Determination of maturity stages of Greenland Halibut (*Reinhardtius hippoglossoides W.*)

Objectives

*Investigate and determine the maturity stages of Greenland Halibut*

- Establish a sampling protocol for collecting blood samples from Greenland halibut.
- Analyse blood samples and histology samples for determining early maturity stages of Greenland Halibut.
- Verification of visual (subjective) maturity classifications that are basis for spawning stock estimates through histological assessment of ovaries and blood samples.

Main supervisor

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This master project is part of the CLIMA project (“Changes in fish distribution and species composition as a result of climatic changes in the East Greenland Ecosystem: implications for fisheries and management”), and aims to study and estimate the maturity stages of Greenland halibut, particularly looking at the differences between stage 2 and 3, and way to distinguish them (fig. 1). Such knowledge is important for stock assessment/management and will provide a better overall understanding of the species biology and reproductive strategy.

Background

Greenland halibut (Reinhardtius hippoglossoides W.) is a deep-water boreal species inhabiting large areas of the North-Atlantic. It has the biological characteristics of a typical deep-water species: slow growth and late maturation. Even though Greenland halibut are an important commercial resource, knowledge of its reproductive biology is relatively sparse. Males mature at lengths of about 40–50 cm while females mature at about 50–60 cm (Morgan et al., 2003). They have a low fecundity (Gundersen et al., 1999) with very large eggs; developing oocytes have been documented as large as 2.4 mm (Gundersen et al., 2016) and eggs collected in the field have been documented as large as 4.17 mm (Magnússon, 1977). Greenland halibut populations are known to exhibit a yearly maturation cycle with an extended spawning season; in the area around Iceland this runs from January until March (Morgan et al., 2003). Several studies have examined fecundity in Greenland halibut from several areas including the Northwest Atlantic (Lear, 1970; Bowering, 1980; Serebryakov et al., 1992; Junquera et al., 1999, Rideout et al., 2012), Northeast Arctic (Gundersen et al., 1999; Gundersen et al., 2000) and Iceland (Gundersen et al., 2009). However, sampling time in respect to time of year varies considerably between these studies.

In order to calculate stock reproductive potential (Trippel, 1999) it is essential to have accurate estimations of fecundity. The use of inaccurate values of fecundity can result in inaccurate perceptions on the state and productivity of a stock.

Maturity and maturity processes of Greenland halibut have been studied intensively during recent years. An important conclusion is that Greenland halibut needs more than one year to mature a batch of eggs. Consequently, it has been agreed upon that early maturing females should not be included in the spawning stock estimate as they are not likely to participate in the upcoming spawning event. Even if these fish are maturing they are functionally immature (Figure below). More research on this aspect is needed and vital for a better understanding of this maturation strategy and in order to improve our ability to distinguish between the early stages of maturity (ICES WKBUT 2013). In this project, you will address this part by introducing hormone analyses of the fish blood in different stages of maturity and compare with histology results of gonads.
Methods:

**Field work:** Gonads and blood samples for in depth maturity study will be collected on the IMR Fall survey during fall 2017.

*Figure 1: Maturity cycle of Greenland halibut females as established by the WMSRGH*

*Figure 3: Sampling ovaries*

*Figure 2: Blood sampling of fish*
Lab work: Blood samples (plasma) will be analysed for vitellogenin (and possible other proteins/hormones) to verify and determine maturity stages (protein quantification: high performance liquid chromatography coupled to electrospray ionization tandem mass spectrometry (HPLC-ESI-MS/MS). Exact type of method and analysis will be decided.

The gonad samples will be used for histology (in situ hybridization (method described by Gundersen 2002; 2003) to look at gonad maturity stage and compare this with corresponding results from the blood samples.

Combining and comparing results of these two methods will give a determination of the early stages of gonad development. Previously determined maturity stages will be corrected according to findings, and might give a new picture of the stocks reproductive strategy.

Data collection: Maturity data will be available from several ongoing surveys (East Greenland deep water survey, GN, Fall survey IMR) on individuals of Greenland halibut (length, weight, maturity stage, gonad weight).

Approach: Developing protocols for blood sampling. Descriptive maturity studies. Comparing different maturity classification. Results will independently or in combination with other results from the CLIMA project, be published in a scientific journal.

As part of the CLIMA project you will be invited to present your results for the project group, and if of interest, present poster at a relevant conference.

You are welcome to external stay at The Greenland Institute of Natural Resources in Nuuk or at Møreforsking in Ålesund, where you will be provided with an office (accommodations partly covered).

For any questions, please contact:
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