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Preliminary comparison of Scotian Shelf and southwest Newfoundland herring taken during the winter of 1971

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Introduction

The study of Hodder and Parsons (1970), involving the analysis of data from herring samples taken at Bird Rocks, just north of Magdalen Islands, and along southwest Newfoundland revealed no differences that could be construed as indicating that the samples were drawn from different populations. On the basis of that study together with information on the seasonal nature of the fishery (Hodder, 1969), they hypothesized that a substantial portion of the stock complex of herring, which spawn and feed in the southern Gulf of St. Lawrence from spring to autumn, migrates eastward via the Magdalen Islands and Bird Rocks to overwinter in the fjords along southwest Newfoundland. They also suggested the possibility that some of the herring which pass around the southern part of the Magdalen Islands move eastward around Cape Breton to overwinter in deep water along the southern side of the Laurentian Channel. This was also suggested by Iles and Tibbo (1970), who further hypothesized that the spring influx of herring into the Gulf in April involves fish which in winter are exploited in Chedabucto Bay by Canadian vessels and also on Banquereau by European fleets, particularly those of USSR, Poland and Germany. However, recent data on the incidence and intensity of the larval nematode *Anisakis* in herring (Parsons and Hodder, 1971) suggests a relationship between Chedabucto Bay and Banquereau herring but that these may not be closely related to the southern Gulf-southwest Newfoundland stock complex.

The east-west seasonal migration of herring between the southern Gulf of St. Lawrence in summer and southwest Newfoundland in winter has recently been confirmed by tagging experiments undertaken during 1970 (Hodder and Winters, 1970; Winters, 1971). The absence of a Canadian offshore fishery for herring on the Scotian Shelf and the lack of facilities on board of European vessels, which fish there, to recover magnetic metal tags have thus far restricted our accumulation of knowledge on migration routes, based on tag recaptures, to stocks exploited inshore by Canadian vessels for reduction purposes. In March 1971 herring samples were obtained from Canso Bank and Banquereau, but in the short time available it has not been possible to completely analyze the data. This report compares such data as could be readily analyzed for the Canso Bank and Banquereau herring with similar data for herring samples collected in December 1970 and January 1971 along southwest Newfoundland.

Materials and Methods

The Canso Bank and Banquereau herring samples were taken during a 2-week cruise of the midwater trawler *J. B. Nickerson*, under charter to the Fisheries Research Board of Canada for the period March 15-28, 1971, to conduct a survey over the northern half of the Scotian Shelf to assess the distribution and abundance of herring. The area surveyed is indicated in Fig. 1. The Canso Bank samples were obtained near Station 16, off Chedabucto Bay, and the Banquereau samples near Station 25 on the southern slope of that bank. This preliminary study is based on analysis of some of the data on 200 specimens from each area and the length compositions are based on an additional 100 specimens.

The Newfoundland herring data, used for comparison, were derived from 200 specimens taken in December 1970 and 200 in January 1971 from purse-seiner catches in the fjords of southwest Newfoundland.

Length compositions are based on the grouping of total length measurements, initially recorded in millimeters, into 1-cm intervals to the 0.5 cm below, i.e. all herring in the size range 300-309 mm were grouped in the 30-cm interval. The maturity condition of the gonads is based on the classification into stages as adopted by ICNAF (1964). The absence of stages 5-7 in the samples facilitated the classification of the adult specimens as spring or autumn spawners based on gonad development: those classed as stages 3 and 4 (mostly 4) were designated as possible spring spawners and stage 8 as autumn spawners. Age compositions of the samples are not yet available.

The nematode incidence (percentage of the specimens containing nematodes) and the nematode intensity (average number of nematodes per fish examined) are based on the nematodes found on the viscera and in the body cavity.

Vertebral numbers, excluding the hypural, were determined from radiographs of the specimens.

Results

Size composition

Most of the Canso Bank herring are in the length range of 26-35 cm with the majority of those below 31 cm classed as immature (Fig. 2). The relative proportions of spring and autumn spawners and immatures are 38, 14 and 48% respectively. Cursory examination of the otolith patterns of the immature specimens indicates that about 80% of those will probably be autumn spawners when they reach sexual maturity, thus suggesting a spring to autumn spawner ratio of 20 to 80% for the Canso Bank herring.

The Banquereau herring samples, on the other hand, consist almost entirely of adult herring (1% immature), mostly in the length range of 33-38 cm with a distinct mode at 36 cm. Autumn spawners constitute 94% and spring spawners 5% of the specimens examined.

