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ESTIMATES OF MACKEREL STOCK COMPOSITION IN DIFFERENT AREAS AND
SEASONS AS INDICATED BY A CESTODE PARASITE

by

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SUMMARY

Recently collected data support earlier indications of the value of the plerocercus of the trypanorhynch cestode Grillotia angeli as a biological tag for estimating the size of the Western stock component in populations of adult mackerel, Scomber scombrus L., of mixed stock composition. During 1981, three samples of mackerel were examined from the northern North Sea, one from the Norwegian Sea and one from off the north coast of Scotland. The proportion of Western stock mackerel in each of these samples was estimated by comparing the prevalence rate of G. angeli in each sample with the mean prevalence rate in mackerel samples from the western English Channel. The results indicate that some mackerel of Western stock origin do not return to Western stock spawning grounds but remain in the North Sea to spawn. The sample from the Norwegian Sea was estimated to consist of about 90% North Sea stock, a result contrasts strongly with calculation of stock composition in ICES Division IIa based on returns of "mechanical" tags.

RÉSUMÉ

Des données nouvellement recueillies confirment la potentialité de la larve plerocercus du cestode trypanorhynche Grillotia angeli à des fins de marquage biologique dans une évaluation de l'importance de l'élément occidental parmi les parties composantes des populations mixtes de maquereaux adultes Scomber scombrus L. Au cours de 1981, trois échantillons de maquereaux de la Mer du Nord ont été examinés dont l'un venait de la Mer Norvégienne et l'autre des eaux au large de la côte nord de l'Ecosse. Le pourcentage de maquereaux aux origines occidentales dans chacun des trois échantillons a été évalué en comparant le taux de fréquence de G. angeli dans chaque échantillon avec le taux de fréquence moyen dans les échantillons de maquereaux de la partie occidentale de la Manche. Les résultats indiquent qu'un certain nombre de maquereaux aux origines occidentales ne rentrent pas à la frayère des populations occidentales mais restent pour frayer dans la Mer du Nord. On estime que l'échantillon de la Mer Norvégienne s'est composé d'environ 90% de maquereaux ayant leurs origines dans la Mer du Nord, lequel resultat est tout opposé à l'estimation de la composition des populations dans la Division du CIEM IIa fondée sur le retour des marques 'mécaniques'.

INTRODUCTION

A report submitted to last year's meeting (MacKenzie, 1975) described the selection of the plerocercus larva of a trypanorhynch cestode as a biological tag for mackerel, Scomber scombrus L. These early results showed that the cestode, Grillotia angeli Dollfus, appeared to meet the requirements for a parasite which could be used to estimate the proportions of Western stock mackerel in adult populations of mixed stock composition. The present paper gives the results of examinations carried out since the first report and gives estimates of stock composition in the populations sampled.

MATERIALS AND METHODS

Figure 1 shows the positions of capture of samples taken, with one exception, in 1981. Sample 1, which was taken in February 1980 off Lizard Point in Cornwall, is included because examinations of fish from this sample were not complete at the time of writing the first report. All mackerel were preserved by deep-freezing and all samples were taken by research vessels except that taken off the north coast of Scotland (sample 8), which came from a Faroese commercial catch. The otoliths of all mackerel examined were removed for age determination and the length and sex of each fish was recorded. (Not all the ages shown in the tables in this paper have been expertly checked yet, so some minor adjustments may have to be made later.)

RESULTS

Table 1 shows the results of examinations of samples taken in 1980 and 1981 from the western English Channel and Celtic Sea. Table 2 summarises the results from this southwestern part of the study area since sampling began there in July 1978, and Table 3 shows that there was no significant variation in prevalence of G.angeli from age group three to age group nine and older. The best represented year-class in samples from this area was that of 1976. Table 4 shows that there was no significant variation in prevalence of G.angeli from age group two, sampled in July 1978, to age group five of this year-class. The mean prevalence of G.angeli in all 3-group and older mackerel in samples from the western English Channel (13.6%, see Table 2) was taken as an estimate of the true prevalence of G.angeli in adult Western stock mackerel, until such time as data from other parts of the study area become available.

Table 5 shows the results of examinations of samples taken in 1981 from the northern part of the study area. Table 6 summarises the results from the North Sea, Norwegian Sea and off the north coast of Scotland since sampling began there in February 1977. The youngest mackerel from this area infected with G.angeli was five years old. From age group five the prevalence of G.angeli increased slightly to a peak of 6.7% in age group eight, after which it decreased slightly towards the higher age groups.

