Status of wild Atlantic salmon in Norway 2024


Photo: Eva B. Thorstad

Norwegian Scientific Advisory Committee for Atlantic Salmon

The status of Norwegian wild Atlantic salmon is evaluated annually by the Norwegian Scientific Advisory Committee for Atlantic Salmon. This is an English summary of the 2024 report.

The committee is appointed by the Norwegian Environment Agency to evaluate status of salmon and importance of different threats, and to give science-based catch advice and advice on other issues related to wild salmon management.

Thirteen scientists from seven institutions serve on the committee: Torbjørn Forseth (leader), Sigurd Einum, Peder Fiske, Morten Falkegård, Øyvind A. Garmo, Åse Helen Garseth, Helge Skoglund, Monica F. Solberg, Eva B. Thorstad, Kjell Rong Utne, Asbjørn Vøllestad, Knut Wiik Vollset and Vidar Wennevik. The committee is an independent body, and the members do not represent the institutions where they are employed when serving on the committee.

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Status of Atlantic salmon - short summary

Atlantic salmon stocks in Norway are at a historically low level. The number of salmon returning from the ocean to Norway in 2023 was the second lowest ever. The two lowest returns occurred during the last three years, in 2021 and 2023. The greatest decline in salmon stocks has occurred in western and central Norway, as well as in the large Tana watercourse.

The biggest threats to Norwegian salmon are salmon farming and climate change. Salmon lice from farms, escaped farmed salmon and infections are the biggest threats from salmon farming. The present mitigation measures are insufficient to stabilize and reduce the threats from salmon lice and other infections. The threats to Atlantic salmon are relatively similar to previous years' assessments. The threats from escaped farmed salmon, pink salmon, the parasite *Gyrodactylus salaris* and overexploitation were slightly reduced in 2024 compared to 2023 due to mitigation measures.

Hydropower regulation and other physical alterations are also major threats that reduce salmon populations. Further measures could be implemented to reduce the effects of hydropower regulation and other physical alterations. Methods for improving conditions for salmon in regulated rivers are well developed. Pink salmon is an invasive species with an exponential increase in abundance since 2017. This is a difficult threat to assess, because almost no knowledge exists on the effects of invasive pink salmon.

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The River Kongsfjordelva. Photo: Eva B. Thorstad

Extended summary

- **Atlantic salmon stocks are at a historically low level**

The pre-fishery abundance, which is the number of adult Atlantic salmon that return from the ocean to Norway each year, was in 2023 the second lowest ever recorded. The pre-fishery abundance in 2023 was ca. 400,000 wild Atlantic salmon, including those caught in the fishery. This is close to the lowest level ever recorded, which was in 2021. Hence, the two lowest returns occurred during the last three years. The pre-fishery abundance was more than halved from 1983-1986 to 2020-2023 (figure 1).

The reported catch of Atlantic salmon in sea and river fisheries in 2023 was also the second lowest ever recorded, based on a time-series that was established in 1980. The total catch at sea and in rivers in 2023 was 82,000 Atlantic salmon, with a total weight of 297 metric tons. In addition, 19,000 Atlantic salmon (81 t) were reported caught and released. Of salmon caught in the rivers, 27% were released. The proportion of salmon released back into the river was the third highest ever recorded.

