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Maturity of Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides*)

by

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Abstract

The maturity cycle of Northeast Arctic Greenland halibut was studied on two locations in the spawning area, in the continental slope of Northern Norway. Ovaries were collected once a month throughout 1997. Samples from ovaries were mounted in Technovit®. Sections were studied in the microscope, aiming to describe the maturity process throughout the year. Together with diameter measurements of oocytes from each month and field observations of Greenland halibut females, the study has increased the knowledge about the maturity process of Northeast Arctic Greenland halibut females. Measurements of oocyte diameter show a pattern that supports the hypothesis about peak spawning in November-January. After spawning in January and February, oocyte distribution was uniform with a peak between 500 and 900 micrometers. In March-April a peak of oocytes was separated from the early maturing oocytes and this peak grew steadily until spawning. In August this peak was found between 1 700 and 2 200 micrometers. In October-November the peak was between 2 400 and 2 700 microns. The maturity process of the oocytes is described through histological analyses, which also are used to study extent of atretic oocytes during the maturity cycle.

Key words: Greenland halibut, Barents Sea, reproduction, maturity, oocyte development, oocyte distribution, atresia

Introduction

The Northeast Arctic (NEA) Greenland halibut *Reinhardtius hippoglossoides* (W.) is mainly distributed along the continental slope of Norway from 62°N to the waters north and east of Spitsbergen, and is considered as a separate management unit. Spawning is mainly located between 70-75°N. Maturation has been poorly described. Peak spawning is observed in November - January (*Albert et al*., 2001). Eggs and larvae drift with the currents to the areas north of Spitsbergen or into the Barents Sea. Nursery grounds for ages 1-3 years are mainly located north and east of Spitsbergen. Greenland halibut recruit to the fishable stock at about 6 years old.

In the Atlantic Ocean a total of 5 management units are defined, comprising the following areas: Gulf of St. Lawrence, Northwest Atlantic (Canada and West Greenland), Inshore West Greenland, the West Nordic component comprising East Greenland, Iceland and the Faeroe Islands, and finally the NEA Greenland halibut.

Based on the experience obtained during an extensive Norwegian research programme, our hypothesis was that spawning of NEA Greenland halibut is mainly confined to winter with a peak spawning in December.

The main objectives of this study were to obtain information on:

- Maturity cycle of females based on field observations, followed by histological analyses
- Oocyte growth during the maturity process
- Changes in gonad and liver indices during maturation

Material and Methods

In 1997 female gonads were sampled monthly from longline catches in the spawning area. Ovaries were staged (Table 1) and preserved in 3.6% buffered formaldehyde at sea (Fig. 1).

Ovary tissue was embedded in Technovit for microscopic analyses (Fig. 2). The method comprised of:

- Dehydration in ethanol (4 steps)
- Infiltration of Technovit (3 steps)
- Polymerisation and mounting
- Sectioning and staining

Oocyte diameter:

Whole mount preparations were used. Oocytes were measured by the longest and shortest axis (the mean was used as a measure for diameter).Test of roundness excluded deformed oocytes

Gonadosomatic index (GSI) was expressed as:

Gonad weight (GW) / (Round weight - GW)

Liver index (HSI) was expressed as:

Liver Weight / (Round weight - GW)

Results

Immature ovaries were characterised by peri-nucleolar oocytes. Cortical alveoli appeared first as a distinct peripheral ring for later to appear in a wider bond (Fig. 3).

Yolk (vitellogenesis) appeared first singly and peripheral, then in the entire cytoplasm. Yolk granulas grew continously until late maturity when merging together. After spawning post-ovulatory follicular cells were noticed.

Oocyte growth indicated peak spawning in November-January (Fig. 4). After some recovery time a group of oocytes started growing, maturing for the next spawning season. A group of oocytes <1 000µ was present all year.

GSI increased from immature to late maturing ovaries (Fig. 5 and 6). Overall, GSI ranged from 0.1-19.3% (Table 1).

