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Maturity Stages in March and August of Greenland halibut in Div. 1A, West Greenland

by

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Introduction.

Attention has recently been paid to the life cycle of Greenland halibut (Reinhardtius hippoglossoides Walb.) in the West Greenland area because of an expanding fishery for this species (Riget & Boje,1987). Smidt (1969) advanced a theory on migration pattern of Greenland halibut in the fiords of West Greenland. Smidt assumed a spawning migration to the Davis Strait south of 67oN when Greenland halibut reaches maturity. After spawning fish re-immigrate to the West Greenland fiords. Further spawning in the West Greenland fiords is supposed to be negligible.

This paper provides information on maturity stages of Greenland halibut from two of the most important localities for the Greenland halibut fishery in West Greenland, Jakobshavn and Umanak (Fig.1) with attention on remarkable observations of spent fish. Furthermore is discussed possible spawning grounds for populations in the West Greenland fiords in comparison with Smidt's (1969) assumptions and the suggested spawning migration pattern in Canadian waters (Subareas 0 and 2).

Material and Methods.

Stages of development of the gonads of Greenland halibut were recorded during research fisheries by long-lines and from commercial long-line and gill-net catches of Greenland halibut in Disko Bay and in Umanak District in March 1987, August 1987 and March 1988.

The March 1987 and 1988 samples were taken from catches of the commercial ice-fishery in Jakobshavn Icefiord and around Umanak. Of the March samples from Umanak the 1987 sample was taken from both gill-net and long-line fishery while the 1988 sample was taken mainly from long-line fishery. Of the March samples from Jakobshavn the 1987 sample was taken from both gill-net and long-line fishery, while the 1988 sample was taken mainly from gill-net fishery. The August 1987 samples were taken from a research fishery by long-line off Jakobshavn Icefiord, a nearby icefiord and the fiords in Umanak District. All catches were taken in the depth range about 200-800 m with bottom temperatures ranging between 1.4 C and 2.6 C in August.

A total of 4759 Greenland halibut were examined. Length measurements were recorded as total length to the centimeter below. Length ranges from 34 cm to 107 cm for females and for males from 34 cm to 83 cm. As definitions of maturity stages varies between researchers, maturity was recorded in three broad stages as described in the text table. It must be mentioned that spent males can very well have been included in the recordings of stage I males.

Text table. Maturity stages used for visual analyses of Greenland halibut.

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females:

stage I: juvenile,immature or maturing with eggs less than 2 mm, if eggs visible less than half of eggs clear.

stage II: ripe condition or running stage; contents are almost liquid or in running stage with some eggs extruded, eggs more than 2 mm.

stage III: spent stage; ovary appears reddish purple in appearence, wall is thick and tough and some clear or opaque eggs may be seen.

males:

stage I: juvenile, immature or maturing with length of testes less than 3/4 of length of abdominal cavity. The stage might include the spent stage.

stage II: including ripe and running condition with testes big and white with a length of more than 3/4 of length of abdominal cavity.

Results.

Table 1 presents occurrence of maturity stages of female Greenland halibut. In the August samples only maturity stage I was recorded. With the exception of the March 1988 sample from Umanak only 4 females were observed in ripe or running condition and 4 in spent condition of a total of 968 females recorded in March in Umanak and Jakobshavn. The sample from Umanak in March 1988 differs from the other March samples since 50 spent females were recorded, corresponding to 23% of fish longer than 80 cm in comparison with 0-1% for the other samples (it is assumed that females become mature at 70 - 80 cm ,Smidt 1969). Generally, stage II and III fish were observed only among fish greater than 70 cm. The frequency of these stages increase with increasing length.

Among males only stage I and II were recorded (Table 2). Maturity seems to differ between samples from the two localities Jakobshavn and Umanak, of which Umanak generally shows a greater part of fish in ripe condition or running stage than does Jakobshavn. Percentage of males above 60 cm in stage II ranges between 9% and 13% for Umanak and between 0% and 1% for Jakobshavn (it is assumed that males become mature at about 60 cm, Smidt 1969). There seems to be a tendency towards a higher stage of maturity with

increasing length although the tendency is less clear than for females.

Discussion.

The data may be biassed as samples were taken unevenly from the gill-net fishery and the long-line fishery which are supposed to select differently among fish in ripe/running condition. Thus, fish in ripe or running condition are not expected to react to the bait of the long-lines. However, there does not seem to be any difference between the samples concerning the ripe/running females. As regards the abundance of males in ripe/running condition the difference between samples cannot be explained by gear selection.

