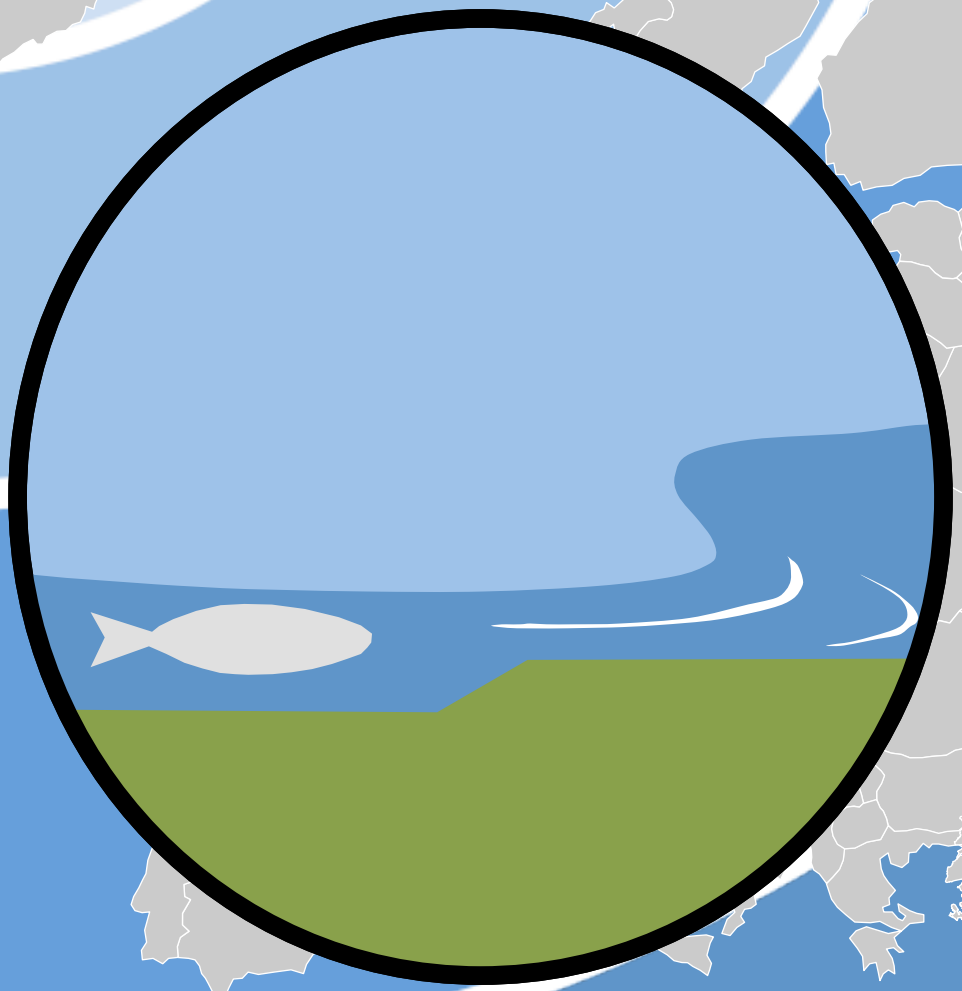
Europe's biodiversity in a changing climate

Part 3: Fresh water biodiversity



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Biodiversity

Freshwater ecosystems

The main story

Physical changes

Warmer water

- Worldwide, lake's summer surface temperatures showed an average warming trend of 0.34 °C per decade for the period 1985 - 2009.
- Climate change will further increase river temperatures during the 21st century and will result in strong declines in low (summer) flow for the end of the 21st century in large parts of the world.
- Rising water temperatures also decrease oxygen solubility and increase organic matter decomposition, causing lower dissolved oxygen concentrations.

Additional pressures

However, direct human impacts such as land-use, pollution and water resource development will continue to dominate the threats to most freshwater ecosystems globally over the next three decades.

Ecological consequences

Phytoplankton and zooplankton blooms in several European lakes are occurring one month earlier than 30-40 years ago. Enhanced harmful algal blooms in lakes resulting from climate change may counteract nutrient load reduction measures.

A long-term study of 24 European lakes revealed a decline in the abundance of cold-stenothermal fish species, particularly in shallow lakes, and an increase in the abundance of eurythermal fish species, even in deep, stratified lakes.

Remobilisation and bioaccumulation of toxic substances (e.g. mercury) in fish increase under higher water temperatures.

Higher river temperatures and declines in low (summer) flow could in particular threaten fish populations. Climate change is likely to reduce the spatial area of suitable habitats of cold water fishes, which could be invaded by cool or warm water species if other habitat requirements (e.g. food availability) are also fulfilled.

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Examples from southern Europe

In arid and semi-arid parts of the region, the biggest danger facing the lakes is the expected decrease in water input resulting from increasing evapotranspiration with increasing temperature and decreasing precipitation. This process can lead to conversion of existing freshwater to saltwater.