Acknowledgements

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Referrence

ALBERT, O.T., E. NILSSEN, A. STENE, A.C. GUNDERSEN, AND K.H. NEDREAAS. 2001. Maturity classes and spawning behaviour of Greenland halibut (Reinhardtius hippoglossoides). Fisheries Research, 51: 217-228.

Table 1. Gonadosomatic index (GSI, %) of female Greenland halibut, with respect to maturity stage (SD=standard deviation).

Maturity	N	Mean GSI	Min GSI	Max GSI	SD
1	129	0.7	0.1	2.1	0.4
2	151	2.1	0.5	5.9	1.1
3	103	4.6	1.3	10.4	1.9
4	67	9.4	4.2	19.3	3.3
5	1	3.7			
6	23	3.4	2.3	4.7	0.7
7	5	1.3	0.1	2.2	0.9
Total	479	3.3	0.1	19.3	3.3

Fig. 1. Greenland halibut ovary used in the analyses.

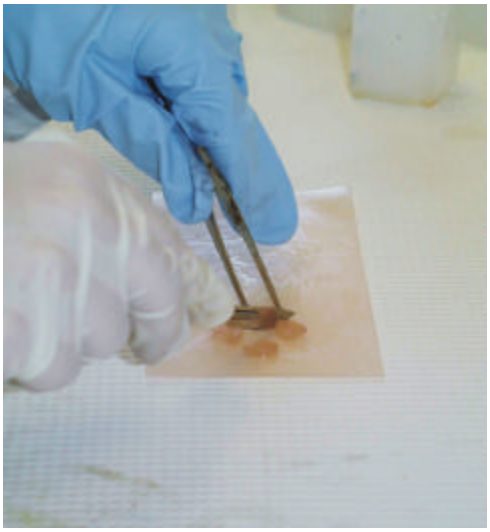

Fig. 2A. Preparing sections.

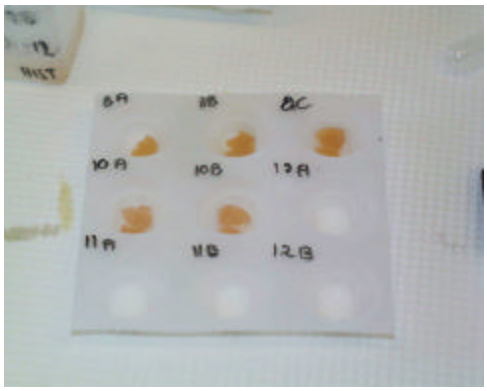

Fig. 2B. Embedding.

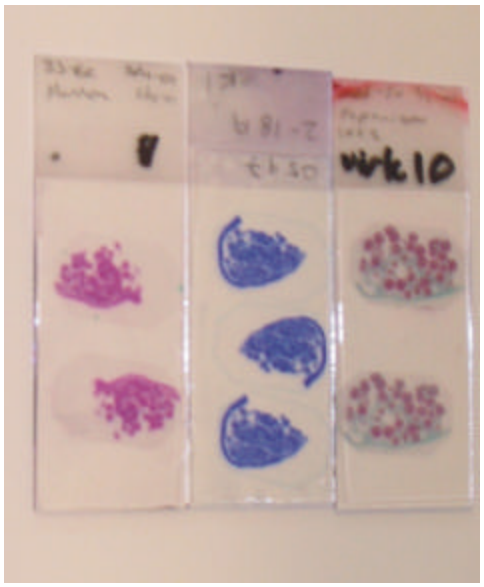

Fig. 2C. Sections.

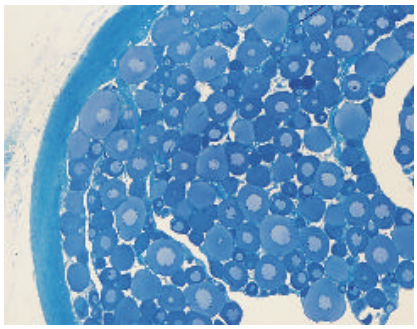

Fig. 3A. Immature Greenland halibut. stage.

