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Recaptures by Year-class of Cod in East Greenland/Icelandic Waters
from Tagging Experiments at West Greenland

by

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Introduction

At present, the cod stock at West Greenland is totally dominated by the 1984 year-class (Anon., 1989), and this year-class is believed to be of mainly Icelandic origin i.e. that a major proportion of the year-class drifted as eggs and larvae from Iceland to East Greenland and to the southern part of West Greenland (Anon., 1987). A present concern is whether the 1984 year-class (now 5 years old) will show a substantial migration from West Greenland to Iceland in the coming years.

In this paper the historical trends in migrations from West Greenland to East Greenland and Iceland as interpreted from tag returns are evaluated to see whether some year-classes show particularly high migration rates.

Materials and methods

Data consist of recaptures from tagging experiments carried out at West Greenland in the period 1946-84. Only recaptures of fish which were at least 4 years old when tagged are included in the analysis. Furthermore, recaptures within the tagging year have been omitted. For more details concerning the tagging experiments see Hovgård and Christensen (1988).

The tagging experiments have been grouped by NAFO divisions and further by fiords and outside-fiords areas. Returns are pooled in two groups: 1) West Greenland and 2) East Greenland and Iceland.

Otoliths of recaptured cod were returned with the tag in about 70% of the total recaptures. Returns without otoliths have subsequently been given an age in accordance with an overall age-length key.

Results

The proportion of recaptures taken at East Greenland and Iceland for each tagging area is shown in Table 1. The fractions are generally higher for taggings outside fiords than for tagging

inside fiords. The results are in agreement with findings by Hansen (1949) from cod tagging experiments in the period 1924-1939, and agrees well with the findings by Hovgård and Christensen (1988) that fiord cod are largely stationary.

Further, the proportion of eastern recaptures is increasing the more southerly the taggings were made. For Div. 1A and 1B 2-4% of the recaptures are taken from the eastern side while for Div. 1E and 1F 30-40% are returned from the east. The same trend is also found by Hansen (1949) from pre-war tagging. However, the fraction of recaptures returned from the eastern areas was somewhat higher for the pre-war experiments: For Div. 1E and 1F over 70%. This difference between the pre-war and the post-war period would be expected if the fishery at West Greenland has increased relatively more than the fishery at Iceland.

The fractions of eastern returns are given by year-class and tagging areas in Table 2 and shown in Fig 1. From each tagging area only year-classes with ten or more recaptures are included.

For the year-classes of the thirties few recaptures came from East Greenland and Iceland, although most of the tagging experiments took place outside fiords in Div. 1F. However, it must be pointed out that the earliest tagging experiments in the present analysis were in 1946, when fish of these year-classes must have been quite large and old when tagged. According to Hansen et. al. (1935) older cod do not show the same tendency to undertake long migrations as the younger medium-sized cod.

A face value evaluation of the year-class effect on emigration behavior is somewhat impeded by the strong geographical effect and by the unbalanced data. Therefore, the two effects have been separated by a two way ANOVA :

$$\% \text{ returns at east} = \text{year-class}(i) + \text{tagging area}(j) + \text{noise}$$

where (i) signifies year-class and (j) areas. In the analysis the year-classes prior to 1941 and the fiord experiments, except for the fiords in Div. 1D, have been excluded as they contribute little information. Results from the ANOVA are shown in Table 3.

The year-class effect as shown in Fig. 2 is expressed as marginal means, i.e. as the means expected had the design been balanced. This is just a scaling adding the mean geographical effect to the estimated year-class effects. It should, however, be noted that the values in Fig. 2 do not reflect the expected proportion of returns from the eastern areas, as the stock is not evenly distributed on divisions.

In general, the impression from Fig. 2 is that there is no great variation in % returns at east for the period concerned.

Discussion

Describing the migration to East Greenland and Iceland from the proportion of recaptures taken in these areas is of course very rough, as no considerations are given to changes in fishing effort or reporting rates of tags. However, we are at present not able to apply good corrections and will, therefore, consider the data shown as the best information available.

The cod is spawning off West Greenland, the main areas being the banks in NAFO Div. 1D and 1E. However, in some years there is evidence of a larvae drift from spawning off Iceland and East Greenland (Harden-Jones, 1968; Hovgård and Messtorff, 1987). It is also known that a part of the mature cod migrate from West Greenland to East Greenland and Iceland. Some researchers assume that a homing to the spawning grounds occurs and if so year-classes of eastern origin should show an above average emigration out of the West Greenland area.