The length composition of southwest Newfoundland herring in the winter of 1971 is typically pyramidal with a mode at 35 cm and most of the specimens in the range of 32-37 cm. Spring and autumn spawners constitute 18 and 82% of the samples respectively. The sharply-peaked length frequency with a narrow size range has been rather typical of southwest Newfoundland herring sampled in the past several years with the majority of the autumn spawners belonging to the 1958 year-class and spring spawners to the 1959 year-class (Hodder, 1971).

Nematode incidence and intensity

For Canso Bank herring there is a rapid increase in nematode incidence from about 10% at 27 cm to 100% at 34 cm (Fig. 3A). Similarly for Banqureau fish the incidence increases to 100% at 34 cm and fluctuates between 85 and 100% for the larger fish. Southwest Newfoundland herring, on the other hand, exhibit a gradual increase from 25% infestation at 31 cm to 53% at 37 cm. All 5 herring in the 38- and 39-cm length groups contained nematodes. For herring larger than 30 cm the nematode incidences on Canso Bank, Banquereau and along southwest Newfoundland are 78, 91 and 43% respectively.

The nematode intensity (Fig. 3B) likewise increases with fish size for both Canso Bank and Banquereau herring. The high value for Canso herring at 34 cm is due to the influence of a single specimen with 44 nematodes, whereas most of the specimens contained less than 10 nematodes. The nematode intensity increases rapidly for the larger sizes of Banquereau fish. In contrast the southwest Newfoundland herring have an average of less than 1 nematode per fish for all sizes from 31 to 37 cm. The higher values at 38 and 39 cm are based only on 3 and 2 fish respectively.

Vertebral numbers

The frequencies of vertebral numbers for herring samples from the 3 areas are given in Table 1. Canso Bank fish have the lowest vertebral average (55.520), followed by a slightly (but not significantly) higher average for Banquereau fish (55.570); the averages for the southwest Newfoundland samples for December 1970 and January 1971 are 55.650 and 55.675 respectively (55.662 combined), which are significantly higher ($P \leq 0.05$) than the vertebral average of Canso herring but not significantly different from that of Banquereau fish. Spring and autumn spawning types (Fig. 2) in the southwest Newfoundland samples had almost identical vertebral averages, as also was the case for the Canso and Banquereau samples, and both types were combined for this preliminary analysis. When compared with the combined Canso Bank and Banquereau samples, the vertebral average of the southwest Newfoundland samples (December + January) is significantly higher ($P < 0.05$) than that for the Scotian Shelf samples.

Table 1. Average vertebral numbers of herring from Canso Bank and Banquereau in March 1971 and from southwest Newfoundland in December 1970 and January 1971.

Vertebral number	Canso Bank March	Banquereau March	Southwest Nfld. Dec.	Southwest Nfld. Jan.
53		1		
54	6	3	5	6
55	94	89	76	73
56	91	96	103	102
57	8	10	16	18
58	1	1		1
N	200	200	200	200
$\bar{v}$	55.520	55.570	55.650	55.675
S.E.	0.046	0.048	0.047	0.050

Discussion and Conclusions

Parsons and Hodder (1971) demonstrated the usefulness of the incidence of the larval nematode *Anisakis* in herring as a possible indicator of stock heterogeneity, particularly in regard to the southwest Newfoundland-southern Gulf of St. Lawrence stock complex, for which the nematode incidence ranged from 25 to 30% for herring samples taken at various points along the migration route between southwest Newfoundland and the Gaspé Peninsula. They also suggested that Banquereau and Chedabucto Bay herring (64-66% incidence) were probably closely related, but the substantially higher nematode incidence in those areas, although based on only a few specimens, indicated little, if any, relationship with the more northerly stocks.

The preliminary analysis of data from recently acquired herring samples from southwest Newfoundland and the northern part of the Scotian Shelf support the above-mentioned hypothesis in two ways: (1) The average vertebral number for Canso Bank and Banquereau herring is significantly lower than that in herring from southwest Newfoundland, and this conforms with the general principle of decreasing average vertebral number with decreasing latitude. (2) More significant, however, is the similarity of the nematode incidence versus fish length curves for Canso Bank and Banquereau herring, and likewise for the nematode intensity curves, contrasted with the incidence and intensity curves for southwest Newfoundland herring.

Since the accumulation of larval nematodes in herring is obviously a function of the size (and hence age) of the fish (Parsons and Hodder, 1971), the usefulness of this biological characteristic as a means to differentiate between stocks must be considered in relation to the size and/or age frequencies of the samples used for comparison. The overall percentage incidence values for Canso Bank and Banquereau herring (78 and 91%) must be considered in this light. For southwest Newfoundland herring the higher nematode incidence (43%) in the samples used for this study than that (30%) in the samples examined during the 1969 and 1970 winter fisheries (Parsons and Hodder, 1971) is due to the fact that the average length of the former was 34.7 cm compared with 33.5 cm for the 1969 and 1970 samples.