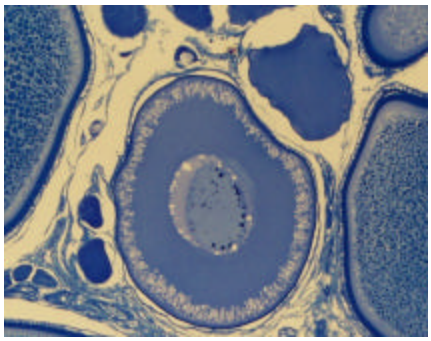

Fig. 3B. Maturing Greenland halibut. Cortical alveoli

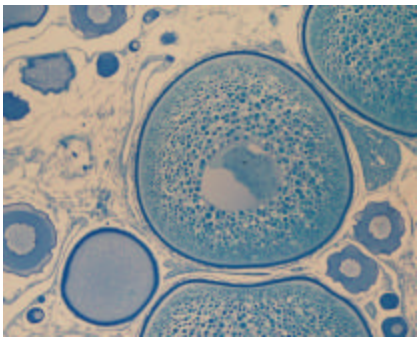

Fig. 3C. Maturing Greenland halibut oocyte: Early vitellogenesis.

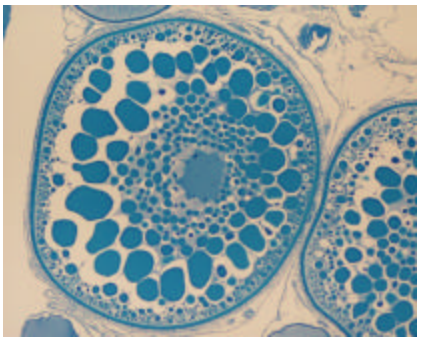

Fig. 3D. Maturing Greenland halibut. Vitellogenesis.

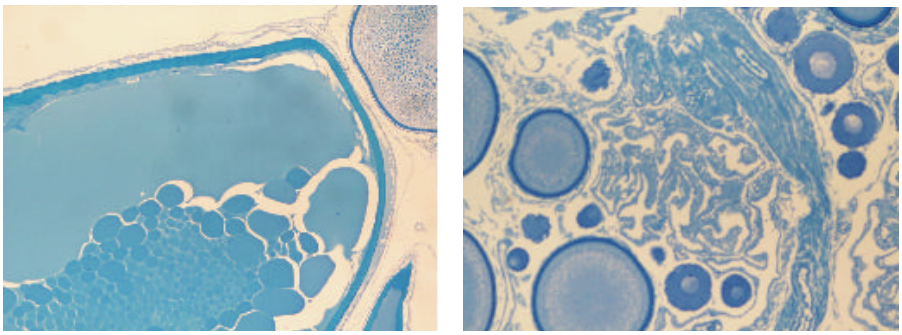

Fig. 3E. Late maturing (left) and spent (right). In the left picture one can see the young granulas merging together.

