

	<p>Council</p> <p><i>Management actions to mitigate the effect of climate change on salmon</i></p>	<p>CNL(23)57</p> <p>Agenda item: 7a)</p>
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Management actions to mitigate the effect of climate change on salmon

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The Scientific advisory board recently made an assessment of likely effects of climate change on Norwegian salmon populations (Vitenskapelig råd for lakseforvaltning 2021). Their summary of the likely impacts was as follows:

“Climate change is a global threat, which is already impacting salmon populations, and will impact salmon populations to a great extent in the future. Climate change impacts the life of the Atlantic salmon at all life stages, through changes in water temperature, precipitation, water quality and other environmental factors. There is extensive knowledge on how these factors impact Atlantic salmon in the freshwater phase, but less knowledge on the marine phase. There is also little knowledge on how climate change will impact long-term genetic and ecological changes and adaptations in different populations. Since salmon populations are genetically different, and will experience different changes in climate, it is likely that different populations will respond differently to climate change.

Climate change amplifies the negative effects of other threats to Atlantic salmon populations. Threats like escaped farmed salmon, salmon lice, other infections related to salmon farming, habitat alterations, negative impacts of introduced species, pollution and others become even larger when occurring in a changing climate. This is also the case for river regulation for hydropower production, but such regulation can also in some cases be adapted to help reducing the impacts of climate change.

Climate change is a threat that increases the importance of having large and genetically variable populations to enable them to meet the rapid changes in the best possible way. Hence, it is important to protect and preserve the size and genetic variation and integrity of salmon populations, and thereby the abilities of populations to adapt to new and changing conditions. Climate change increases the needs to reduce the impacts of other threats to Atlantic salmon.”

Action 1. Get an overview of the situation and possible mitigation efforts

In 2010 and 2020 the Scientific advisory board was asked to provide an assessment of what challenges the climate change predicted from scenarios posed for the management of salmon populations and propose mitigating measures. The advice from the board was broadly similar in the two reports (Vitenskapelig råd for lakseforvaltning 2011; 2021) and can be summarized as follows:

1. Norway is expected to have a larger proportion of the European salmon stock in the future, because climate change may affect stocks south of Norway harder than Norwegian stocks. Norway’s responsibility for the protection of salmon is therefore expected to increase in the future.
2. At sea survival of Atlantic salmon may decrease because of climate change, but this prediction is very uncertain. Furthermore, targeted measures to increase at sea survival are difficult. Measures should therefore be taken to ensure that a maximum number of smolts leave the rivers.
3. The long-term development of the salmon populations may be affected by their genetic composition. Therefore, it is important to maintain genetic integrity and variation to

allow adaptations to altered conditions to occur. This should involve continued efforts to reduce genetic introgression from escaped farmed salmon, a critical evaluation of the use of hatchery fish and ensuring that spawning populations are sufficiently large to avoid loss of genetic variation and maintain life history variation.

4. Water discharge regimes in rivers developed for hydropower production should be adapted to protect salmonids in the river. More water available due of increased precipitation in parts of Norway may open opportunities for adjustment of discharge regimes to the benefit of salmon when the rules for the hydropower plants are revised.
5. Increased sea temperatures may increase infestation pressures from sea-lice from salmonid farming. Planning of new aquaculture facilities should take this into account.
6. Elevated freshwater temperature may increase juvenile growth and in some cases lead to younger and smaller smolts that are be more susceptible to negative impacts from sea-lice. Altered temperature in fresh water and changes in waterflow may lead to earlier smolt migration. The mitigation measures to reduce negative impacts from salmon-lice in aquaculture should take that into account and adjust their timing accordingly.
7. More frequent and large floods because of more intense rainfall will increase the need for flood protection measures. Such measures should consider habitat conditions for fish. River flow concentrations, channelization and the use of culverts should be avoided. Instead, flood protection measures should be based on restoring the original river course and avoid building of infrastructure and houses in the floodplains. Measures to reduce erosion should also consider fish habitat requirements, by for example by allowing for riparian vegetation.

Following these recommendations the salmon management in Norway has:

1. **Recommendation 1, 2 and 3.** To ensure that stocks in rivers are above the Conservation limits, fishing regulations is used. This is done by reducing exploitation on salmon from rivers that has not reach CLs through reductions of fishing time and effort in the rivers, and reductions or closure of sea-fishery in areas where the stocks are exploited. Furthermore, in season regulatory measures are taken if information suggest CL is not likely to be achieved if fishing continues unchanged. This is monitored by a yearly assessment of the CL-attainment in more than 200 rivers ([Hjem - Vurdering av enkeltbestander \(vitenskapsradet.no\)](https://www.vitenskapsradet.no)). The proportion of rivers attaining their CLs has increased, and the number of spawning salmon in Norwegian rivers has increased over time despite the pre-fishery-abundance being reduced (Vitenskapelig råd for lakseforvaltning 2022).
2. **Recommendation 4.** The terms of operations for hydropower regulations are currently and within the next decade or so under revision in many of the regulated salmon rivers in Norway. The aim of the revisions is to improve environmental conditions, and production of salmon is a central theme. So far, this has resulted in new minimum flow stipulations and other measures in some rivers, whereas hydropower production have been given priority over environmental flow in others.

Litterature

Vitenskapelig råd for lakseforvaltning. 2011. Prognoser for lakseinnslag, regnbueørret og klimaendringer: utfordringer for forvaltningen. Temarapport fra Vitenskapelig råd for lakseforvaltning, 2: 1-45. [NINA Brage: Prognoser for lakseinnslag, regnbueørret og klimaendringer: utfordringer for forvaltningen](#)

Vitenskapelig råd for lakseforvaltning 2021. Status for norske laksebestander i 2021. Rapport fra Vitenskapelig råd for lakseforvaltning,, 16: 1-232. [NINA Brage: Status for norske laksebestander i 2021](#) (extended English summary: [Status of wild Atlantic salmon in Norway 2021.pdf \(vitenskapsradet.no\)](#))

Vitenskapelig råd for lakseforvaltning 2022. Status for norske laksebestander i 2022. Rapport fra Vitenskapelig råd for lakseforvaltning, 17: 1-125. [NINA Brage: Status for norske laksebestander i 2022](#) (extended English summary: [Status of wild Atlantic salmon in Norway 2022.pdf \(vitenskapsradet.no\)](#))