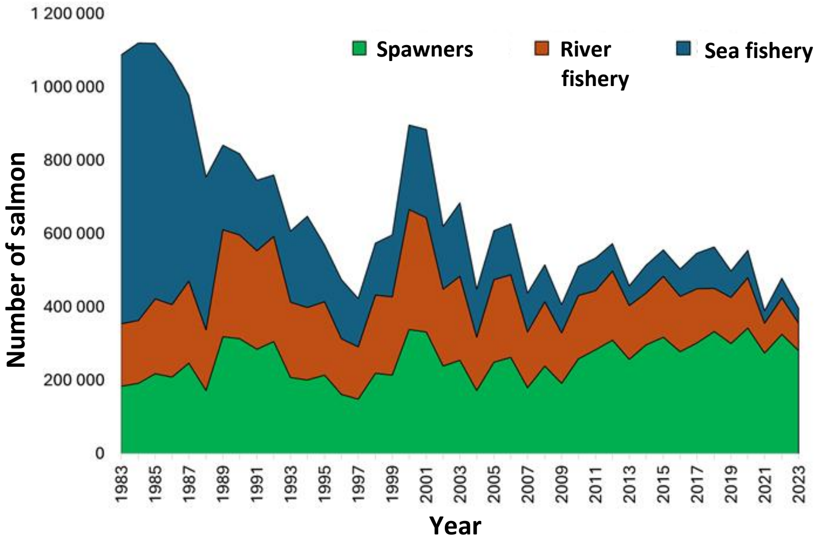

Figure 1. *Estimated number of wild Atlantic salmon returning from the ocean towards Norwegian rivers each year, divided in number of fish caught in the sea fisheries, number of fish caught in the rivers during angling, and the number of fish left for spawning in the rivers during the period 1983-2023.*

- **The largest stock declines are seen in western and central Norway, as well as in the large Tana watercourse**

The temporal changes in numbers of Atlantic salmon returning from the ocean each year (pre-fishery abundance) differ among regions. Since 1989, a large decline in abundance of Atlantic salmon is seen in western and central Norway. In southern Norway, the abundance has increased during the same period. In northern Norway, the abundance of Atlantic salmon has been relatively stable, but a decrease is seen in the last few years.

The abundance of small salmon (body mass < 3 kg) is the most reduced. The abundance of small salmon has been reduced in all regions, but to the largest extent in western and central Norway. The abundance of larger salmon (body mass ≥ 3 kg) has decreased in western and central Norway, but increased in the rest of the country, particularly in southern Norway.

The large Tana watercourse has had a marked decline in numbers of Atlantic salmon returning from the ocean, in contrast to the rest of northern Norway, with a reduction of 82%

since 1989. Both small and large salmon have been reduced. The pre-fishery abundance of salmon to the Tana watercourse in 2023 was the lowest ever recorded, since the time series was established in 1983. The returns in the last four years, 2020-2023, were the four lowest in the time series.

- **Salmon fishing at sea and in rivers has been significantly reduced**

An important principle in Norwegian legislation, which forms the basis for salmon management, is that both conservation and harvestable surplus of salmon should be ensured. The aim of the Salmon and Freshwater Fish Act is to ensure that populations and their habitats are managed such that diversity and productivity are conserved. Further, populations should be managed to ensure increased yields, to the benefit of fisheries stakeholders and recreational fishers. Similar principles are embedded in the Nature Diversity Act.

Overall, 29% of the Atlantic salmon that returned from the ocean were caught at sea or in rivers in 2023 (figure 2). Most salmon were caught in the rivers, and in 2023 18.6% of the salmon that returned from the ocean were caught in the rivers and 10.5% were caught at sea (figure 2).

There has been a strong reduction in salmon fishing. In the 1980s, more than 80% of the salmon returning from the ocean were caught in fisheries. Drift net fishing in the sea was banned in 1989, and later both sea fisheries and angling in the rivers have been considerably restricted. The status of Atlantic salmon populations varies widely among rivers and different parts of the country. Exploitation is regulated according to the state of the populations, and the exploitation rates thus vary among rivers. Many rivers now have very low exploitation or has been closed to fishing due to reduced stocks.

Fishing has been reduced to an even greater extent than salmon populations have declined, and the result is that the number of salmon spawning in the rivers has increased in recent years (figure 1). The reduced fishing has thus more than compensated for the decline.