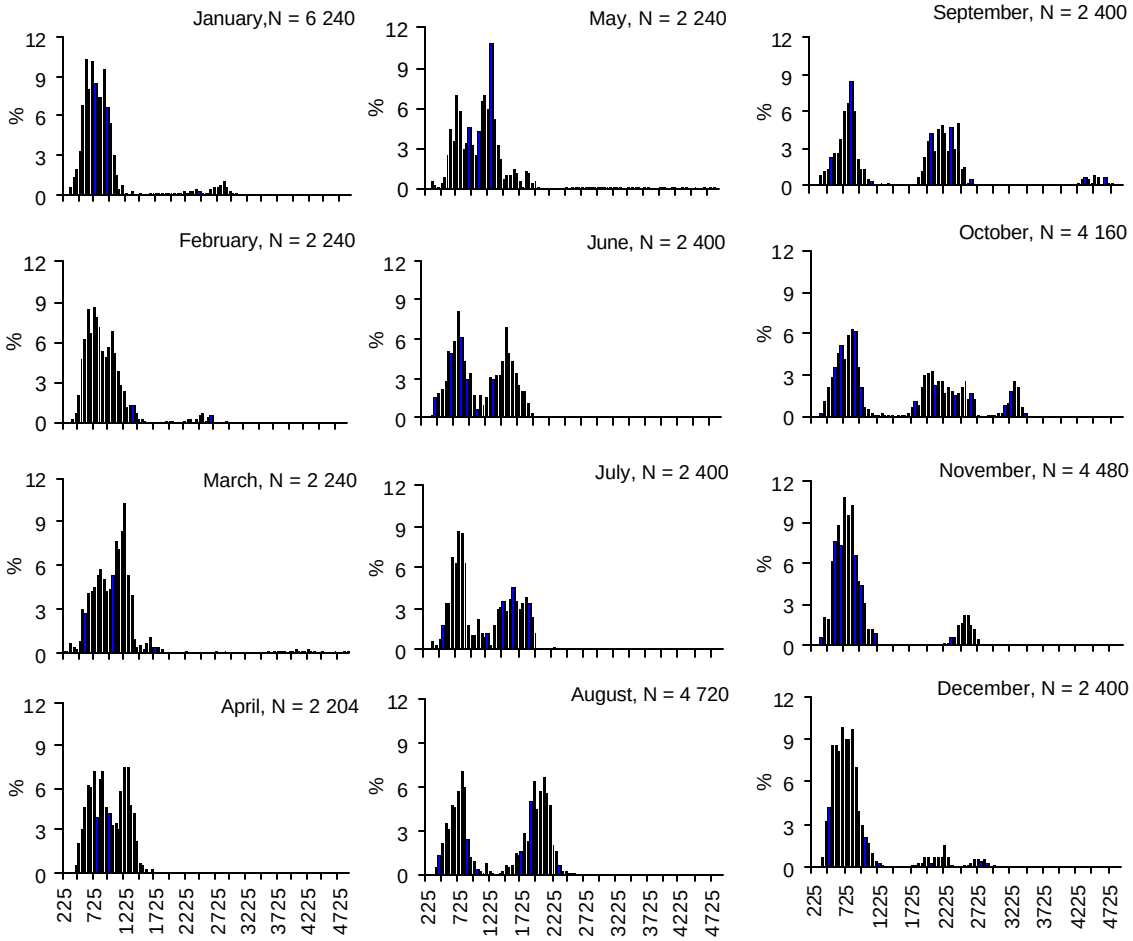

Fig. 4. Oocyte diameter development of Greenland halibut throughout the year based on samples taken monthly in the spawning area (N = number of oocytes).

