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PARASITES AS INDICATORS OF HERRING MIGRATIONS IN THE NORTH SEA AND TO THE NORTH AND WEST OF SCOTLAND

by

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Summary

Variations in the occurrence of three helminth parasites, two forms of Renicola (R1 and R2) and Lacistorhynchus (L), are being used to trace recruitment migrations of autumn-spawned herring within the study area. The numbers of pyloric caeca are included as another variable feature. Juvenile (1+) herring from the North Sea showed decreasing R1 and R2 infections, and increasing L infections from west to east. The mean numbers of caeca were low in juveniles from Scottish coastal waters and higher in the open North Sea. Herring from the Minch showed changes with age in the values of these parameters consistent with substantial recruitment from the Bløden area. A South Minch sample with several unusual features may have originated from further south on the western seaboard. Adult herring from Shetland and Longstone still show no evidence of recruitment from Scottish coastal juvenile populations.

Introduction

MacKenzie (1974) showed that differences between juvenile autumn-spawned herring samples from Scottish coastal waters and Bløden in the occurrence of three helminth parasites could provide a basis for identifying herring recruited from these areas in samples of adult fish. This paper presents the results of examinations of further herring samples for the same parasites. It also introduces the number of pyloric caeca as an additional variable feature which may prove useful in tracing recruitment migrations.

Materials and Methods

Samples of herring were obtained from commercial and research vessel catches. The discovery that preservation in 70% alcohol retains the opaque white appearance of Renicola cysts permitted larger samples to be taken than were possible when examinations were limited to fresh material. Otoliths were removed for age and race determination, and pyloric caeca for parasitological examination. Commencing in November 1974, the number of caeca in each herring was noted. The small and large forms of Renicola are hereafter referred to as R1 and R2 respectively, and Lacistorhynchus as L.

Results

Details of herring samples examined from July 1974 to July 1975 are shown in Tables 1 and 2, and sampling positions in Figure 1.

Juvenile herring from Scottish coastal waters had heavy infections of R1, but none of L. The incidence of R2 infection was moderate in the Minch and light in the North Sea. In four North Sea samples, R1 and R2 infections decreased, whilst L infections increased slightly, from west to east. Samples from the open North Sea had higher mean numbers of caeca than those from Scottish coastal waters.

In samples of adult herring taken at Papa Bank, near Shetland, and at Longstone, infections were similar to those reported by MacKenzie (1974) from Shetland and Longstone. The mean numbers of caeca in both these samples were relatively high.

All Minch samples, with one exception (position 10), showed similar levels of infection. They were therefore combined with earlier samples from this area to produce Figure 2. It was found that the incidence of R1 infection decreased continuously with host age, whilst that of R2 decreased from ages 1+ to 4+ and levelled off at 4+ and older. The incidence of L infection remained constant up to the age of 3+ and increased slightly thereafter. The mean numbers of caeca increased progressively with age, and their standard deviations showed a similar tendency.

The sample from position 10 in the South Minch differed from other Minch samples in having the highest incidence of L infection (26%) yet recorded in this project together with light R1 and R2 infections. These fish also had considerably fewer larval Anisakis ("herringworm") than is normally found in Minch herring (R. Wootten, personal communication).

The numbers of caeca counted in individual herring from all areas ranged from 15 to 33.

Discussion

It is now possible to make some comments on recruitment to the Minch herring stock.

1. In Scottish coastal waters L is a rare parasite, and the increase in infection between 3+ and older herring in the Minch suggests its introduction with fish infected elsewhere. Saville and Morrison (1973) reported that some herring tagged as juveniles at Bløden were recovered in the Min ch, and MacKenzie (1974) showed that L occurred fairly commonly at Bløden. Recruitment from this area to the Minch could therefore account for the observed increase in infection.

2. Juvenile herring from Scottish coastal waters had relatively low mean numbers of caeca, so that the increase in means and standard deviations in Minch herring was probably due to the influence of fish recruited from another area. Juvenile herring samples from the open North Sea had higher mean numbers of caeca, but the figures for juveniles within the Bløden area are not yet known.