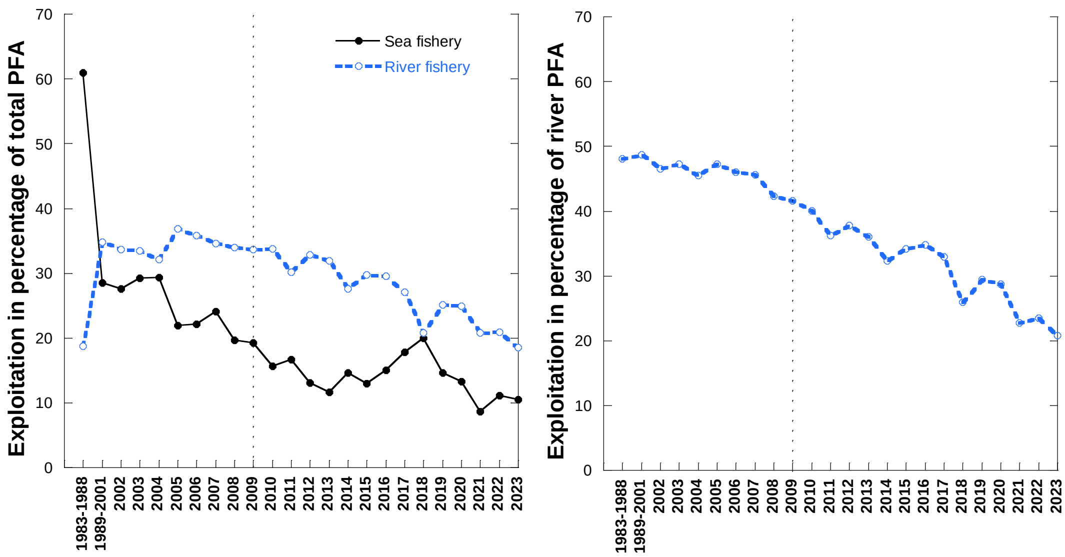

Figure 2. *Left graph: Exploitation of Atlantic salmon given as percentage of the pre-fishery abundance (total PFA, in numbers) for the periods 1983-88 and 1989-2001 and thereafter as annual values. Right graph: Exploitation of salmon in the rivers given as the proportion of salmon entering the rivers (those left after exploitation in sea fisheries, river PFA) for the same periods and years. Hatched vertical line indicates the year when management based on spawning targets was introduced.*

- **Most salmon populations reach the spawning targets and management targets**

Attainment of spawning targets (conservation limits) was assessed for 251 salmon rivers (including 9 tributaries) in 2023. The spawning target was attained for approximately 70% of the rivers, and this was the lowest proportion of rivers attaining the spawning target since 2014.

The scientific foundation for management according to spawning targets and management targets for Norwegian rivers is described by Forseth et al. (2013). For each river, the harvestable surplus was also estimated - as the pre-fishery female abundance minus the spawning target - expressed as percentage of the spawning targets. The average harvestable surplus in 2023 was the lowest ever recorded (37%).

The management target of a population is attained when the average probability of reaching the spawning target over a four-year period is 75% or higher. The management targets for the period 2020-2023 were attained, or likely attained, for 91% of the populations. The number and proportion of populations reaching their management targets have increased markedly since 2009. The increase in proportion of populations reaching their spawning targets is largely due to stricter regulations of fisheries causing reduced exploitation rates.

- **Many salmon stocks have poor or very poor population status**

Stock status is good only when the spawning target has been attained and there is a harvestable surplus for fisheries. When a stock does not have a normal harvestable surplus, it indicates that local or regional factors have affected the stock negatively. A stock that reaches the spawning target, but where harvesting has ceased because of a too low populations size, does not have a good populations status.

In 2023, almost a third of the salmon stocks had a very poor status. Many of the stocks in poor or very poor status are located in western and central Norway, and in 2023 there was a further negative development compared to previous years especially in Western Norway. In Northern Norway, the status of the salmon stocks is better than in western and central Norway, but the proportion of stocks in poor or very poor condition has increased since 2018. Southern Norway has the largest proportion of stocks in good or very good condition, and the development since 2010 has been positive.

- **The greatest anthropogenic threats to Norwegian salmon are the effects of salmon farming and climate change**

Salmon lice is the largest threat to wild salmon, and escaped farmed salmon and infections related to fish farming are also among the largest threats (figures 3 and 4). The number of salmon stocks that are assessed as critically endangered due to salmon lice has increased in recent years. The proportion of escaped farmed salmon observed in Norwegian rivers has decreased over time, but genetic changes due to interbreeding of escaped farmed salmon have been demonstrated or indicated in two thirds of the screened salmon populations.

