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I. Cod Investigations by Arno Meyer

Subarea 1

German trawlers have fished off Greenland for the last ten years. This fishery was - as that of other nations fishing around Greenland - in the beginning only a seasonal fishery, restricted to the spring and summer months. Since 1958 the fishery became, in spite of most difficult weather conditions, expanded over the whole year, and for the last two years it has been so intense that Greenland since 1961 is the most important fishing area for the German trawlers; the development of the fishery is shown in Table 1. The up to now only provisional figures for the fishery off Greenland in 1961 show a landing of 159,000 tons (gutted), of which cod account for 55.6% and redfish for 42.4%. The rapid increase of the catches was in the main caused by a stronger fishery off S. Greenland (Division 1F) and W. Greenland (1B - 1E). Off W. Greenland alone the cod landings increased from 1960 to 1961 to 60,000 tons, or to three times the 1960 landings - also on account of a greater production of salt cod.

Investigations on the cod at sea could only be carried out during a cruise with the "Anton Dohrn", mainly for mesh-size studies off E. Greenland, and during cod-tagging cruise by a commercial trawler. All other data collected are from landings of trawlers, including samples of ungutted cod preserved especially for research. A total of 48 samples are available, including 19,358 length measurements, 8,079 otoliths and 635 observations on maturity.

West Greenland (Division 1B - 1E)

Fishery was carried out off W. Greenland through the whole year, except for the period 16 January to 24 February. Exceptionally low air-temperatures (down to -26°C) obstructed the fishery considerably during March. As already noted in the German Research Report for 1960 (Serial No. 876), German trawlers succeeded for the first time to locate during March (1961) large concentrations of spawning cod far westwards off the Banan Bank in surprisingly deep water, 350 - 550 m. The spawning was at its peak by the end of March and the beginning of April, when 48% of the mature cod were in the spawning stage, 34% were just about to spawn, 14% had finished spawning, and 4% were close to finishing. About 10% of the cod in the spawning concentrations were young, immature cod. The 1953 year-class was predominating with 48% (see Table 2); the 1955 and 1954 year-classes accounted for 17 and 11% respectively. The previously so strong year-classes of 1950 and 1947 only amounted together to 8%. The amounts of immature cod in the year-classes were as follows: 1957 - 100%, 1956 - 100%, 1955 - 16%, 1953 - 5%, and 1952 - 14%. The landings from the trawlers in the preceding period (January to mid-March), from the area Fylla and Banan Bank showed a similar age-composition, with the only difference that here - in more shallow water - the still immature 1956 year-class was the next-strongest with 15% (see Table 2). The mean lengths were about the same, 73.1 cm. in January - March and 73.6 cm. in March - April.

Cod is generally caught in shallower water than redfish. The observations from 1961 show, however, that in the spawning season the cod can be concentrated off West Greenland in greater depths than the redfish. Similar observations of a reversion of the depth-zones for cod and redfish were made during the cod spawning season off S.E. Greenland. Already in the German Research Report for 1960 it was noted that 550 m. was in no way the greatest depth for spawning cod, and that the cod concentrations at this depth had not decreased in strength, only the bottom conditions had not permitted fishery below this depth. The all round hydrographic conditions off West Greenland indicate that the spawning cod must migrate into greater depths due to the deep level of the warm Atlantic component of the West Greenland Current. Therefore, further spawning places, south of 64°N, must be sought for farther westwards than it has been the case up to now. These most recent observations show that the transport of Greenland cod larvae by means of the left branch (towards Baffin Land and Labrador) of the West Greenland Current must be considerably greater than previously considered. It is possible that the varying strength of the year-classes - i.e., the amount of young cod left in Greenland waters - is directly dependent on the depth range and volume of the Atlantic component of the West Greenland Current. The correlation between water temperature and year-class strength, observed by Rasmussen, may, therefore, well be related to the depth range and to the more eastern or western displacement of the warm Atlantic water. The solution of this problem would be a promising part of the international hydrographic researches planned for the next year.