Table 7 shows the proportion of Western stock mackerel estimated to be present in the five samples taken from the northern part of the study area in 1981. The samples which included the greatest estimated proportion (about 30%) of Western stock mackerel were those taken in the central northern North Sea in

May and off the west coast of Norway near Bergen in September. The sample taken off the north coast of Scotland in November included an estimated 20% of Western stock. The estimated proportion in the samples taken in the Norwegian Sea in August and at the entrance to the Skagerrak in September was about 10%.

DISCUSSION

The data collected since the first report (MacKenzie, 1975) support earlier indications of the value of the plerocercus of G. angeli as a biological tag for estimating the size of the Western stock component in populations of adult mackerel. These recent data support early indications that infection of mackerel with G. angeli is complete by the end of age group two. The absence of any significant decrease in prevalence with age in mackerel from the southwestern part of the study area indicates that the life span of the plerocercus in mackerel equals that of the infected fish.

Table 6 suggests that the youngest mackerel of the Western stock present in the northern part of the study area were five years old, but it must be stressed that the numbers of 2, 3 and 4-group mackerel examined from this area so far are small. Sample 3 taken from the central northern North Sea in May was of mackerel which would have spawned within the following few weeks as shown by their advanced state of maturity. Approximately 30% of these fish were estimated to be Western stock but the timing suggests that they would have spawned in the northern North Sea. This indicates that some mackerel of Western stock origin do not return to Western stock spawning grounds but remain in the North Sea to spawn.

The proportion of Western stock mackerel in sample 5 from the Norwegian Sea was estimated at about 10%. The age composition of this sample, in particular the large proportion of 1969 year-class fish present, also indicated that it consisted predominantly of mackerel of the North Sea stock (Mr M Walsh, personal communication). This result contrasts strongly with the stock composition in this area (ICES Division IIa) calculated from returns of "mechanical" tags. Anon. (1982) quoted proportions of from about 6% to about 40% of North Sea stock mackerel in Division IIa based on these tag returns, as compared with an estimated 90% North Sea stock in sample 5 of the present study. However, Anon's (1982) calculations were based on "a very limited number of tag returns" and sample 5 was of only 79 mackerel, one of which was infected with G. angeli. Much more data are required from both methods of tagging.

Stock compositions in the other two North Sea samples (6 and 7) and in sample 8 from off the north coast of Scotland calculated from biological tag data agrees generally with recent estimates based on age compositions and returns of mechanical tags (see Anon., 1982).

Further samples of mackerel from areas already investigated and from the Bay of Biscay, west of the Outer Hebrides, west of Ireland and from other parts of the Celtic Sea have been collected and are awaiting examination.

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tag for mackerel. ICES CM 1981/H:57,
5 pp (mimeo). |

TABLE 1 Results of examinations of mackerel samples from the south-western part of the study area for G. angeli infection. See Figure 1 for sampling positions.

Sample No.	Sampling date and area	Year class	Age group	Number of mackerel	
				Examined	Infected
1	February 1980 Off Lizard Pt.	1979	1	2	0
		1978	2	126	2
		1977	3	8	2
		1976	4	28	3
		1975	5	17	2
		1974	6	9	0
		1973	7	2	0
		1972	8	13	3
		1971	9	12	1
		1970	10	17	2
		1969 and earlier	11 and older	33	4
2	25 2 81 W English Ch.	1978	3	6	0
		1977	4	5	0
		1976	5	14	2
		1975	6	7	0
		1974	7	12	2
		1973	8	4	0
		1972	9	2	0
		1971	10	2	0
		1970 and earlier	11 and older	7	4
4	13 6 81 Celtic Sea	1980	1	10	0
		1979	2	17	1
9	8 12 81 Eddystone Bay	1980	1	14	1
		1979	2	20	1
		1978	3	10	1
		1977	4	10	0
		1976	5	17	3
		1975	6	9	1
		1974	7	4	1
		1973	8	5	3
		1972	9	3	1
		1971	10	2	0
		1970 and earlier	11 and older	9	1
10	8 12 81 Eddystone Bay	1980	1	1	0
		1979	2	5	0
		1978	3	2	0
		1977	4	1	0
		1976	5	4	0
		1975	6	2	0
		1974	7	1	0
		1973	8	4	0
		1972	9	1	0
		1971	10	1	0
		1970 and earlier	11 and older	3	0

TABLE 2 Prevalence rates of *G. angoli* in different age groups of mackerel in samples taken from the south western part of the study area from July 1978 to the end of 1981.