Although the frequency distributions of the Canso Bank and Banquereau herring are distinctly different, this does not preclude the possibility of the existence on the northern part of the Scotian Shelf of a stock complex, most of the adults of which overwinter offshore on Banquereau and the younger herring closer to shore in the Canso Bank-Chedabucto Bay area, where a winter fishery on small herring has recently developed. To what extent the adults migrate seasonally is presently unknown, but it is probable that the overwintering concentrations on Banquereau disperse to feed in the warm near-surface water layer during the summer and, since the majority are autumn spawners, spawn on the shallow parts of the Scotian Shelf in early autumn. The coastal waters in the vicinity of Chedabucto Bay are probably the nursery grounds for the juveniles resulting from these bank spawnings.

The extent of mixing of southern Gulf of St. Lawrence herring with those probably resident on the northern part of the Scotian Shelf is unknown, but the absence of tag recaptures in the 1971 winter fishery in or near Chedabucto Bay, despite the fact that more than 80,000 herring were tagged during March-August 1970 in southwest Newfoundland and the southern Gulf of St. Lawrence (Winters, 1971; Beckett, 1971), suggests that little if any mixing occurs.

If the northern part of the Scotian Shelf contains a substantial adult stock consisting mainly of autumn spawners, it should be possible to approximately locate the major spawning areas by autumn larval surveys. Information on the relationship between Chedabucto Bay and Canso Bank herring on the one hand and Banquereau fish on the other could be obtained by tagging experiments both in the inshore and offshore waters.

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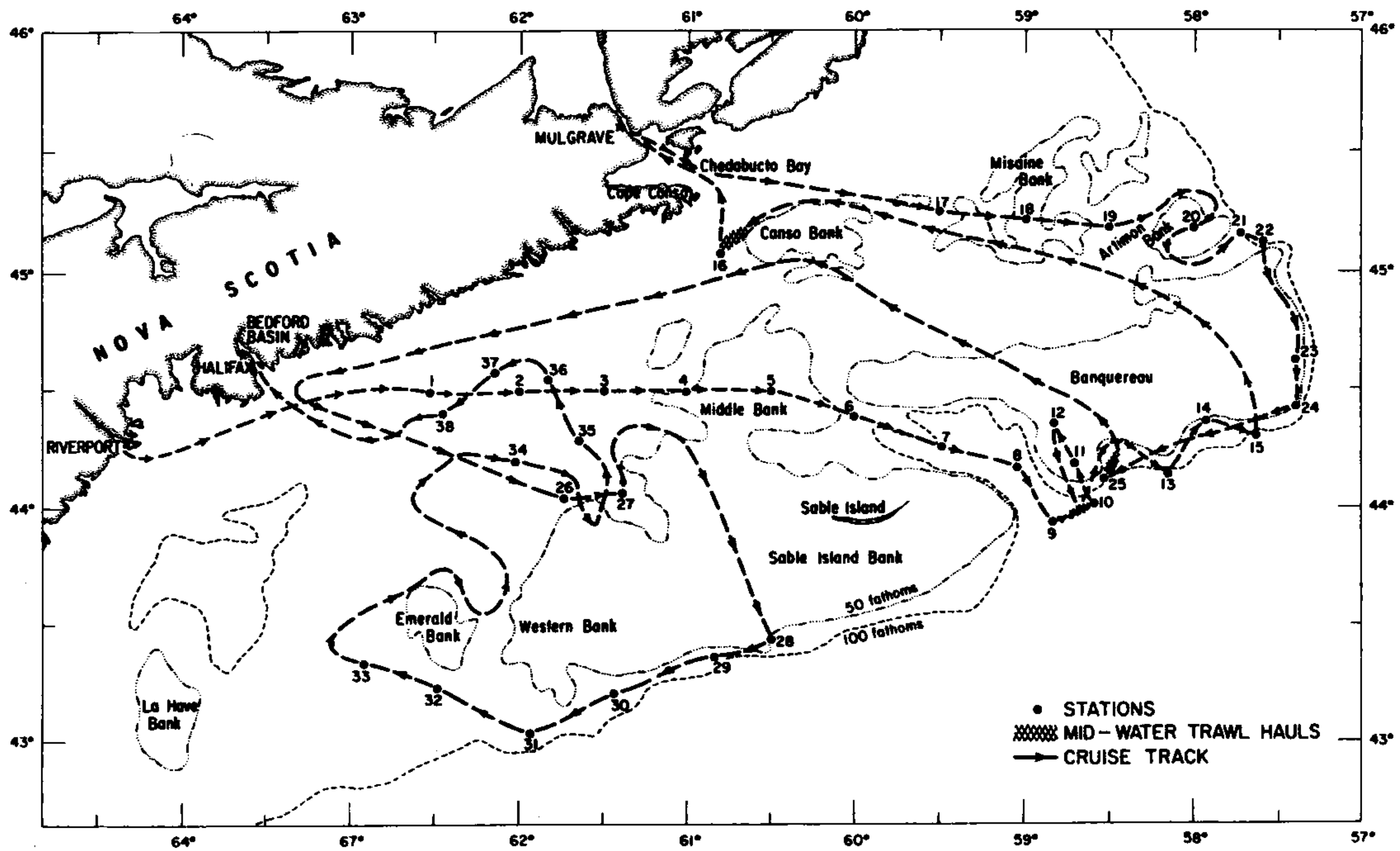