The relatively few observations of female Greenland halibut in ripe or running condition indicates that no or only very sparse spawning takes place in the area of sampling. This may be due to the temperature conditions limiting to the gonad development (Riget and Boje, 1987). However, the high amount of spent fish observed in Umanak in March 1988, may suggest spawning in this area. That spawning might be local and probably occur sporadically is supported by the fact that spent fish were found only in Umanak and no similar observations were done at the same time in Jakobshavn which is situated less than 100 nautical miles from Umanak, and that the abundance of spent fish seems to vary considerably between years. However, it may be possible that these fish can be immigrants from spawning grounds in the Davis Strait south of 67oN.

The only other information available on maturity in West Greenland waters is from Smidt (1969), who, in a selected sample from Godthaab Fiord in March 1954, found a considerable amount of spent females (table 3). 10 females were recorded in spent stage composing 12% of those above 80 cm, while only one specimen in ripe/running stage was observed. These findings support the observations from Umanak in March 1988.

In contrast to the females, males in ripe/running stage were recorded in considerable amounts in the Umanak samples. This suggests that males must participate in spawning nearby or in the area of Umanak. The few stage II males observed in Jakobshavn are in accordance with the few stage II/III females.

The observations of spent females in March indicate a participation in spawning in mid-winter. The high number of ripe/running males in March, also supports this time of spawning although males seem to be delayed in time of year in gonad development. The observations of ripe/running males in August further show that spawning might occur at other times of the year as well.

Smidt's data (1969) as well do not give any clear tendency for the time of spawning, as he found specimens in ripe condition in March, June, July and August and spent fish were observed from March to June.

Smidt (1969) interpreted his observations of spent females in Godthaab Fiord and Julianehaab Fiord, as a re-immigration of post spawners to the West Greenland area from spawning grounds in the Davis Strait south of 67oN. If Greenland halibut in Umanak behave similarly the distance of migration is considerable as the distance from Umanak to the proposed spawning grounds south of 67°N are more than 300 nm in comparison with less than 100 nm from these grounds to Godthaab and Julianehaab.

Spawning migrations on the Canadian east coast as described by Templeman (1973), Zilanov et al. (1976) and Bowering (1978) are assumed to be a stepwise migration over several years towards spawning grounds south of the submarine rigde at 67oN. After having reached spawning grounds the mature fish remain in the area although Atkinson and Bowering (1987) suggest a migration to the West Greenland fiords in the non-spawning period.

Tagging experiments indicate stationarity of Greenland halibut in the West Greenland fiords (Riget & Boje 1987) although a migration to the Davis Strait cannot be rejected. However length composition of Greenland halibut in the commercial fishery at West Greenland seems to be rather constant throughout the year, (unpublished data of the Greenland Fisheries Research Institute) which suggests that no yearly migrations occur between the Davis Strait and the West Greenland fiords. Moreover, fish above 80 cm appearing in the commercial fishery in Umanak have not been found in similar quantities in the Davis Strait at any time of the year.

Therefore, if Greenland halibut in the West Greenland fiords participate in spawning in the Davis Strait, the spawning migration occurs in another way than the spawning migration along the Canadian east coast. More likely, the population of Greenland halibut in the West Greenland fiords constitutes a dead end of the Davis Strait stock complex and local spawning may occur sporadically. Future investigations covering other times of the year than those presented here can undoubtly give valuable information.

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Table 1. Maturity of female Greenland halibut in numbers by length and maturity stage.

Length (cm)	Locality: Umanak							Jakobshavn					
	March 1987			March 1988			August 1987	March 1987		March 1988			August 1987
	I	II	III	I	II	III	I	I	II	I	II	III	I
30-39							13						24
40-49							50						126
50-59				4			77	26		21			396
60-69	48			61			118	67		88			472
70-79	102	1		123	1	3	254	93		52			144
80-89	89	1		96	1	11	212	73		80			80
90-99	48		2	48	1	15	61	33	1	81	1		22
100-109	9			12		21	8	17		33		2	1
no of fish	296	2	2	344	3	50	793	309	1	355	1	2	1265
% > 80 cm	98	1	1	76	1	23	100	99	1	98	1	1	100

Table 2. Maturity of male Greenland halibut in numbers by length and maturity stage.

