

Age, growth rate, and otolith growth of polar cod (*Boreogadus saida*) in two fjords of Svalbard, Kongsfjorden and Rijpfjorden

Authors: Fey D.P., Węśławski J.M

Abstract

This work presents biological information for polar cod (*Boreogadus saida*) collected with a Campelen 1800 shrimp bottom trawl in Kongsfjorden (two stations located in the inner part of the fjord adjacent to the glacier) and Rijpfjorden (one station at the entrance to the fjord) in September and October 2013. The otolith-based ages of polar cod collected in Kongsfjorden (6.1 to 24 cm total length TL; n=813) ranged from 0 to 4 years. The growth rate was relatively constant at approximately 4.7 cm year⁻¹ between years 1 and 4, which indicates that growth was fast in the glacier area. The ages of polar cod collected in Rijpfjorden (8.6 to 15.9 cm TL; n=64) ranged from 2 to 3 years. The fish from Rijpfjorden were smaller at age than those from Kongsfjorden, and their growth rate between years 2 and 3 (no other age classes were available) was approximately 3.3 cm year⁻¹. In both fjords, males and females were of the same size-at-age and the same weight-at-TL. The low spatial scale of the origin of samples, the results on growth rate are not representative of the entire fjords. Instead, the results can be discussed as presenting the possible growth rates of some populations. A strong relationship was identified between otolith size (length and weight) and fish size (TL and TW), with no differences between males and females or the fjords. A significant, strong relationship was also noted between fish and otolith growth rates.

Keywords: Arctic; fish growth; annual rings; sagitta.

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Determining thermal preferences and limits of fish and zooplankton species using trawl survey observations

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Abstract

Geographic distributions of fish and zooplankton have been widely linked to temperature. While organisms may tolerate a range of temperatures, they do not thrive at the range extrema. Temperature exerts control over enzymatic function that in turn controls critical life processes such as growth, reproduction, and migration. To date most studies of thermal optima and extrema use controlled laboratory experiments. While this method allows the control of factors other than temperature, it is resource intensive and therefore few species' thermal preferences are known. Furthermore, methodological differences contribute to varying results within species. It would be valuable - and perhaps more reliable - to calculate thermal optimums and limits from *in situ* data that is inherently subject to a range of ambient temperature scenarios over a time series. We hypothesized that it would be possible to derive species-specific thermal preferences and/or limits from survey data. Surveys along the United States Northeast continental shelf from Cape Hatteras, North Carolina up to Nova Scotia have collected fish and zooplankton abundances with paired temperatures since 1968 and 1977, respectively. Several methods (single parameter quotient, cumulative distribution function, and generalized additive model) were used to define ranges of thermal preferences and limits of several zooplankton and fish species. For each species, observationally derived temperature thresholds were compared to experimentally derived thresholds in the literature to determine which methods, if any, produced accurate results. Preliminary results suggest that the best methods vary across species.

Keywords: temperature, thermal preference, fish, zooplankton

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Re-visiting the drivers of capelin recruitment in Newfoundland since 1991

Authors:

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Abstract

Capelin (*Mallotus villosus*) is a small forage fish that plays a key role in the transfer of energy from secondary producers to vertebrate predators in Arcto-boreal food webs. Previous research found that capelin larval survival and year-class strength was related to onshore winds. Profound changes in abundance and distribution of capelin occurred in 1991 in Newfoundland, which corresponded with the collapse of the groundfish stocks. There is evidence of a recent (2011-2015) population increase. We re-assessed the relationships between larval survival, recruitment, and onshore winds post- 1991. We also investigated the link between larval capelin vital rates (growth) and recruitment for three current years of data: 2002, a collapsed population state; 2006, a transitioning state; and 2013, a recovering state. There was a positive relationship between the age-2 recruitment and larval abundance. There was no relationship between onshore winds and recruitment post-1991, which may be an important factor in the lack of population recovery in capelin over the past two decades. Recruitment at age-2 was, however, related to *Pseudocalanus* sp. densities. Increased availability of preferred prey in autumn, due to a shift in zooplankton phenology seen around 2006, may be an important driver of recent larval survival. We found faster growth in the recovering population state (2013) compared to the other two years. This study provides an important update on capelin larval research from the 1980s and provides new data on the drivers of capelin recruitment.

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Deciphering the relationship between historical abundance fluctuations in the offshore Atlantic cod (*Gadus morhua*) stock around Greenland and the environment

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Abstract

The Greenland offshore stock of Atlantic cod (*Gadus morhua*) was historically subject to strong abundance fluctuations. With a Total Stock Biomass (TSB) of more than 4 mio tons, the stock was the second largest Atlantic Cod stock in the world and produced catches of up to 460.000 tons annually. Because the last assessment was done in 1996 and in order to get reliable up-to-date abundance and fishing mortality estimates, we used two different stock assessment models, SAM and XSA. Results show, that TSB dropped by more than 90 % between 1967 and 1975. Indices for sea surface temperature and salinity at 100 m depth indicate that the major part of the collapse was attributed to drastic changes in the environment. Environmental parameters as well as abundance indices show significant regime shifts in the 1960s, when temperature and salinity dropped steeply. Such hydrographic changes could be carried by the East Greenland current into our study region. Although fishing mortality F was with values of ~ 0.4 - 0.6 above long-term sustainable levels, it did not show a substantial increase during the collapse. From historical records and our findings, we conclude that environmental fluctuations regularly cause changes in the Greenland ecosystems. When biomass was low in the late 1980s and early 1990s, excessive fishing mortalities with values of ~ 1 - 2 on the oldest age classes depleted the stock and reduced its productivity for the coming 25 years. Models show that the stock is still at negligible levels, compared to its historical size.

Keywords: Greenland cod, East Greenland Current, Environmental drivers, Fishing mortality

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Regional differences in Ocean Conditions and Groundfish Distributional Changes in the Gulf of Alaska

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Abstract

It has been increasingly accepted that many species are on the move in many regions associated with climate variability. Here we report the different ocean conditions and corresponding groundfish distributional changes in the Gulf of Alaska (GOA) based on long term bottom trawl survey in the summer of 1996-2015. A group of commercially exploited fish species of gadids, sablefish, rockfish, and flatfish were selected as representatives for the GOA and length bins were chosen through expert opinion to capture ontogenetic differences in distribution for each species. As the survey started in late May in the western GOA, the temperature increased during the survey moving eastward. We thus separate the whole gulf into western, central and eastern GOA to solve the spatial and temporal issue. We show larger sea bottom temperature swings between warm and cold years in the western GOA than those in central and eastern GOA. We computed the centroids (depth, temperature, longitude, and latitude) for each species each size bin and link their distributions with environmental changes. We found ontogenetic shifts in all species in all three regions. We also compare regional differences in distributional shifts between species and within species. Different responses to changes in temperature between predator and prey fish may also change the trophic interactions in the food webs. This study highlights the contribution of size composition to the species distribution and different regional mechanisms across the GOA.

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