3. Information collected so far on the biology of Renicola indicates that in herring all R1 and R2 infections probably occur in the first summer of life and persist for a number of years, since herring up to the age of 11+ have been found infected. The progressive decreases in

R1 and R2 infections with age in Minch herring suggest continuous dilution of the native juvenile population with herring from an area of low incidence of R1 and R2 infections. It has been shown that these infections decrease from west to east in the North Sea. Recruitment from the eastern North Sea would therefore be likely to produce the effect observed in the Minch.

4. The changes with age in the values of the above parameters are all consistent with substantial recruitment to the Minch stock from the open North Sea generally and the Blyden area in particular. However, it should be noted that each age-group in Figure 2 includes two or three different year-classes, whereas ideally such a figure should be based on a single year-class. Such is the eventual aim, but at this stage it can only be said that observations on different year-classes at the same age have shown little variation.

5. The sample taken in October 1974 from position 10 in the South Minch was excluded from Figure 2 as it had a parasite fauna radically different from any other Minch sample. As mentioned earlier, L is a rare parasite in Scottish coastal waters, so that these fish were probably infected elsewhere, in an area where L is abundant and R1 and R2 are uncommon. The best clue to their origin lies in the unexpectedly low infections of the nematode Anisakis. Schultz (1974) reported a progressive decrease in nematode infections in autumn-spawned herring from north to south along the west side of the British Isles. This sample therefore appears to be evidence of an element in the Minch recruited from an area to the south.

Parasitic infections and mean numbers of caeca in the samples from Papa Bank and Longstone suggest little, if any, recruitment from Scottish coastal waters, thus adding further support to the conclusions of Parrish and Sharman (1959), Saville (1971) and MacKenzie (1974).

Acknowledgements

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Table 1

Incidence of Renicola and Lacistorhynchus infection and mean numbers of pyloric caeca in samples of juvenile (1+) autumn-spawned herring taken in the period July 1974 to July 1975 (see Fig. 1 for sampling positions).

Sampling position	Date	Number of herring examined	Incidence of infection (%)			Mean number of pyloric caeca
			R1	R2	L	
1. Loch Etive	August 1974	65	63	34	0	21.5
2. Tiree Passage	March 1975					
3. Loch Buie	April 1975					
4. North Minch	March 1975					
5. Western North Sea	March 1975	135	76	3	0	21.3
6. Western North Sea	March 1975	156	62	4	0	21.8
7. Western North Sea	February 1975	115	35	1	1	21.7
8. Eastern North Sea	February 1975	200	2.5	0	1.5	21.8

Table 2

Incidence of Renicola and Lacistorhynchus infection and mean numbers of pyloric caeca in samples of adult (older than 1+) autumn-spawned herring taken in the period July 1974 to July 1975 (see Fig. 1 for sampling positions). Dominant age-groups are shown separately.

Sampling position	Date	Age	Number of herring examined	Incidence of infection (%)			Mean number of pyloric caeca
				R1	R2	L	
2. Tiree Passage	March 1975	2+,3+	12	58	33	0	21.9
4. North Minch	March 1975	2+	119	42	10	1.7	21.7
		All ages	200	34	10	1	21.9
9. South Minch	July 1974	2+	71	30	6	1	-
		4+	73	18	1	4	-
		All ages	180	24	3	3	-
10. South Minch	Oct. 1974	2+	26	4	4	20	-
		All ages	50	2	4	26	-
11. North Minch	Nov. 1974	4+	91	11	2	5	22.1
		All ages	177	16	3	3	22.1
12. North Minch	Feb. 1974	2+	36	30	22	0	21.1
		All ages	72	21	15	0	21.5
13. North Minch	June 1975	2+	132	51	15	1.5	21.7
		5+	53	8	6	4	22.7
		All ages	255	35	11	2	21.9
14. Papa Bank	July 1975	All ages	113	2.5	1	7	22.3
15. Longstone	July 1975	All ages	127	0.8	0	13	21.9

