### Background
This document contains key messages for the secondary parameter ‘Coastal and Migratory fish’, as provided by the lead authors Örjan Östman, Jens Olsson, Noora Mustamäki and Rahmat Naddafi.

### Action requested
The Meeting is invited to **review** the final key messages, **provide** possible **comments** for finalization of the key messages and **endorse** them to be sent for peer review.
Coastal and Migratory Fish

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1. Description
Fish of freshwater origin dominate many coastal areas of the Baltic Sea, including species spawning in warm (perch, cyprinids) and cool waters (salmonids, burbot). These species are characterized by a high degree of spatial population structuring and spawning fidelity. Spawning migrations are common. Small scale environmental variation, local fishing pressure, habitat availability and food web interactions are of importance for the reproduction, recruitment, growth and mortality of the species. The main climate parameters affecting coastal and migratory fish are water temperature, salinity levels, ice cover, and discharge from rivers which influences eutrophication and local oxygen conditions.

2. Where is the change seen first? Is it already happening?
Increasing water temperature has positively affected recruitment of many spring and summer-spawning fish species (high confidence). In contrast, recruitment of autumn-spawning species, e.g. vendace and whitefish, is disfavored by high winter temperature and these species show contracted spatial distribution with lower ice cover and higher winter temperatures (medium confidence). Fish spawning in warm waters is more and more common amongst cool water spawning species (medium confidence). Anadromous species like salmon return to rivers earlier following warm springs, but the post-smolt survival seems to be negatively affected by increasing sea temperatures in autumn and winter months (medium confidence).

3. What is expected to happen?
Increasing temperatures are expected to cause earlier onset of spawning and shorter egg-larval periods, increased larval survival of coastal fish (high confidence), and earlier migration from nursery habitats (medium confidence). Recruitment of autumn-spawning species is expected to decrease with increasing temperatures and spatial distributions will be reduced if ice-cover is further reduced (medium confidence). Body growth is affected by water temperature, but differs among species and size-classes, and is generally expected to increase for smaller but not larger sized fish (medium confidence). Possible brownification can result in decreased body growth (low confidence).

4. Other drivers
Several anthropogenic pressures such as eutrophication, fishing and habitat exploitation affect coastal fish (high confidence). Pharmaceutical residues and plastics might have a negative effect on fish species locally (low confidence). Increasing populations of cormorants and seals consume substantial amounts of coastal fish, although the actual impact on fish populations is variable and uncertain.

Anadromous fish are affected by many anthropogenic factors in rivers not considered here (high confidence), especially alternations in hydrological regimes and migration barriers caused by dams. In the Baltic Sea, anadromous species are affected by fishing but also by increasing seal and cormorant populations (medium confidence).

5. Knowledge gaps
Indirect and interactive effects of different parameters and other human pressures are poorly studied. To elucidate causal relationships, modelling based on monitoring data in combination with experimental studies are needed. The impact of some expected changes, such as changes in ice-cover and darker waters, on fish stocks is poorly studied in the Baltic Sea.
The relative importance of relative average changes of extreme weather events in climate is under-studied. Follow up studies of extreme weather events (like heatwaves, ice-free winters) are of key importance to understand recovery and resilience of fish stocks and communities after these events.

6. Policy relevance
Management plans need to be adaptive regarding how climate change might impact the outcome of measures, e.g. temporal fishing regulations and closures, and habitat protection/restoration to mitigate climate change effects. Especially extreme weather events should trigger implementation of management actions, such as protected areas, spatial and temporal fishing closures or bag-limits, to provide possibilities for affected fish populations to recover. Climate change may also impact baselines and reference levels for status assessments of coastal fish. Ignorance of climate effects on status classifications might result in misinterpretation of status and factors affecting the ecosystem state.

7. References