Age of mackerel	Number examined	Number infected	Prevalence (%)
0	152	0	0
1	196	6	3.1
2	234	11	4.7
3	203	29	14.1
4	79	7	8.9
5	77	13	16.9
6	32	2	6.3
7	26	3	11.5
8	28	6	21.4
9 and older	97	14	14.4
3 and older	544	74	13.6

TABLE 3 Comparison of prevalence rates of *G. angeli* in different age groups of adult mackerel from the south western part of the study area.

Number of mackerel	Age group							Totals
	3	4	5	6	7	8	9 and older	
Infected	29	7	13	2	3	6	14	74
Uninfected	176	72	64	30	23	22	83	470
Totals	205	79	77	32	26	28	97	544

$\chi^2 = 5.35$

df = 6

$P > 0.05$

TABLE 4 Prevalence rates of *G. anguli* in different age groups of the 1976 year class of mackerel from the south eastern part of the study area.

Age	Number of mackerel		% prevalence
	Examined	Infected	
2	21	3	14.3
3	150	23	15.3
4	28	3	10.7
5	35	5	14.3
2-5	231	34	14.7

TABLE 4 Prevalence rates of *G. anguli* in different age groups of the 1976 year class of mackerel from the south eastern part of the study area.

Age	Number of mackerel		% prevalence
	Examined	Infected	
2	21	3	14.3
3	150	23	15.3
4	28	3	10.7
5	35	5	14.3
2-5	231	34	14.7

TABLE 5 Results of examinations of mackerel samples from the northern part of the study area for G. angeli infection. See Figure 1 for sampling positions.

Sample No.	Sampling date and area	Year class	Age group	Number of mackerel	
				Examined	Infected
3	21 5 81 Central northern North Sea	1978	3	1	0
		1976	5	4	0
		1975	6	10	0
		1974	7	32	2
		1973	8	27	1
		1972	9	19	1
		1971	10	22	1
		1971/70	10/11	3	0
		1970	11	31	1
		1970/69	11/12	6	0
		1969	12	40	1
		1969/68	12/13	1	1
		1968 and earlier	13 and older	19	1
		5	7 8 81 Norwegian Sea	1976	5
1975	6			8	0
1974	7			7	0
1973	8			16	0
1972	9			3	0
1971	10			10	0
1969	12			17	0
1968 and earlier	13 and older			11	1
6	1 9 81 Off west coast of Norway	1978	3	5	0
		1977	4	4	0
		1976	5	22	1
		1975	6	34	2
		1974	7	44	1
		1973	8	34	3
		1972	9	29	2
		1971	10	38	2
		1970	11	20	0
		1970/69	11/12	3	0
		1969	12	71	3
		1969/68	12/13	5	0
		1968	13	29	1
		1968/67	13/14	6	0
		1967	14	21	1
		1967/66	14/15	3	0
1966 and earlier	15 and older	20	0		
7	2 9 81 Entrance to Skagerrak	1977	4	1	0
		1975	6	3	0
		1974	7	18	0
		1973	8	7	1
		1972	9	3	0
		1970	11	2	0
		1969	12	22	0
		1968	13	5	0
		1967	14	2	0
1966 and earlier	15 and older	2	0		

TABLE 3 (contd.)

Sample No.	Sampling date and area	Year class	Age group	Number of mackerel	
				Examined	Infected
6	21 11 61 Off north coast of Scotland	1977	4	1	0
		1976	5	5	0
		1975	6	14	0
		1974	7	19	0
		1973	8	8	1
		1972	9	7	1
		1971	10	4	0
		1970	11	9	0
		1969	12	43	0
		1969/68	12/13	1	1
		1968	13	11	0
		1967	14	1	0
		1965	15	1	0

TABLE 6 Prevalence rates of *G. anguli* in different age groups of mackerel in samples taken from the North Sea, Norwegian Sea and off the north coast of Scotland from February 1977 to the end of 1981.

Age of mackerel	Number examined	Number infected	Prevalence (%)
1	183	0	0
2	1	0	0
3	18	0	0
4	20	0	0
5	67	1	1.5
6	96	2	2.0
7	136	3	2.2
8	104	7	6.7
9	66	4	6.1
10	78	3	3.8
10/11	3	0	
11	63	1	1.6
11/12	9	0	
12	195	4	2.1
12/13	8	2	
13 and older	132	4	3.0

TABLE 7 Estimates of the proportions of Western stock mackerel in samples taken from the northern part of the study area in 1981.