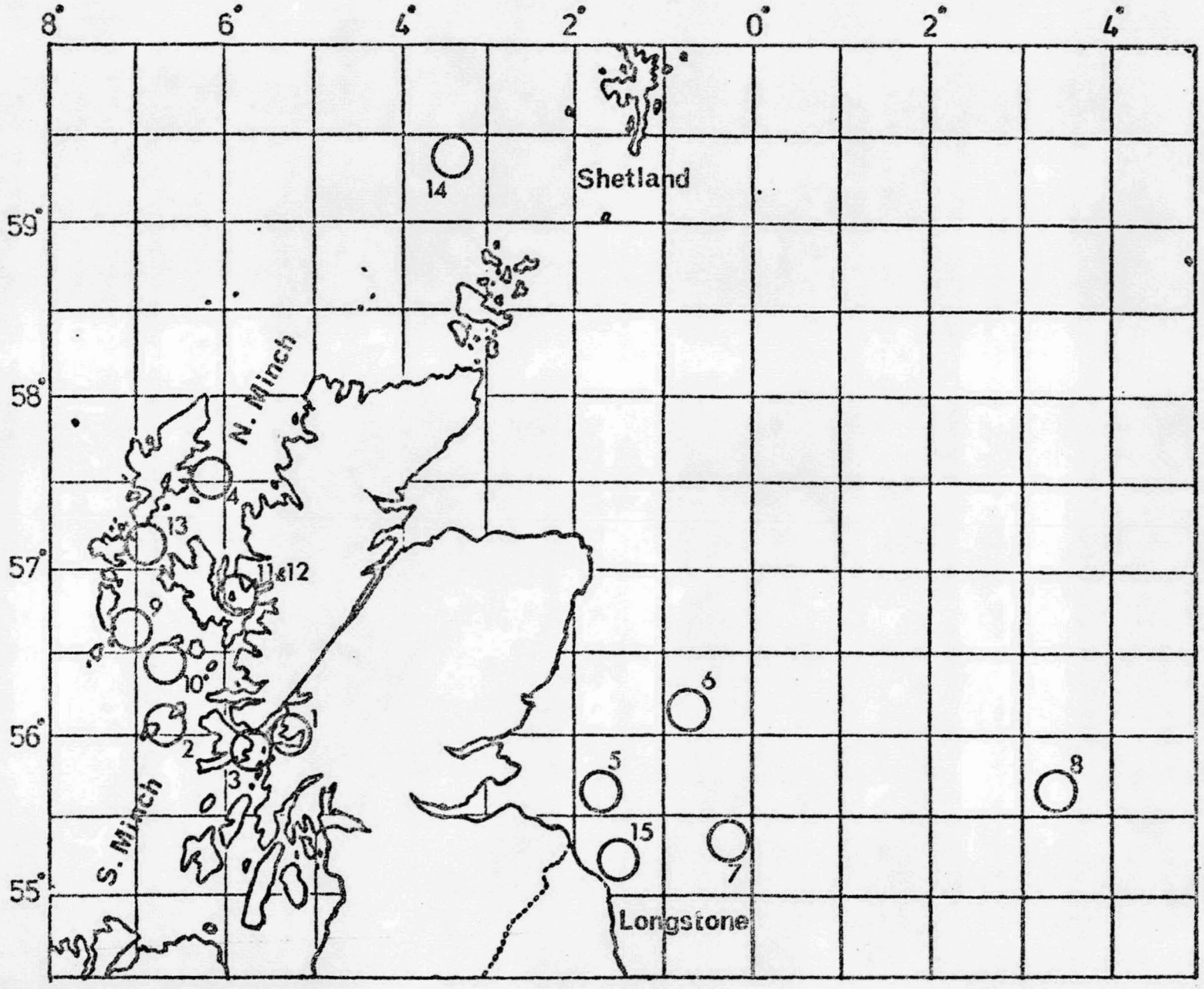

FIG 1 : HERRING SAMPLING POSITIONS, JULY 1974 to JULY 1975.

Figure 2 Incidence of parasitic infection, together with means and standard deviations of pyloric caeca numbers, in combined samples of herring taken from the Minch in the period August 1973 to July 1975