Infections related to fish farming is also a significant threat to wild salmon. However, knowledge of the impacts of infections related to fish farming is poor, and the uncertainty of the projected development of this impact factor is high. More knowledge on this impact factor is needed. There is a risk that this threat is underestimated due to lack of knowledge.

- **The threat assessment projects the situation two to three salmon generations into the future, and climate may pose a greater threat to salmon stocks in the longer term than what is assessed here**

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

- **Other major threats to salmon are hydropower regulation and other habitat alterations**

Hydropower regulation and other habitat alterations have a lower risk of causing further loss of wild salmon in the future than the threats related to salmon farming.

- **Negative effects of hydropower regulation and other habitat alterations can be mitigated at a much larger scale than the current practice**

Further measures could be implemented to reduce the effects of hydropower regulation and other physical alterations. Methods for improving conditions for salmon in regulated rivers are well developed and available.

- **Pink salmon has increased tremendously in numbers and distribution, but knowledge of effects on Atlantic salmon populations is poor**

Pink salmon is an invasive species with an exponential increase in abundance since 2017. More than 360,000 pink salmon were caught in rivers and the sea in 2023 by targeted fishing, trapping and angling in rivers, and as bycatch in coastal Atlantic salmon fisheries. Knowledge of the effects of pink salmon on Atlantic salmon, sea trout and Arctic char is poor, and the future development is uncertain. Extensive mitigation measures were performed to remove pink salmon from many rivers in 2023. Traps were installed in the lower parts of 50 rivers in the northernmost Troms and Finnmark region to catch and kill upstream migrating pink salmon. The risk of increased negative impacts by pink salmon in the future is still moderate even though extensive measures are now being implemented, because there is little knowledge about the effect of the planned measures, and the areas with high numbers of pink salmon appear to be increasing beyond the areas where extensive measures are planned.

- **The parasite *G. salaris* and acid rain are threats that at present affect Atlantic salmon to a small extent due to successful measures**

The invasive parasite *G. salaris* has been one of the major threats to Atlantic salmon, but successful eradication programs have strongly reduced the number of rivers infected with the parasite, and the salmon stocks have been re-established from live gene banks. In January 2024, the last of several previously infested watercourse in the Vefsna region, northern Norway, was declared free of the parasite. Of total 53 infested rivers, 43 rivers have been declared free of the parasite due to eradication measures. The measures have also limited the risk of spreading to new rivers.

Acid rain has been one of the major threats to Atlantic salmon, but due to large-scale liming of rivers and reduced emissions, the risk of increased negative impacts due to acid rain is low.

- **Overfishing affects salmon to a small extent due to restrictions on fishing**

Overfishing was previously a major threat to salmon but is now generally considered to have a small impact on salmon stocks. The reason is the highly reduced exploitation of Atlantic salmon in river and sea fisheries.