Little is known about the magnitude of a possible eastern component in the period concerned. For the period 1953-79 Hansen and Buch (1986) classified the 1956, 61, 63 and 73 year-classes as being mainly from the eastern areas. The 1973 year-class is the best documented year-class of those originating from east as great numbers of 0-group cod were observed in the Icelandic 0-group survey off East Greenland in that year (Anon., 1989). This year-class is giving the highest proportions of returns from the eastern areas (42% and 56%, respectively from taggings in fiords and outside fiords in Div. 1D, see Table 2). However, the fishery of this year-class was heavily regulated at West Greenland during 1977-79 to protect young undersized fish and this resulted in large amounts of cod being misreported as being of other groundfish species (Horsted, 1980). It is quite likely that the tag returns from these fisheries have never been reported and this could explain the low proportion of returns of this year-class taken in West Greenland. Year-class 1956 shows eastern returns a little above average whereas both the 1961 and the 1963 year-classes are below average. In general, no good correspondance is found between the year-classes classified as eastern by Hansen and Buch (1986) and the present results.

The present results rather indicate that the proportion migrating is relatively constant, may be excepting the 1973 year-class. This is somewhat in contrast to assessment results from the ICES Working Group on Cod Stocks off East Greenland where large between-year variation in migration is postulated.

The 1984 year-class is presently very dominant in the cod stock at West Greenland, and like the 1973 year-class it is believed to have been recruited mainly from the Icelandic area (Hovgård and Messtorff, 1987). Therefore it can not be excluded that a relatively high migration out of the West Greenland area will occur in the coming years.

References

Anon., 1987. Report of the Working Group on Cod Stocks off East Greenland. ICES, Doc. C.M. 1987/Assess 10.

Anon., 1989. Report of the Working Group on Cod Stocks off East Greenland. ICES, Doc. C.M. 1989/Assess 8.

Hansen, P.M., Jensen, Ad.S. and A. Vedel Tåning 1935. Cod Marking Experiments in the Waters of Greenland 1924-1933. København.

Hansen, P.M., 1949. Studies on the Biology of the Cod in Greenland Waters. Rapp. proc. Verb. de Reun. 123: 1-85.

Hansen, H. and E. Buch 1986. Prediction of Year-class Strength of Atlantic Cod (Gadus morhua) off West Greenland. NAFO Sci. Coun. Studies, 10: 7-11.

Harden Jones, F.R. 1968. Fish migrations. Edward Arnold Ltd., London, 325 p.

Horsted, S. Aa., 1980. Subarea 1 cod : Data from 1979 and early 1980 and estimates of stock and yield for 1980-82. NAFO SCR Doc. 80/72.

Hovgård, H. and S. Christensen 1988. Migration Patterns of Cod (Gadus morhua) in West Greenland Waters. NAFO SCR Doc. 88/44.

Hovgård, H. and J. Messtorff 1987. Is the West Greenland Cod Mainly Recruited from Icelandic Waters? An Analysis Based on the Use of Juvenile Haddock as an Indikator of Larval Drift. NAFO SCR Doc. 87/31.

Table 1. Percent of recaptures reported in East Greenland and Iceland by NAFO division and tagging area. Total number of recaptures in brackets.

	1A	1B	1C	1D	1E	1F
inside	0	0	0.011	0.032	0	0.107
fiords	(8)	(68)	(94)	(1156)	(25)	(178)
outside						
fiords	0.040	0.024	0.064	0.093	0.383	0.315
	(50)	(1312)	(1241)	(2071)	(222)	(1280)

Table 2. Percent of recaptures reported in East Greenland and Iceland by Year-class and tagging area. Total number of recaptures in brackets.