Bosnia and Herzegovina
On-going intrusion of salt water into freshwater habitats in the lower Neretva delta has already caused habitat degradation and habitat loss, and this effect might be increased. In addition, species that are adapted to the freshwater rivers may be threatened or may even disappear.

Montenegro
Temperature increase in the continental part of Montenegro would eventually lead to the acceleration of eutrophication of mountain lakes and then their withdrawal or complete disappearance.

Greece
A study for two Greek wetlands (lakes) shows that climate change will disturb the water balance by increasing evaporation and by decreasing water input from precipitation and lake's catchment run-off. The surface area of these lakes may have shrunk by 5-20% in 2020 - 2050 and by 14-37% in 2070 – 2100.

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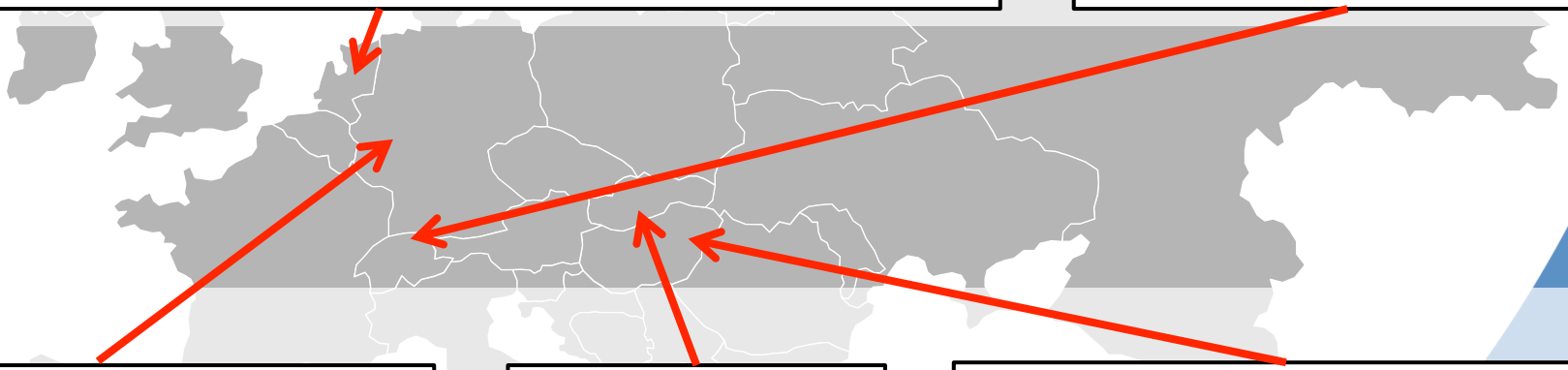
Examples from central Europe

Netherlands
The water temperature in the shallow lakes of the Netherlands is gradually increasing. The rising temperature will probably facilitate blooms of blue algae and botulism in Dutch lakes, thereby leading to a higher chance of mortality among waterfowl. Increasing peaks in rainfall will increase the leaching of phosphorus from the soil into surface water and, consequently, loading of lakes. More phosphorus means a higher chance of algal blooms, as a result of which lakes may become even more turbid. Turbid lakes have a lower biodiversity than those with clear water. The risk of eutrophication, algae blooms and low oxygen levels in fresh water systems will increase in warmer and drier summers due to the longer residence time of water in rivers, lakes and canals.

Switzerland
Since 1950, water temperatures in rivers and near the surface of lakes in Switzerland have in some cases increased by more than 2°C. In some lower-lying Swiss rivers, there is evidence suggesting that the maximum temperature that can be tolerated by local species of trout is now being exceeded.



Germany
Water temperature of the River Rhine (near Koblenz) has been rising by over 2°C in summer between 1978 and 2011. Studies indicate that mean annual water temperature will continue to rise as a response to projected climate change, between +1.9 and +2.2 °C at the end of this century (with respect to 1961-1990).

Slovakia
The expansion of invasive fish species is another serious problem; they come from the lower part of the Danube up the river and migrate into the rivers of Eastern Slovakia.

Hungary
Due to increased evaporation, the surface area of several smaller lakes will significantly decrease, and saline content and the risk of eutrophication will increase. Especially small and shallow oxbows along the river Tisza may sometimes dry-up. Warming up of shallow waters might cause mass botulism and avian botulism.