Sample No.	Sampling date and area	Number of mackerel		Prevalence (%)	Proportion of Western stock in sample
		Examined	Infected		
3	21 5 81 Central northern North Sea	215	9	4.2	0.31
4	7 8 81 Norwegian Sea	79	1	1.3	0.09
5	1 9 81 Off west coast of Norway	394	16	4.1	0.30
7	2 9 81 Entrance to Skagarrak	71	1	1.4	0.10
8	21 11 81 Off north coast of Scotland	118	3	2.5	0.19

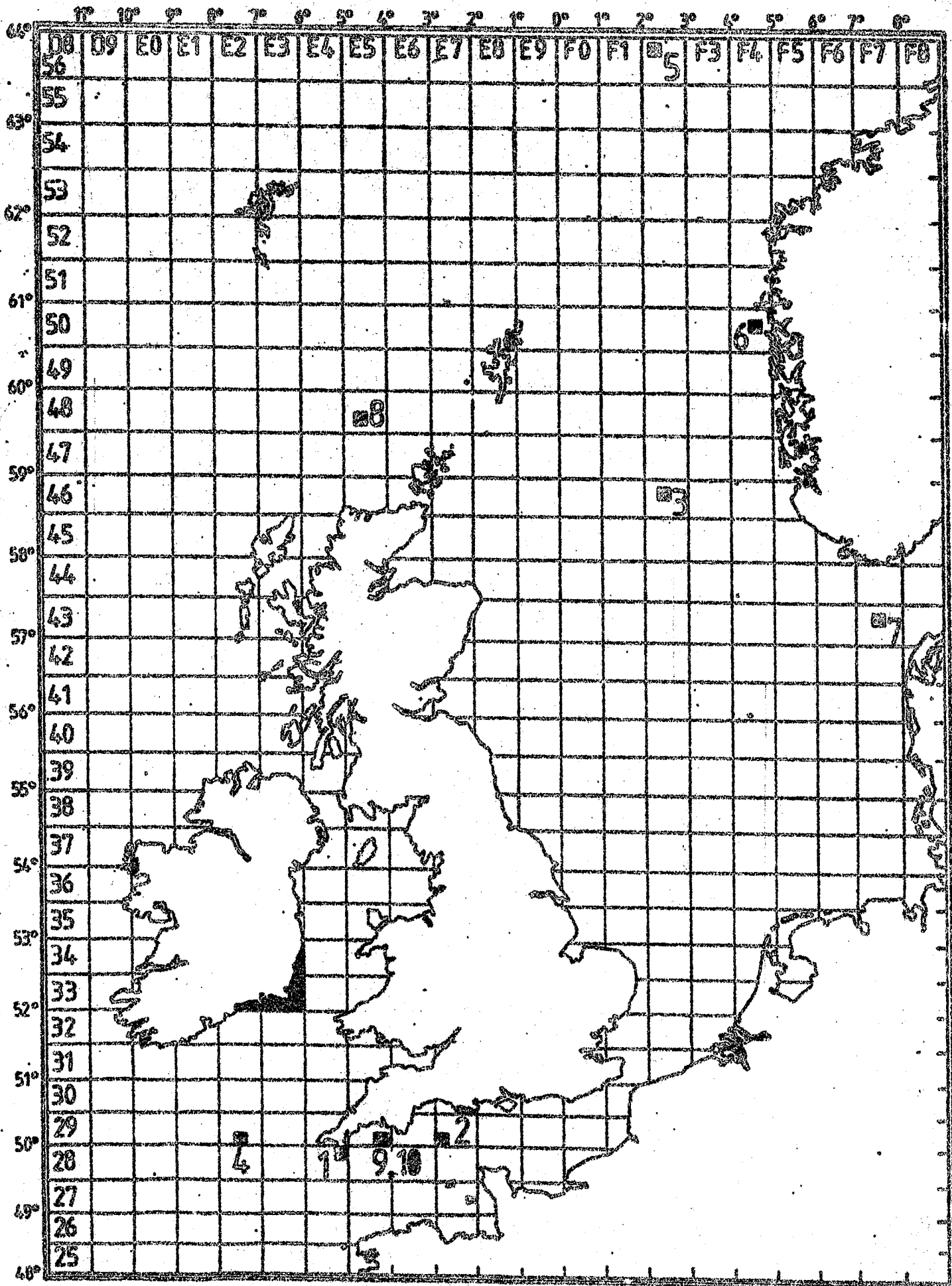


Figure 1. Positions at which the samples discussed in this paper were taken