Fig. 1. Cruise track, MV *J. B. Nickerson*, March 15-27, 1971.

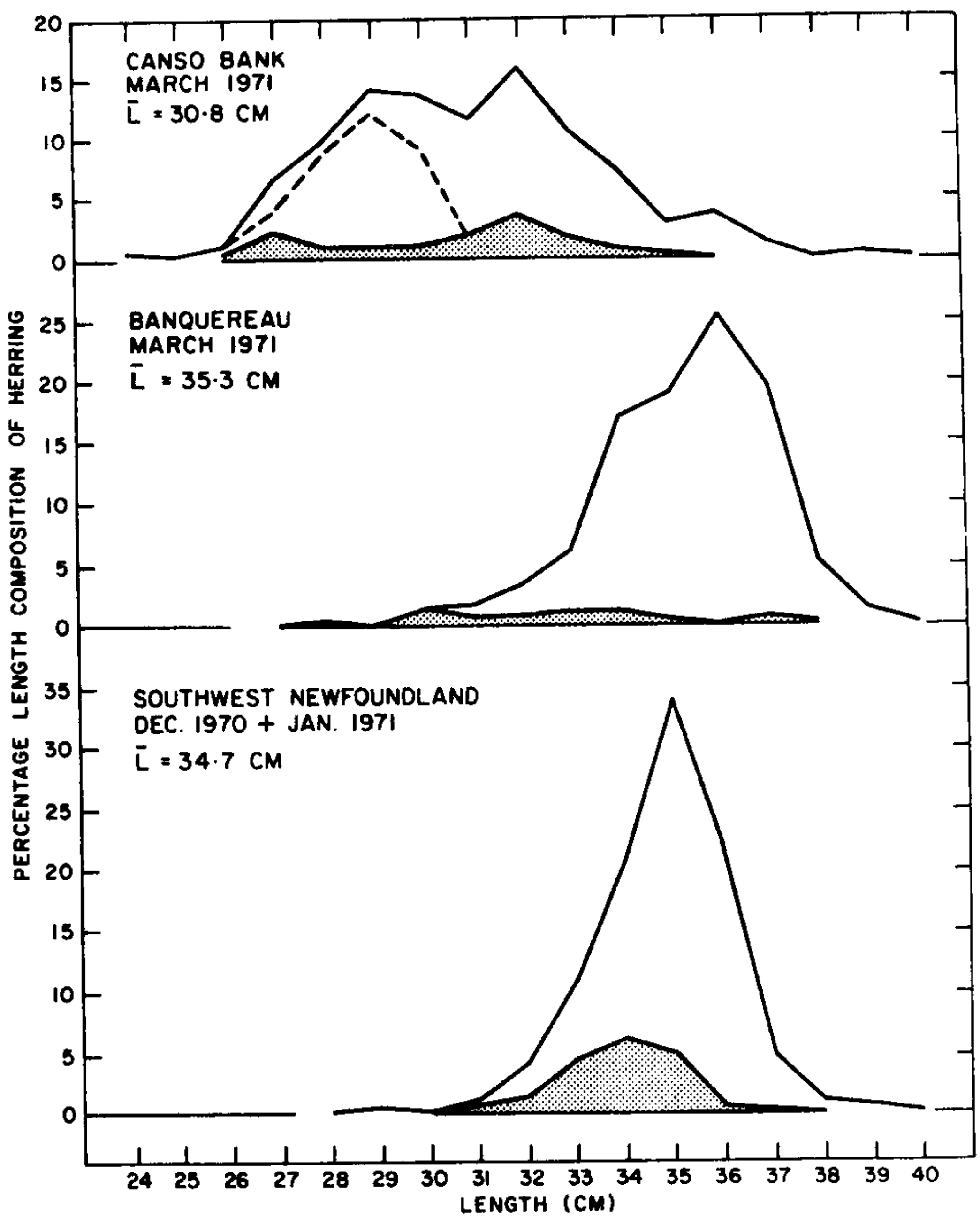

Fig. 2. Size composition of herring taken on the Scotian Shelf in March 1971 and along southwest Newfoundland in December 1970 and January 1971. The shaded portions represent the distribution of spring spawners; the frequency distribution (broken line) in the upper panel represents immature herring.

