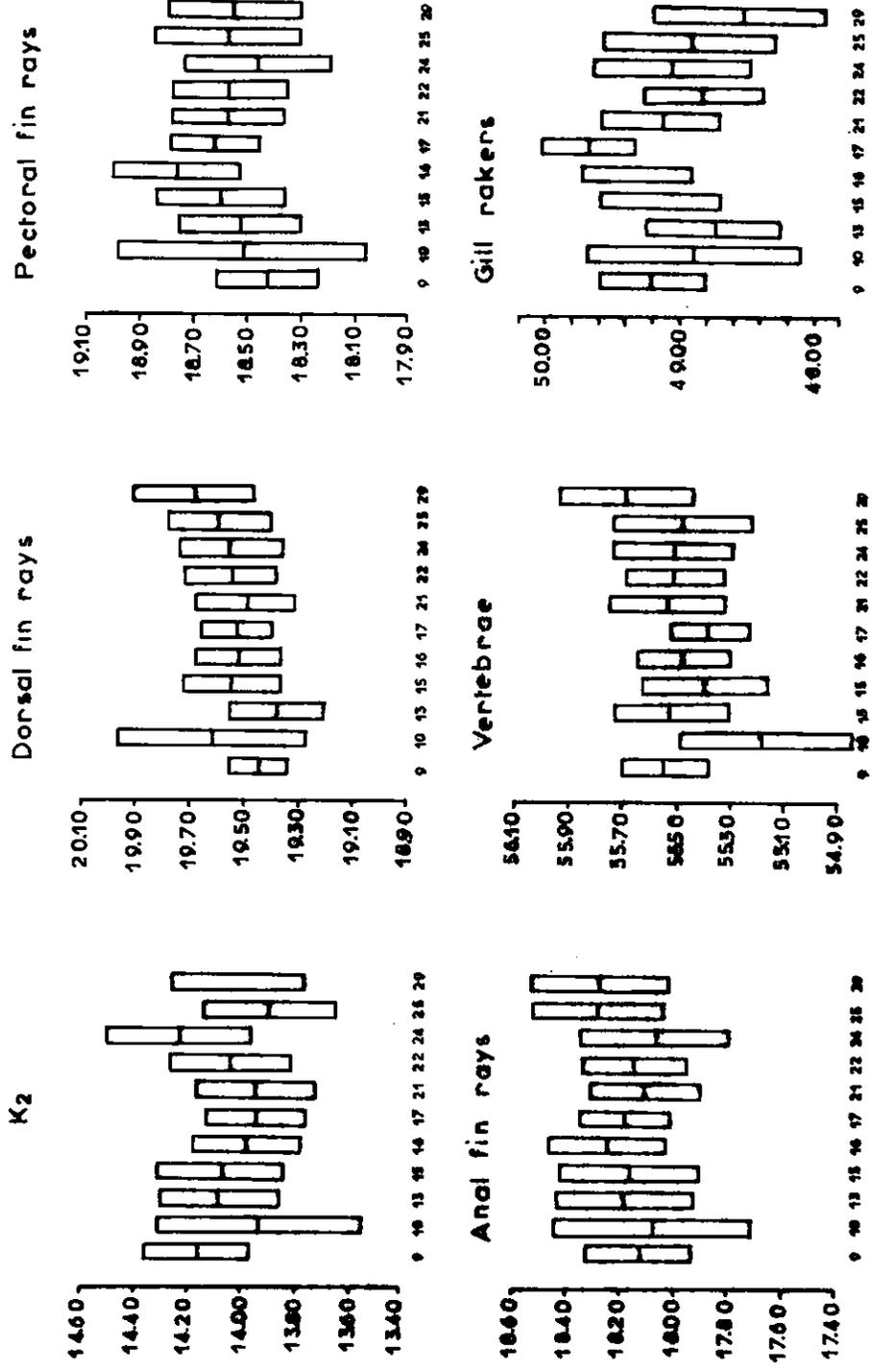


Fig. 4. Average numbers of K2, dorsal fin rays, pectoral fin rays, anal fin rays, vertebrae and gill rakers in autumn spawning herring from ICNAF Division 4V (each vertical bar represents the mean plus and minus 2.6 standard errors) (March 1976).

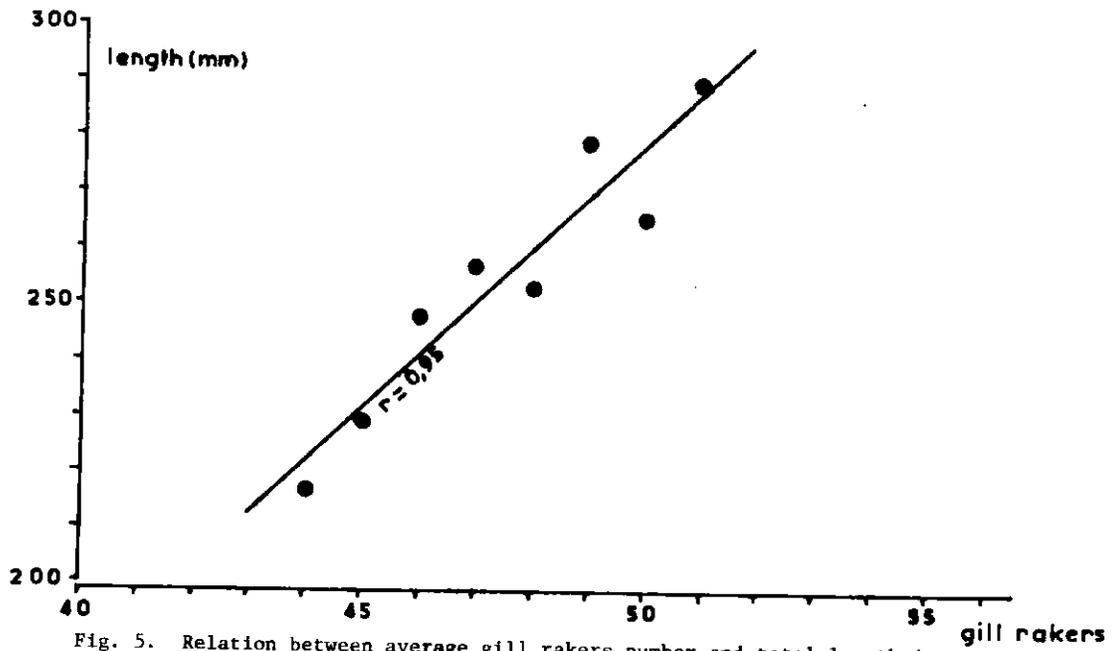


Fig. 5. Relation between average gill rakers number and total length in autumn spawning herring from ICNAF Division 4V (March 1976).