The older year-classes were, as in previous years, found in the area of the southern West Greenland banks, especially at Noname Bank. Here, and in the best fishing season beginning of June, the old and strong 1950 and 1947 year-classes accounted together for 20%, in 1960 even for 38%. Due to the high mean lengths (1950 year-class: 84.1 cm; 1947 year-class: 85.0 cm) of these 11 - 14 years old cod the exceptionally high average for Greenland cod of 76.9 cm was observed (in 1960 75.3 cm). The 1953 and 1954 year-classes predominated at Noname Bank with 31 and 22% respectively (see Table 2).

The autumn and early-winter catches presented a completely different composition of the stocks. The 1956 year-class (with a mean length of 66.1 cm) predominated with 50% in the landings from Fylla and Fiskenaes Banks from mid August to beginning of November, whereas the successful December-fishery on the southern part of Store Hellefiske Bank depended on the exceedingly strong 1957 year-class which accounted for 70%. At the end of the 5th growth season this new-recruited 1957 year-class had an average of 57.5 cm.

The future fishery in Subarea 1 will depend upon these two very rich 1956 and 1957 year-classes. Both present a typical distribution. The 1957 year-class presents (as the once so rich 1947 year-class) a northern distribution, whereas the 1956 year-class (as the famous 1945 year-class) is mainly distributed in the southern Division 1D to 1F, mostly in 1F. The importance of the 1956 year-class to the fishery was already predicted from the German search-trips in 1958. From the now established picture of distribution it can be concluded that this year-class to a considerable extent is derived from East Greenland (possibly also in part from Iceland), whereas the rich 1957 year-class is derived from the West Greenland cod stock. The exhaustive fishery on the rich, older 1950 and 1947 year-classes with the resulting rejuvenescence of the stock is now causing for West Greenland the ending of the period with catches of relatively large fish, and we can for the future expect lower mean lengths for the cod in the catches. Besides the two year-classes of 1956 and 1957, the 1953 year-class will be the only important one in 1962/63.

South Greenland (Division 1F)

The ice-conditions were more favourable in 1961 than in 1960, causing the fisheries for cod and redfish off South Greenland to continue through almost the whole of the winter. The unusual high mean length of 78.7 cm. for the cod caught here from the end of January to mid March is noteworthy. The older 1953, 1950 and 1947 year-classes were predominating in the catches with 40, 17 and 10% respectively. Observations on maturity revealed that this stock was almost exclusively composed of mature individuals in the pre-spawning stage (V). The previous observations, the tagging results and the observed uniform age-and-length composition of the catches from March - April proved that these large cod were migrating toward the spawning places off East Greenland, where the spawning reaches its maximum in April. That the cod during its spawning migration toward the east pass South Greenland in the late winter becomes also evident from the fact that the South Greenland cod-fishery remains idle from mid-March to end of April, to begin only anew in the end of April or the beginning of May, and then again with catches of large cod with an age similar to that found in late winter (see Table 2).

The fishery for the large re-migrating post-spawners changes soon to a fishery for young, immature cod. The catches from mid May to beginning of July were predominated by the rich 1956 year-class (53%, mean length 55.8 cm.) which is especially abundant in the South. In November this year-class had reached a length of 60.2 cm. and increased its frequency % to 76. The slower growth of the cod in the colder water of South Greenland is clearly denoted by the fact that the 1956 cod on Fylla Bank at the same time already had reached a length of 67.8 cm. The 1957 year-class which prevails on the northern banks (1B and 1C) was only observed in few specimens off South Greenland.

East Greenland

(a) Southeast Greenland (Discord Bank to Moesting Ground)

The winterfishery for cod and redfish on the difficult fishing grounds of South Greenland was again much obstructed by heavy ice floats and strong gales, but the few good fishing days were successful. An intense spawning of cod was observed especially on Fylkir Bank and Bille Bank. Also here the spawning cod was observed at great depth, about 400 m. The spawning shoals which were the subject of fishery from beginning of March to beginning of April had almost the same length - and age composition as the landings from South Greenland in January-March (see Table 2). The three most important year-classes, 1953, 1950 and 1947, were represented in the catches by 30, 17 and 13.5% respectively (see Table 3).