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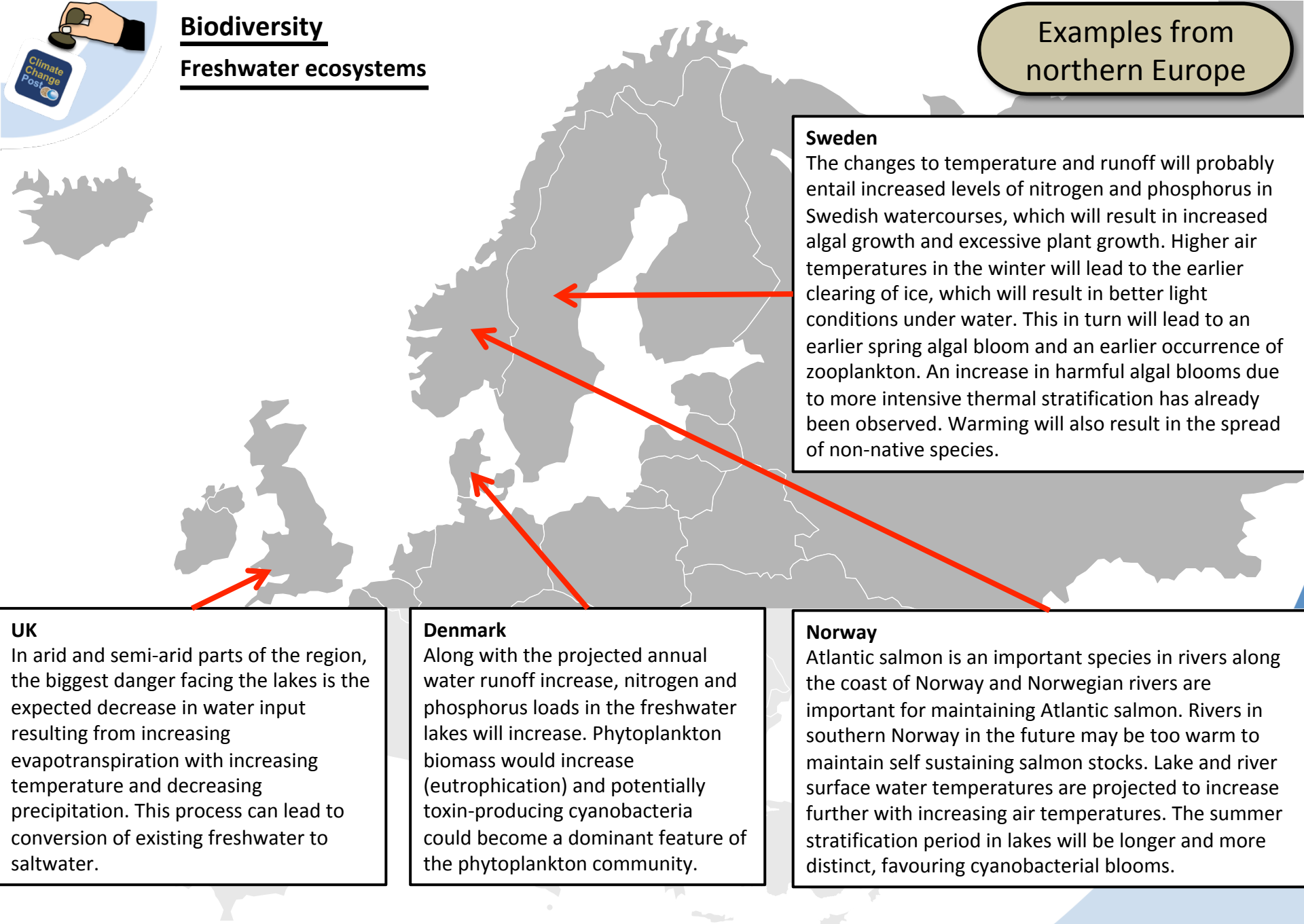
Examples from northern Europe



Sweden
The changes to temperature and runoff will probably entail increased levels of nitrogen and phosphorus in Swedish watercourses, which will result in increased algal growth and excessive plant growth. Higher air temperatures in the winter will lead to the earlier clearing of ice, which will result in better light conditions under water. This in turn will lead to an earlier spring algal bloom and an earlier occurrence of zooplankton. An increase in harmful algal blooms due to more intensive thermal stratification has already been observed. Warming will also result in the spread of non-native species.

UK
In arid and semi-arid parts of the region, the biggest danger facing the lakes is the expected decrease in water input resulting from increasing evapotranspiration with increasing temperature and decreasing precipitation. This process can lead to conversion of existing freshwater to saltwater.

Denmark
Along with the projected annual water runoff increase, nitrogen and phosphorus loads in the freshwater lakes will increase. Phytoplankton biomass would increase (eutrophication) and potentially toxin-producing cyanobacteria could become a dominant feature of the phytoplankton community.

Norway
Atlantic salmon is an important species in rivers along the coast of Norway and Norwegian rivers are important for maintaining Atlantic salmon. Rivers in southern Norway in the future may be too warm to maintain self sustaining salmon stocks. Lake and river surface water temperatures are projected to increase further with increasing air temperatures. The summer stratification period in lakes will be longer and more distinct, favouring cyanobacterial blooms.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