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On Greenland Halibut: Otolith analysis as an IDE to life history changes. A sub-system for modelling and management.

by

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Abstract

The task is part (a sub-system) of a "top-down" system dynamics modelling (described by a non-linear GAM) on *Greenland Halibut* (GH) based on both variable population parameters (carrying capacity, K_i; intrinsic rate of increase, r_i and natural mortality, M_i) and responses to the combined effects from both the environmental forcing and past fishing mortality. The main goal of this work is to produce a framework for both sustainability and conservation. The (laser ablation, spectrometrical) analysis of trace element series may allow for the inference of life history and environmental factors which affect the spatio-temporal evolution of the population: stepwise recruitment from age class 0-1, age at recruitment to the population, timings, feeding and habitat/depth changes and speed of growth, among others. In the first stage of this task, we attempted to estimate the age (without the need for isotope marked otoliths) and recruitment process out the series from the trace elements *Magnesium* (Mg, a proxy for feeding, probably biased by predation on shrimps) and *Barium* (Ba, a proxy for salinity) series (N=2059). To comply with both the Central Limit Theorem and conditions for statistical normality, we sampled 39 out of 144 otolith series and showed what we considered a "typical" example of an adult, large individual (a 94 cm, female, captured within the Davis Strait area at 1189 mts of depth). We worked on the raw, log transformed and standardized data. Also, we assumed that there would be (i) periodic peaks in Mg accumulation and (ii) we could infere the timing for the recruitment process, age and different life history aspects from splitting up the series using smoothers (simple regressions, cubic splines, locally weighted scatterplot smoothings (LOWESS) and B-splines) and *R* programming to determine maxima, minima, zero slopes, inflection points, spectrum and frequencies of processes from the multi-resolution decomposition (MRD, a wavelet analysis) of the data. By exclusion of frequencies, we could determine (D6 processes in the wavelet analysis): (i) yearly processes in Mg accumulation and age (24 years old); (ii) five discrete life history stages (2 for pre-recruits aged 0-6 and 3 for adults aged 7-12, 13-20 and 21-24 years); (iii) age-at-recruitment to the population (during the 6^{th} year) and several migration patterns linked thereby. The knowledge acquired by this method may be translated to major improvements both in modelling, management and sustainable (short term, six years) exploitation strategies. However, there are processes and patterns of higher resolution in the signals which remain to be investigated.