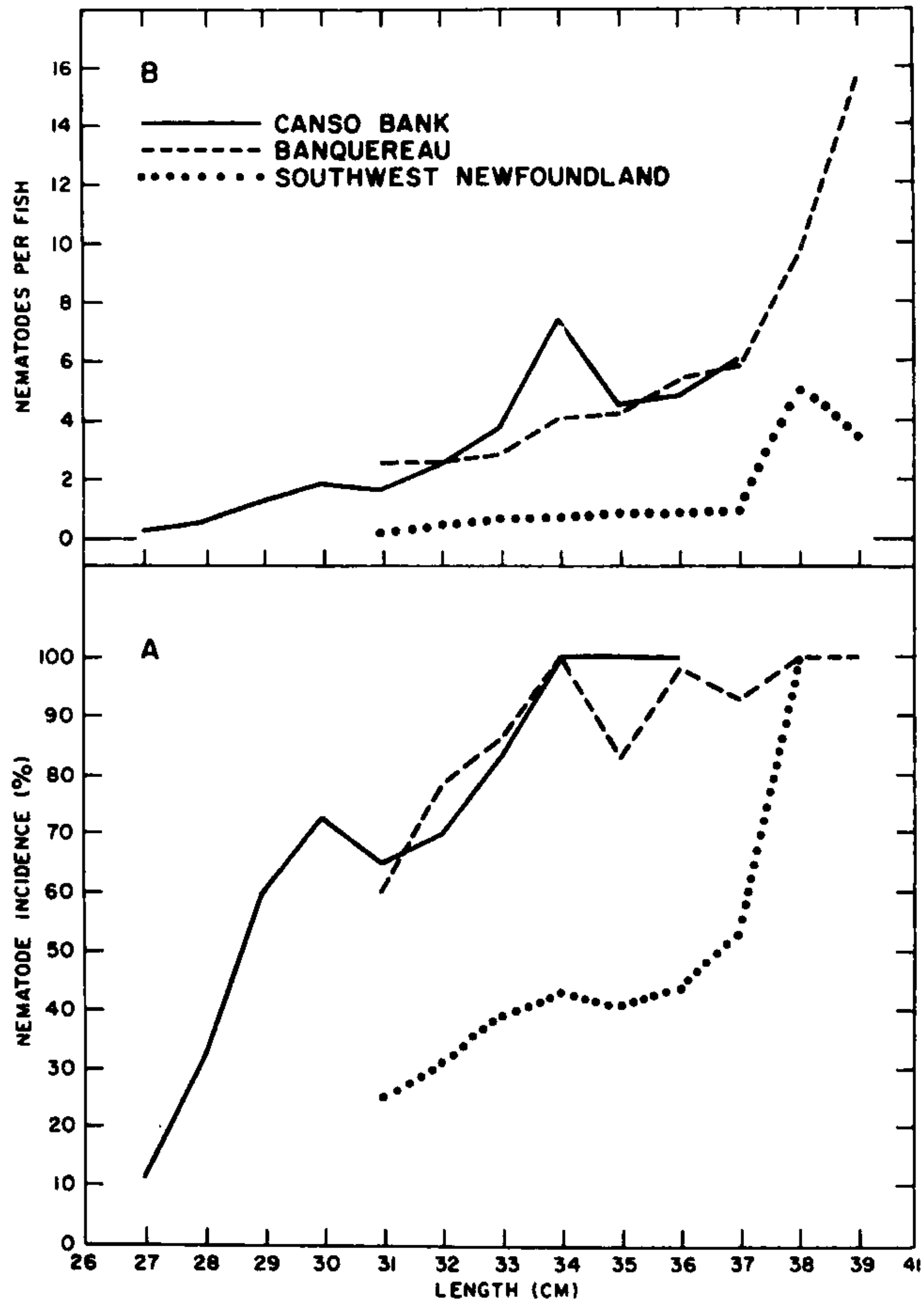

Fig. 3. Nematode incidence (A) and intensity (B) in herring taken on the Scotian Shelf and along southwest Newfoundland during the 1971 winter fishery.