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CERES storyline - fisheries in the Barents and Norwegian Seas

What do we expect under climate change?

Herring - There has no clear effect of climate change on Norwegian spring spawning herring at this stage. However, there has been a correlation between spawning stock biomass and the climatic condition (water temperature), although the mechanisms are not fully understood. Two issues are potentially affected by climate changes; recruitment success and feeding areas. Spawning is taking place along the Norwegian coast in February-March and larvae drift northwards and into the Barents Sea during the spring and early summer. Winds affecting the strength of the northward flowing currents have been shown to influence the recruitment success of herring. The feeding areas for adult fish are in the Norwegian and Icelandic Sea. The geographic distribution of herring feeding in the spring and summer has shifted westward during the last two decades. Warmer waters may have had an impact, but cannot be the main driver for the change directly. Reduced production of prey or higher predation pressure in the traditional feeding areas are more likely reasons for the observed changes in feeding areas.

Cod - Feeding distribution over the Barents Sea expected to change (expand) as sea ice cover shrinks, but the details are likely to be variable and uncertain. Freedom to move northwards to feed may partially offset warming waters, so not easy to predict ambient temperature effects on the cod. Impacts on the ecosystem may change food availability - but cod are generalist feeders so not clear how they will be affected. Current increase of snow crabs in the Barents Sea is being reflected in increase in the diet, suggesting they may be resilient to changes in food availability. Warming is occuring at a period of increasing age structure due to moderate fishing pressure, difficult to seperate these effects.

Capelin - More open water and less sea ice due to warming of the Barents Sea has facilitated increased plankton production in northern areas and made a northern extension of the capelin feeding area possible. However, the capelin stock size is fluctuating and only when the stock is large the need to utilize this larger feeding area is realized. Spawning areas are less flexible since capelin are spawning at the sea floor, and need specific substratum (gravel/sand) for the eggs to develop. It is uncertain what will happen if the water temperatures on the present spawning grounds becomes too high.

How vulnerable are demersals to climate change?

Herring - Adult herring are not directly sensitive to climate changes in the range anticipated for the next century. Warmer waters will lead to a larger potential feeding area. However, climate changes can potentially affect prey organisms and thereby indirectly have an impact on growth and survival. Further, climate changes leading to changes in the ocean currents can impact the advection of larvae drifting northwards, and thereby affect the recruitment success.

Cod - Species are at the northern extreme of their range, and therefore clearly shows effect of climate variation over the past 100 years. Recent warming has been positive for NEA cod, by extending feeding grounds, this is likely to continue in the medium term. Historical data suggests NEA cod do well during warm periods. Being at the north end of their range, NEA cod unlikely to suffer directly from warming temperatures in the medium term, but ecosystem level changes to food supply will likely have unpredictable effects (both negative and positive)

Capelin - Northern expansion of the feeding areas will imply a longer migration route and increased energy expenditure as long as the spawnig areas are unchanged. There are limits to how how far from the spawning areas the capelin may feed. For capelin to feed beyond that limit, the spawning areas will have to be moved northwards as well, but it is highly uncertain where suitable spawning areas may be found

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What is the economic value of this species?

Herring - Landing has the last 20 years been in the range 328 000 – 1 687 000 tonnes. The fishery is important for several countries, but especially for Norway. The fishery is a key pillar in several smaller communities as vessels of all size groups participate in the fishery.

Cod - Landings have been c. 700,000 - 1,000,000 tonnes in recent years (2011-2016), making this the largest and most valuable cod stock in the world. Discarding is largely banned, fishing is controlled by a sustainable HCR.

Capelin - Highly variable. The stock swings from less than 1/2 million tonnes to 7 million tonnes in cycles, and the catches have varied between 0 and 650 thousand tonnes during the last twenty years. The harvest strategy is an escapement strategy where the first priority is to leave enought capelin in the sea to feed the cod and to let a certain amount spawn.

What are the challenges?

Herring - It is not known if climate change will affect the recruitment success in the future. The geographic distribution during feeding may change, affecting the relative allocation in national economic zones.

Cod - It is unclear how cod wil respond to continued climate change, unclear how maturity at age will develop under continued moderate fishing pressure (i.e. if there have in fact been fisheries induced evolutionary changes or not)

Capelin - It is unknown what will happen if higher sea temperature drives capelin from their normal spawning areas along the northern Norwegian and Russian coasts. It is also unknown whether climate change may cause shifts in prey availability in the Barents Sea. So far, the rise in temperatures and loss of sea ice have seemingly been favourable for capelin recruitment and feeding.

What is the working program in CERES?

Models applied

- Altantis ecosystem model
- Gadget multispecies model
- Stockobar Model
- 2-species (cod-capelin) assessment model (Bifrost/ CapTool)

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