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CERES storyline - pelagics in the North East Atlantic

What do we expect under climate change?

This storyline will focus on the pelagic fisheries in the Northeast Atlantic (NEA), with important target species being Atlantic mackerel (*Scomber scombrus*), herring (*Clupea harengus*) and horse mackerel (*Trachurus trachurus*).

Atlantic mackerel

- highly migratory species with wide distribution from Marocco up to northern Norway, incl. North, Baltic and Black Seas as well as the Mediterranean
- stock sizes and migration patterns of different spawning stocks/components changed over time, also the international fishery and management with several nations beeing involved
- in 2014, the EU, Norway and the Faroe Islands (but not Iceland) agreed on a management strategy for 2015-2020: the total declared quotas for 2015/16 exceeded the TAC advice of ICES

Atlantic herring

- most commercially important pelagic fish species in the NEA, several coastal stocks typically aggregated in large and dense shoals, several fleets target for NEA herring
- varying spawning and migration pattern (e.g. autumn vs. spring spawner) increase the complexity of stock separation and distribution
- due to recovery plans and harvest control rules North Sea herring is considered to be harvested on a sustainable level and over the last years, a profitable herring roe fishery developed during the spawning season

Horse mackerel

- distributed from South Africa to Norway, including Mediterranean and Black Sea, the Atlanto-Iberian stock consists of the North Sea, the southern (Iberian) and the northwestern population
- tend to form large schools and migrate to specific spawning, feeding and over-wintering areas
- increasing commercial importance, specifically of the larger NW stock, European market still relatively small and large amounts are exported

Climate change will have significant effects on

- on the distribution of those highly migratory target species and hence key fishing opportunities
- increasing spatial overlaps and hence also inter- and intraspecific competition.
- changes in stock productivities: e.g. NEA herring population fluctuations have been already known to be a response to both natural environmental variations and exploitation by humans. In addition, the apparent decreases in weight at age for mackerel and herring are thought to be influenced by stock size and lack of sufficient food.

An additional issue for these pelagic fisheries will be the consequences of Brexit on fishing opportunities and quota availabilities for the remaining eight EU member states, also causing new trade barriers and disruption of the market.

Are there first signs of climate related changes?

Atlantic mackerel

- distribution shifts to deeper regions and higher latitudes (since mid 1990s), stock size increase in whole catch area (in last decade) as well as good recruitement (in last 3 years) observed by industry

Norwegian spring-spawning herring

- the stocks' more westerly deeper distribution in recent years might be due to better feeding competition with mackerel, but at the same time accounting for a reduced spatial overlap of herring and mackerel in the Norwegian Sea and adjacent waters since 2014.

Horse mackerel

- distribution and spawning season is thought to be affected strongly by changes in temperature: at higher latitudes, a decrease in mean length-at-age were attributed to an increase in water temperature from 1977 to 2007
- the status of the North Sea stock is unknown and difficult to assess

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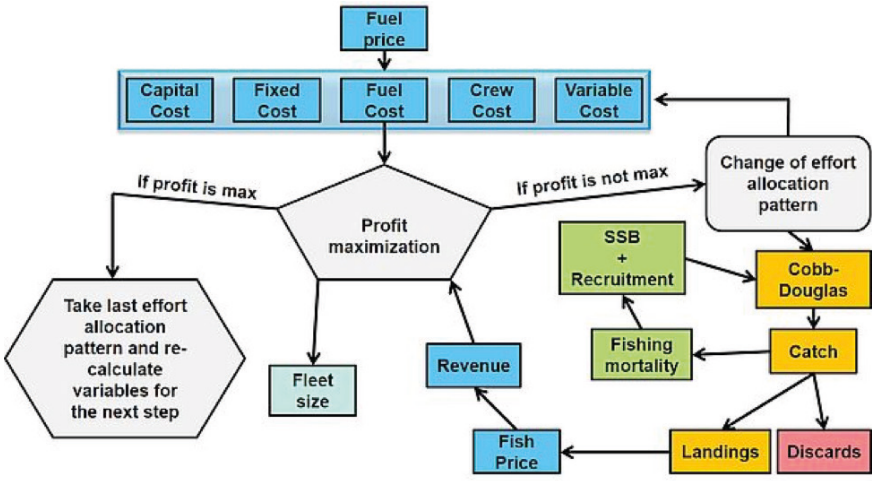

Conceptual model design with arrows that explain the interaction between submodules. In the maximization procedure, the effort allocation pattern is changed until profit of the entire fleet is maximized. When profit is maximized, the last effort allocation pattern is used to calculate catch, which in turn is used to calculate fishing mortality and SSB for the next step.

What is the economic value of this species??

Landings:

- Atlantic mackerel represents by far the most landed species in the NEA (286 thousand tonnes, €300 million) and the North Sea (255 500 tonnes, €221 million)
- Atlantic herring and horse mackerel landings both accounted for approximately 50 thousand tonnes., with decreasing prices per kg in the last years
- In general, the EU NEA fleet accounted for 1.5 million tonnes of landed seafood with a value of €2.4 billion.

Fleets (in 2014):

- ten fleets operated in the NEA, of which half showed limited fishing activities (<30% of landing shares and effort)
- eleven fleets operated in the North Sea and landed 1 500 thousand tonnes of seafood with a value of €1.56 billion.

Total Allowable Catch (TAC)

- The TAC's of the main pelagic species have remained fairly stable over time, especially for mackerel (around 50 thousand tonnes). The TAC's of sprat and herring have both increased from approximately 200 thousand tonnes to nearly 450 thousand tonnes for herring and 350 thousand tonnes for sprat. Due to disputes between the EU, Norway, Iceland and the Faroe Islands, the improvement of the MSC certification on Atlantic mackerel was not granted and negatively affected the prices.

What is the working program in CERES?

This storyline will investigate the potential of current and alternative management measures for the named NEA pelagic fisheries, including the impact of climate change on fish stocks (e.g. recruitment failures, changed distribution patterns, changed body sizes etc.), fleet behaviour and fleet economics (e.g. fish prices, fuel costs, profits, employment).

For pelagic fishery in the NEA the FishRent model (http://fishrent.thuenen.de/) will be applied. FishRent is an integrative bio-economic optimization and simulation model that helps to understand how fisher may respond to management options and natural variations such as climate change. The model includes the economics of multiple fleet segments, the impact of fishing on stock development and the spatio-temporal interplay of fleet segments and fish stocks. It not only considers a possible effort redistribution, but it also accounts for the fact that ecological and economical conditions as well as management regulations will determine fishing effort.

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