Length (cm)	Locality: Umanak						Jakobshavn				
	March 1987		March 1988		August 1987		March 1987		March 1988		August 1987
	I	II	I	II	I	II	I	II	I	II	I
30-39					8		1		1		21
40-49					29		3		2		57
50-59	2		4		39		42		13		194
60-69	57	3	65	3	77	1	67	1	47	1	207
70-79	79	12	51	8	30	14	70	2	36		64
80-89	3		2	1		1	4		6		4
90-99	1						2				
100-109											
no of fish	142	15	122	12	183	16	189	3	105	1	547
% > 60 cm	90	10	91	9	87	13	98	2	99	1	100

Table 3. Maturity of Greenland halibut in numbers by length and maturity stage from a long-line catch in Godthaab Fiord, March 1954 (modified after Smidt, 1969).

Length (cm)	females			males	
	I	II	III	I	II
40-49	1				
50-59	6			5	
60-69	32			20	2
70-79	45	1			
80-89	29			1	
90-99	29				
100-109	15		4		
110-119	4		6		
no of fish	161	1	10	26	2
%females > 80 cm	89	0	11		
%males > 60 cm				93	7

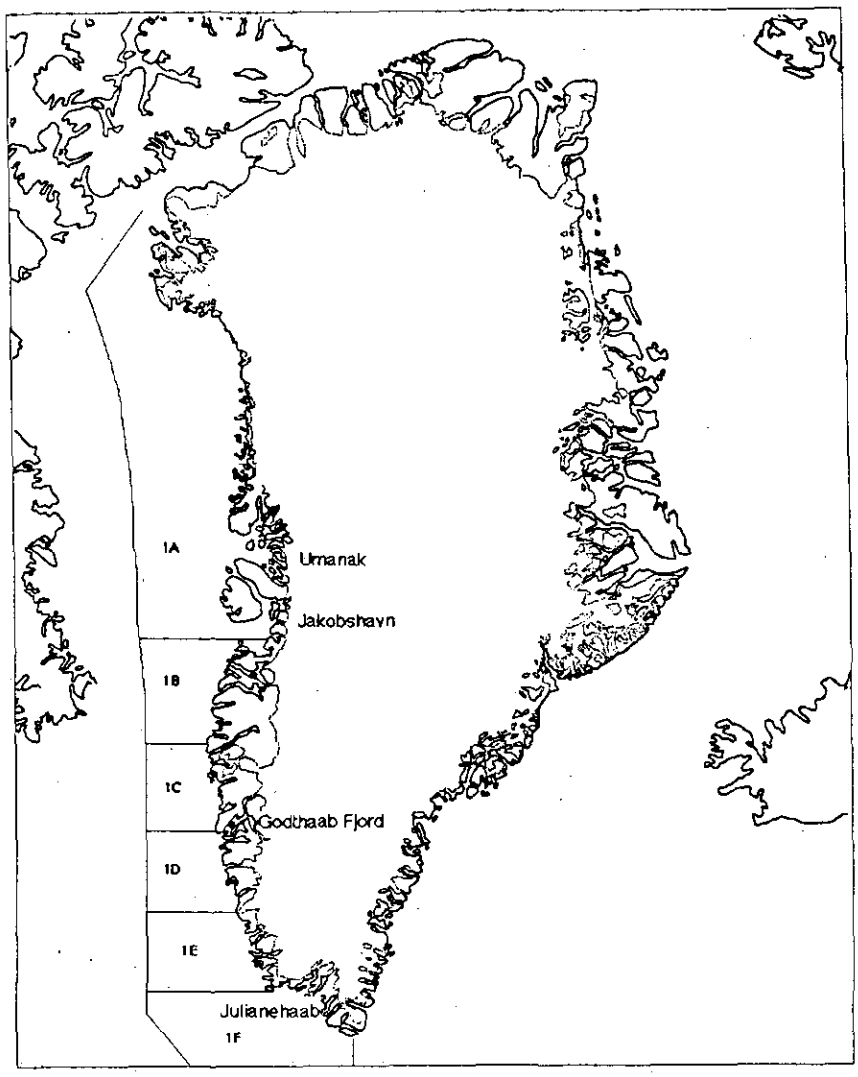

Fig. 1. Map showing localities mentioned in the text.