Year-class	Div. 1B		Div. 1C		Div. 1D		Div. 1E		Div. 1F	
	Fiord	Outside Fiord	Fiord	Outside Fiord	Fiord	Outside Fiord	Fiord	Outside Fiord	Fiord	Outside Fiord
1934										
35		0 (15)		0 (24)		3.6 (55)		3.2 (31)		0 (36)
36		6.7 (15)		0 (15)		13.3 (15)		13.3 (15)		0 (14)
37		6.3 (16)		0 (15)		0 (11)		11.1 (18)		7.5 (40)
38		9.8 (41)		23.1 (39)		1.4 (74)		17.6 (68)		0 (15)
39		0 (30)		0 (38)		0 (12)		2.4 (41)		10.0 (20)
40		0 (221)		0 (202)		0 (76)		1.7 (237)		6.3 (16)
41		1.6 (125)		0 (74)		5.3 (19)		0.9 (108)		8.3 (24)
42		0 (51)		4.5 (44)		0 (38)		11.8 (93)		56.3 (16)
43		0 (152)		7.7 (78)		0 (96)		10.7 (197)		34.0 (53)
44	0 (13)	0 (42)		10.6 (87)		3.1 (32)		9.8 (61)		16.7 (18)
45	0 (21)	1.5 (67)		3.8 (53)		0.5 (186)		9.0 (111)		50.0 (20)
46		0.7 (138)		10.1 (109)		7.8 (64)		9.8 (184)		49.5 (99)
47		0 (34)		6.5 (46)		0 (109)		6.8 (74)		50.0 (20)
48		9.8 (41)		2.3 (43)		7.7 (13)		9.8 (112)		17.9 (36)
49		8.6 (35)		11.9 (59)		5.3 (19)		6.9 (216)		31.7 (41)
50		3.9 (103)		7.2 (97)		5.0 (20)		12.0 (75)		34.0 (103)
51		0 (17)		4.8 (21)		0 (19)		6.3 (16)		40.0 (10)
52		2.1 (47)		7.1 (28)		3.8 (26)		21.1 (19)		43.4 (53)
53	0 (13)	21.4 (14)		38.5 (13)		0 (41)		19.0 (21)		7.1 (14)
54						0 (17)		16.7 (18)		10.7 (47)
55						0 (16)		20.0 (10)		40.0 (20)
56						4.3 (23)		30.8 (13)		27.7 (47)
57						13.3 (15)		26.7 (30)		28.9 (218)
58						0 (17)		37.0 (46)		37.0 (46)
59						0 (19)		41.0 (39)		41.0 (39)
60						0 (19)		26.1 (23)		26.1 (23)
61						3.8 (26)		26.7 (30)		26.7 (30)
62						0 (10)		34.8 (23)		34.8 (23)
63						0 (41)		42.9 (14)		42.9 (14)
64						0 (17)				
66						0 (16)				
67						4.3 (23)				
68						13.3 (15)				
71						0 (17)				
73						42.1 (19)		55.6 (18)		
76						11.8 (17)				
77						10.0 (10)				

Table 3. Results from ANOVA of fractions of recaptures reported in East Greenland and Iceland on year-class and tagging area.

<u>Source of variation</u>	<u>Df</u>	<u>SS</u>	<u>F</u>	<u>P(F>F(obs))</u>	<u>R</u> ²
Year-class	30	6424	3.77	<0.0001	
Tagging area	5	16463	58.03	<0.0001	
Residual	81	4596			0.84