(b) East Greenland (Heimland Ridge to Dohrn Bank)

Only few cod were landed from the redfish fishing ground off Angmagssalik. A by-catch of cod, investigated on an "Anton Dohrn" trip, end of July, showed also a predominance of the 1953 year-class (43%), it was followed by the 1950 year-class (19%) and the 1952 year-class (17%). The maturity investigations re-confirmed the earlier observations of the relatively late maturing of the East Greenland Cod. In spite of a mean age of almost 9 years with a length of 83.5 cm., 58% of the cod were still immature. The following percentages of each year-class were immature: 1953 - 60%, 1952 - 76%, 1951 - 46%, and 1950 - 22%.

Since the beginning of the fishery on Dohrn Bank in 1955, this at first pure redfish ground has gradually changed into a cod ground. The bank is fished on through almost the whole year; it presents, however, the most favourable fishing conditions in the winter and spring when the East Greenland cod concentrate there for spawning or pass on its spawning migration to Iceland. For two years this former redfish ground has even sustained a salt cod fishery from March to May.

In all the samples from the Dohrn Bank, from January to December, the rich, older 1953 and 1950 year-classes predominated with 35 and 32%, this means that the cod fished on the Dohrn Bank in 1961 were relatively large as in the preceding years. Thus the Dohrn Bank is actually not a nursery ground for immature cod. Among the few young cod the 1956 year-class is prevailing with up to 21% (see Table 3). This predominance of the 1956 year-class on Dohrn Bank may also confirm the already mentioned conclusion that the rich stock of 1956 cod off south and southwest Greenland originated from East Greenland or from Iceland.

It is to be noted that the 1947 cod which in 1961 still were of considerable commercial importance off South and East Greenland, were almost completely missing in the Angmagssalik and Dohrn Bank areas. The 1947 cod are obviously - judging from the structure of the otoliths and the slower growth rate - West Greenland cod. They originally grew up under conditions of over-population and under-nourishment on the northern banks off West Greenland, then they spread toward the south, appeared since 1954/5 in great numbers off South Greenland, and finally, in 1956 and 1957, they constituted a considerable part of the catches at Angmagssalik and on Dohrn Bank. Since 1958 cod of the 1947 year-class are, however, poorly represented in the catches from Angmagssalik and Dohrn Bank.

Cod Taggings

From October 1959 to October 1960 1728 cod were tagged off S.W., S. and S.E. Greenland. From these taggings a further number of 28 returns were reported in 1961; the total number of returns now being 3.5%. These new results coincide well with the picture of the cod migrations in the Greenland-Iceland area given in the German Research Report for 1960. Five cod tagged in the Noname Bank-Nanortalik area were recaptured at Iceland, all were large, mature fish; four of them were taken off N.W. Iceland, the fifth (1952 year-class, 77 cm. long) had been tagged 1 May 1960 off Nanortalik and was recaptured 18½ months later 1,100 miles away off Glettingnaes (East-Iceland) with a length of 94 cm; it had obviously in the winter 1960/61 begun its spawning migration to N.W. Iceland (one spawning ring in the otoliths), and after the spawning, completed its feeding migration to E. Iceland: another (1950 year-class) was caught 11 months later on the Heimland Ridge.

Six other large cod, tagged in May off S. Greenland (obviously re-migrants from the spawning off E. Greenland) migrated to the region Fylla Bank - St. Hellefiske-Bank. Three of them were caught there within 53 - 76 days after the tagging - mean migration-speed 3.7 - 7.2 miles per day. One cod tagged in the beginning of May 1960 at Moesting Ground (E. Greenland) and belonging to the 1950 year-class was recaptured 16 months later on Fylla Bank. All immature and smaller cod were either considerably stationary or they had migrated toward the coast. The greatest growth observed was 19 cm. (from 45 to 64 cm.) within 17½ months (29-4-1961 to 16-10-1961).

Another tagging experiment was carried out in Nov./Dec. 1961 from a trawler fishing for fresh cod off Angmagssalik and Dohrn Bank. As the cod here were caught with redfish and at great depth, their survival capacity was much decreased. Therefore, only 111 cod were tagged. Returns have not yet been reported.

