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CERES storyline - pelagic and demersal fishery in the Baltic Sea

How will cod, sprat and herring be affected by climate change in the Baltic Sea?

The different climate scenario projections predict changed **salinity levels** in the water layers of the Baltic Sea. This may affect the survival of Baltic cod eggs and larvae in certain Baltic Sea Basins where cod spawns. Reduced salinity will reduce the cod spawning volumem which is determined by water density (floating eggs in deep haline waters) and oxygen levels (oxygen deficiency layers due to reduced inflow from oxygen rich water from the North Sea). Accordingly the decrease in salinity will potentially impair recruitment success of cod in the Baltic Sea and may even lead to recruitement failure.

The changed **sea surface temperatures** resulting from the climate scenario projections may potentially affect Baltic sprat recruitment in relation to sprat egg survival. Increasing temperature in sea surface layers (where sprat eggs are ditributed) may increase sprat fry survival and accordingly increase the sprat recruitment. This is expected to change the Baltic sprat stock productivity and overall biomass levels, as well as its distribution and abundance patterns.

Changes in **water turbidity** (e.g. due to potential change in frequency, intensity and duration of storms) as projected by climate models may change survival conditions for herring eggs and accordingly impact Baltic herring recruitment. The survival of herring eggs are dependent on their attachment to certain flora and seabed substrates which may be altered by changed variability and intensity in water currents and turbidity. The changes in herring recruitment may accordingly change overall stock productivity and biomass levels, as well as distribution and abundance patterns of herring.

Changed horizontal and vertical spatial and seasonal extension of **oxygen depletion areas**, which are projected in different climate and eutrophication scenarios, may result in changed food availability to and survival of Baltic cod. The change in oxygenated zones may result in changing survival and biomass levels of invertebrate benthic and pelagic food organisms for especially juvenile cod, but also for larger cod. Potential limitations in adequate food supply and availability due to oxygen depletion in certain areas, water layers, and seasons may result in changed survival of cod, especially juveniles. Also in this situation, the Baltic cod stock recruitment, productivity and overall biomass levels are expected to decrease, as well as potentially the cod spatial distribution and abundance patterns.

In general, the changed climate and eutrophication scenarios may change different primary and secondary production patterns and biomass levels of certain plankton groups that are essential prey organisms for fish fry of Baltic cod, sprat and herring, as well as for adult sprat and herring.

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The above adverse effects and impacts may likely result in changed biological interactions between Baltic gadoids and clupeoids (predation and consumption patterns) as integrated indirect effects. This may be associated with changed fish growth levels (temperature dependent). Together with the more direct effects described above influence the fish species productivity and overall biomass levels, as well as their distribution and abundance patterns.

What is the economic value of Baltic cod and herring and sprat?

The Baltic cod, sprat and herring stocks are subject to extensive international demersal and pelagic mixed and target fisheries conducted with mainly trawls and gillnets. The yearly landings values of these species in the total international eastern and western Baltic fisheries amounted in 2014 a value of 45 Mio Euro for cod, 72 Mio Euro for herring, and 52 Mio Euro for sprat, and the landings values for other species in those fisheries amounted in 2014 a value of 49 Mio Euro, all in all resulting in a total landing value of 218 Mio Euro for these fisheries.

What is the working program in CERES?

Global climate scenarios are downscaled to the Baltic Sea region to derive projections of climate change and eutrophication level. The applied model (RCO-SCOBI) provides information on sea conditions such as temperature and salinity, nitrate and phosphate nutrient concentrations, dissolved oxygen concentrations, ice conditions, water velocities and mixed layer depth, water quality and sedimentation of organic matter, as well as fractioned plankton biomass and net primary and community production.

The projections are then used in the model ATLANTIS to derive ecosystem responses, e.g. in the production and biomass levels for important fish stocks such as cod, herring and sprat, as well as recruitment, growth, consumption, spatial distribution and biological interactions.

Different scenarios (based on different future carbon emissions and socio-political developments) will be evaluated.

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