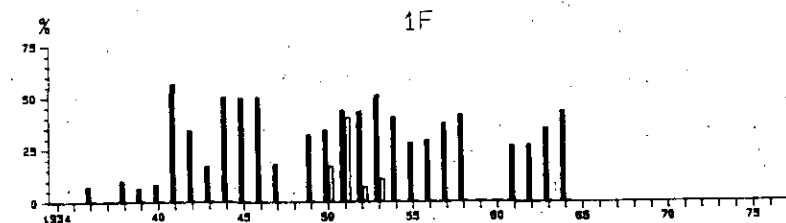
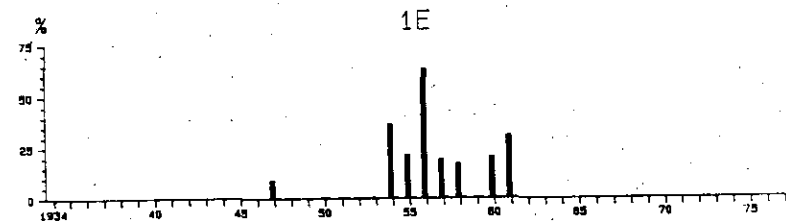
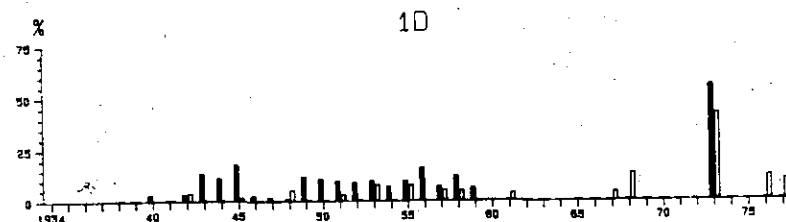
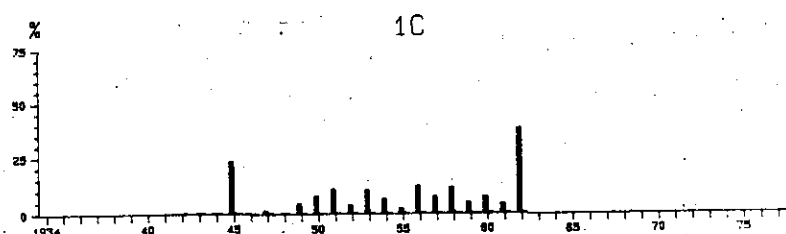
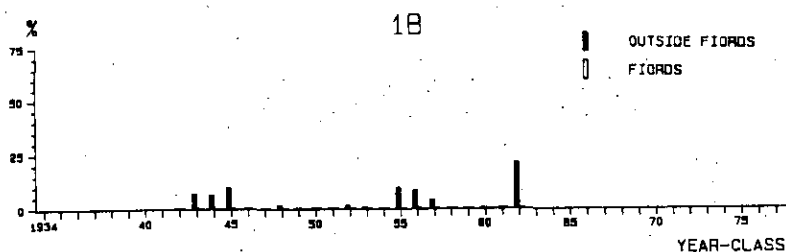


Fig. 1: Percent of recaptures reported in East Greenland and Iceland by year-class and tagging area for each division.

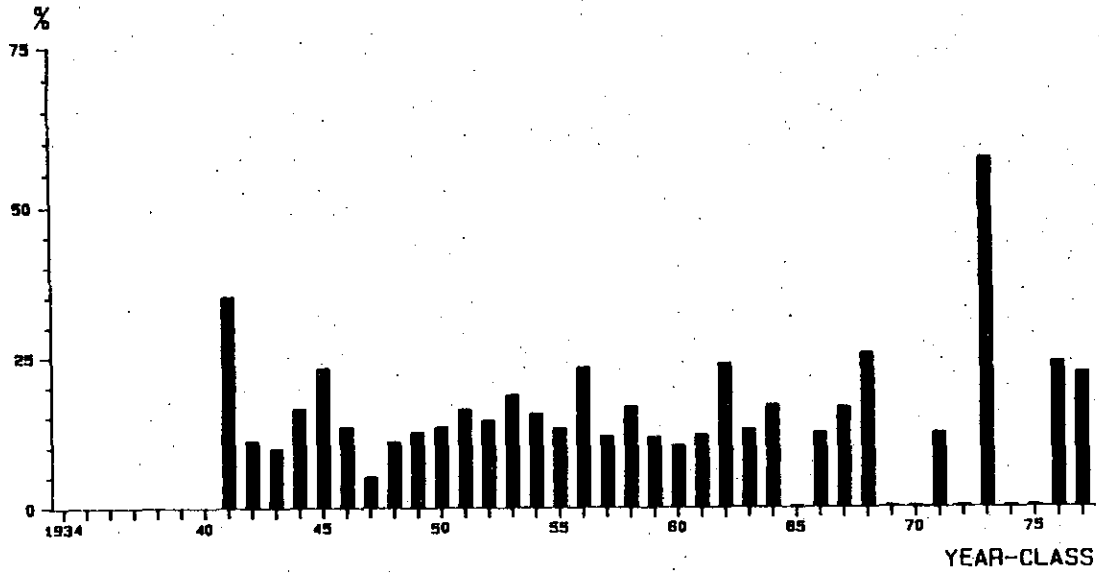


Fig. 2: The year-class effect expressed as marginal means derived from a two-way ANOVA (see text).