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Table 1

10 years German fishery off Greenland in t. (figures for 1961 provisional)

Year	West Greenland					South Greenland						
	Cod	%	Redfish	%	Rest %	Total	Cod	%	Redfish	%	Rest %	Total
1952	822	71.8	300	26.2	2.0	1145	1250	95.4	0	0	4.6	1310
1953	668	90.4	1	0.1	9.5	739	1337	85.4	151	9.6	5.0	1565
1954	829	86.0	106	11.0	3.0	964	153	88.4	10	5.8	5.8	173
1955	5753	28.5	13959	69.2	2.3	20170	287	56.6	202	39.8	3.6	507
1956	23669	76.9	6065	19.7	3.4	30780	566	46.5	574	47.2	6.3	1216
1957	7816	34.2	14605	63.9	1.9	22863	964	73.9	268	20.5	5.6	1305
1958	18241	63.9	9252	32.4	3.7	28549	6684	75.4	1732	19.5	5.1	8863
1959	11142	38.3	16042	55.2	6.5	29061	2252	56.4	1558	39.0	4.6	3995
1960	18664	50.9	14894	40.6	8.5	36662	522	8.3	5395	85.5	6.2	6310
1961	60617	63.8	28255	29.7	6.5	95025	9801	38.4	13406	52.5	9.1	25522

Year	East Greenland					Greenland total						
	Cod	%	Redfish	%	Rest %	Total	Cod	%	Redfish	%	Rest %	Total
1952	-	-	-	-	-	-	2072	84.4	300	12.2	3.4	2455
1953	-	-	-	-	-	-	2005	87.0	152	6.6	6.4	2304
1954	-	-	-	-	-	-	982	86.4	116	10.2	3.4	1137
1955	3001	6.5	40948	88.9	4.6	46067	9040	13.5	55109	82.6	3.9	66744
	7437	16.6	33094	74.1	9.3	44683	31672	41.3	39733	51.8	6.9	76681
1957	5838	26.8	13638	62.5	10.7	21804	14619	31.8	28513	62.0	6.2	45971
1958	4553	31.3	8883	61.1	7.6	14538	29478	56.7	19866	38.2	5.1	51952
1959	9691	31.4	19186	62.2	6.4	30869	23082	36.1	36785	57.5	6.4	63927
1960	15378	31.1	30250	61.2	7.7	49421	34560	37.4	50538	54.7	7.9	92389
1961	10938	28.6	25743	67.3	4.1	38234	88348	55.6	67405	42.4	2.0	158784