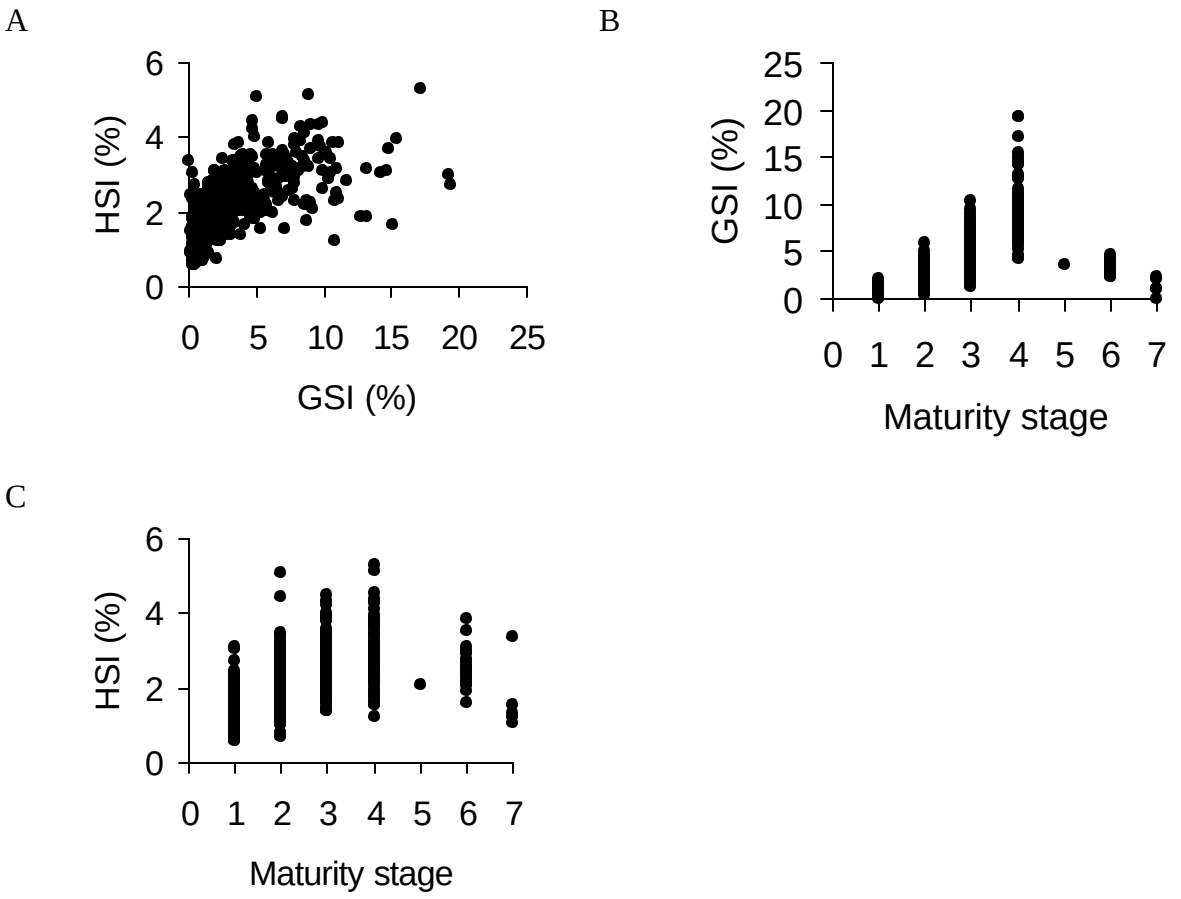

Fig. 5. Relationships between Gonadosomatic index (GSI, %), Liver index (HSI, %), and maturity stage. A) GSI vs. HSI. B) Maturity stage vs. HSI. C) Maturity stage vs. GSI.

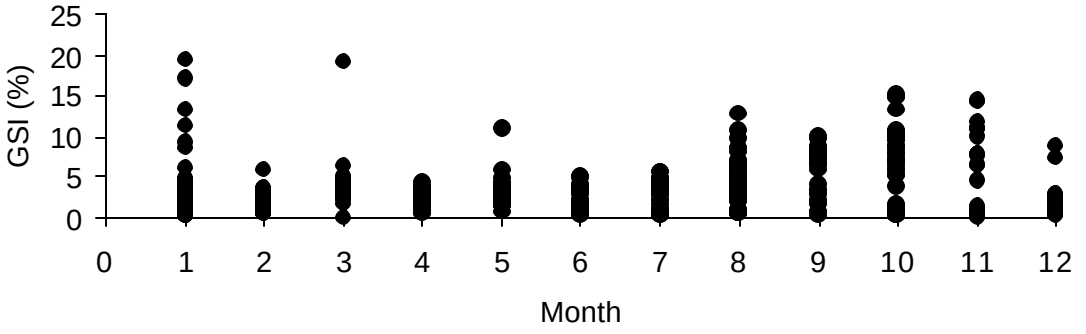

Fig. 6. Gonadosomatic index (GSI, %) vs. month (1(January)-12 (December)). GSI = gonad weight *100% /(round weight – gonad weight).