Cod 1961 West Greenland
Commercial Samples

Cod 1961 South Greenland
Commercial Samples

length cm	Fyllas- Banana- Bank				West of Nona- Banana Bank				Fyllas- Fiskenaes Bank				Gr.Halibut Bank				Thorvaldsen Desolation Nanortalik Thorvaldsen			
	Jan-March o/oo	April o/oo	May-June o/oo	Aug-Nov. o/oo	December o/oo	Jan-March o/oo	April o/oo	May-June o/oo	Aug-Nov. o/oo	December o/oo	Jan-March o/oo	April-May o/oo	May-July o/oo	November o/oo	Jan-March o/oo	April-May o/oo	May-July o/oo	November o/oo		
40-44	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
45-49	3	2	17	9	13	-	-	41	181	6	3	24	-	-	-	-	-	-		
50-54	33	3	37	94	346	-	-	94	346	15	27	230	43	-	-	-	-	-		
55-59	62	9	37	156	193	-	-	208	193	22	48	308	330	-	-	-	-	-		
60-64	130	80	37	208	58	-	-	153	58	85	67	131	336	-	-	-	-	-		
65-69	134	216	79	153	65	-	-	109	65	181	133	60	146	-	-	-	-	-		
70-74	180	316	215	153	69	-	-	97	69	251	214	102	41	-	-	-	-	-		
75-79	194	207	256	199	44	-	-	72	44	238	240	85	38	-	-	-	-	-		
80-84	135	96	199	97	21	-	-	42	21	129	173	41	43	-	-	-	-	-		
85-89	80	39	92	72	8	-	-	12	8	51	70	14	17	-	-	-	-	-		
90-94	32	25	54	42	2	-	-	12	2	13	18	3	5	-	-	-	-	-		
95-99	11	5	14	12	2	-	-	4	2	5	5	1	1	-	-	-	-	-		
100-104	3	1	-	2	-	-	-	2	-	2	-	-	-	-	-	-	-	-		
105-109	2	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-		
110-114	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-		
115-119	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
average	73.5	73.6	76.9	71.3	62.5	78.7	74.4	62.2	63.6											
year class																				
1958	-	6	-	4	699	-	-	92	699	-	1	2	-	-	-	-	-	-		
1957	23	34	84	496	76	-	-	64	76	-	82	530	762	-	-	-	-	-		
1956	150	171	64	45	51	-	-	160	51	31	123	134	103	-	-	-	-	-		
1955	99	117	216	160	34	-	-	33	34	66	126	35	17	-	-	-	-	-		
1954	109	478	306	33	96	-	-	23	96	396	455	168	82	-	-	-	-	-		
1953	413	51	36	33	6	-	-	33	6	64	51	41	15	-	-	-	-	-		
1952	50	25	42	23	6	-	-	33	6	63	11	21	5	-	-	-	-	-		
1951	19	48	121	33	10	-	-	7	10	169	84	42	11	-	-	-	-	-		
1950	41	5	9	7	1	-	-	6	1	11	5	3	11	-	-	-	-	-		
1949	3	4	29	6	3	-	-	6	3	11	14	2	1	-	-	-	-	-		
1948	9	35	75	28	15	-	-	28	15	29	29	19	4	-	-	-	-	-		
1947	61	8	18	3	3	-	-	3	3	103	2	7	4	-	-	-	-	-		
1946	2	1	-	5	-	-	-	5	-	7	16	2	-	-	-	-	-	-		
1945	6	17	-	1	3	-	-	1	3	10	1	1	-	-	-	-	-	-		
1945	15	17	-	1	-	-	-	1	-	16	1	1	-	-	-	-	-	-		
bef.1945																				

Length and age composition of cod of West and South Greenland 1961 (o/oo)

Table 2

C o d 1 9 6 1 E a s t G r e e n l a n d

Comm. Samples Research Samples Comm. Samples Research Sample

South-East Greenland		Angmagssalik		D o h r n b a n k				
length cm	March- April °/°°	July °/°°	November °/°°	January °/°°	April °/°°	July May °/°°	October °/°°	Dec. °/°°
40- 44	-	-	-	-	2	10	-	3
45- 49	-	-	-	-	4	22	1	30
50- 54	-	-	-	3	9	41	5	24
55- 59	3	5	16	11	15	85	13	27
60- 64	15	5	38	14	28	80	19	48
65- 69	73	20	47	39	80	95	25	75
70- 74	185	89	38	153	164	149	91	63
75- 79	278	162	87	192	212	174	144	108
80- 84	223	281	140	213	215	170	206	178
85- 89	131	286	212	196	172	109	193	168
90- 94	62	103	244	116	54	39	148	183
95- 99	20	34	124	34	29	19	94	72
100-104	5	15	42	28	16	7	34	15
105-109	2		12	1	-	-	20	6
110-114	2				-	-	6	
115-119	1				-	-	1	
average length	79.6	83.5	86.3	82.0	79.3	74.0	84.9	80.9
year class								
1958	-	-	5	-	-	23	10	61
1957	-	5	39	4	15	65	37	59
1956	-	34	126	31	79	209	94	147
1955	24	48	107	41	51	84	71	77
1954	56	35	130	82	29	103	55	31
1953	298	434	309	269	350	248	276	260
1952	98	170	67	96	163	38	104	76
1951	88	54	27	74	91	21	45	82
1950	167	189	138	319	149	144	200	171
1949	23	-	36	62	63	39	66	36
1948	44	-	-	14	6	14	7	-
1947	134	26	16	1	4	3	19	-
1946	17	5	-	-	-	-	-	-
1945	33	-	-	7	-	-	13	-
bef.1945	18	-	-	-	-	9	3	-

T a b l e 3

Length and age composition of cod of East Greenland 1961 (°/°°)