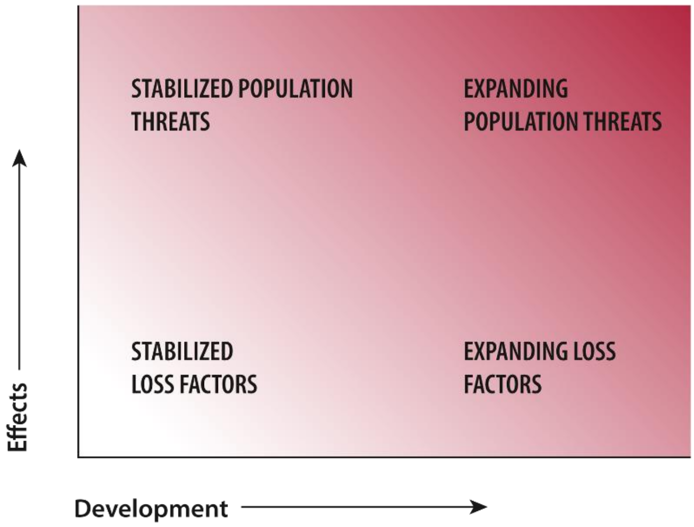

Figure 3. The classification system developed to rank different anthropogenic impacts to Atlantic salmon populations along the effect and development axes. *The four major impact categories are indicated, but the system is continuous. Dark background colour indicates the most severe impacts. The effect axis describes the effect of each impact factor on the populations, and ranges from factors that cause loss in adult returns, to factors that cause such a high loss that they threaten population viability and genetic integrity. The development axis describes the likelihood for further reductions in population size or loss of additional populations in the future.*

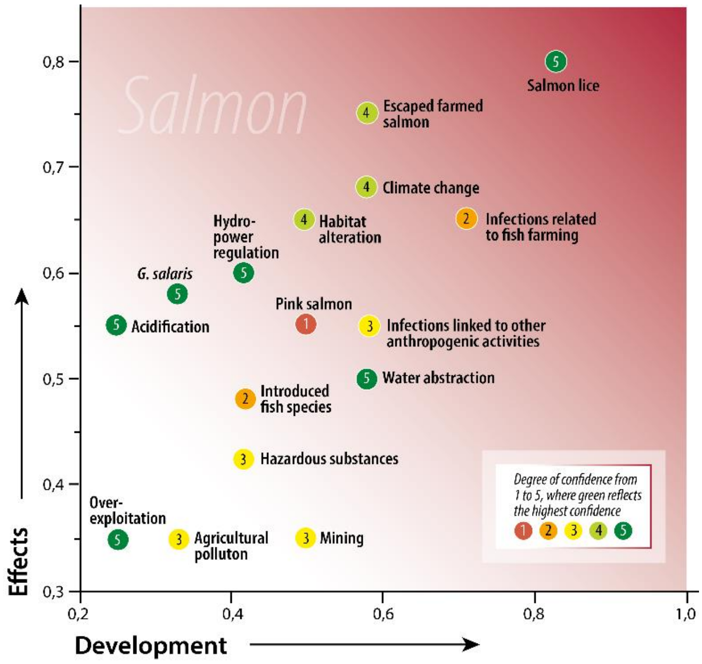

Figure 4. *Ranking of 16 impact factors considered in 2023, according to their effects on wild Atlantic salmon stocks, and the likelihood of a further negative development. Confidence for the assessment of effect by each threat is indicated by the color of the markers, where green indicates the highest confidence level and red the lowest.*

- **The reasons for reduced Atlantic salmon populations are anthropogenic activities and reduced survival at sea**

The reduced abundance of wild Atlantic salmon is partly due to low survival during the ocean migration. Increased age at maturity has also contributed. However, local and regional factors largely affect wild Atlantic salmon, and the development and status of salmon stocks differ among regions. In southern Norway, Atlantic salmon stocks have increased due to extensive liming programs, improved water quality and the re-establishment of salmon stocks in watercourses that were affected by acid rain. The abundance of Atlantic salmon in northern Norway, except for in the Tana watercourse, is relatively stable, but the harvestable surplus has been somewhat lower in recent years, probably due to poorer sea survival in the Barents Sea. The abundance of Atlantic salmon in the large Tana watercourse has, in contrast to the rest of northern Norway, declined significantly. The salmon stocks in the Tana watercourse have a poor status, and many of the stocks in the watercourse have been heavily overexploited for many years. When stocks have reached such low levels as the present situation, low sea survival, perhaps combined with an increased effect of predation, contribute to rebuilding the stocks in the Tana watercourse being very difficult. Fisheries in the Tana watercourse and the adjacent coastal areas were closed from 2021.

- **In contrast to the other parts of the Norway, salmon stocks in western and central Norway have decreased significantly - and the negative effects of salmon farming have contributed to this decline**

In contrast to the development in other regions, the abundance of salmon in western and central Norway has decreased after 1989. In both western Norway and parts of central Norway, the influence of salmon farming most likely makes a significant contribution to the reduced abundance of Atlantic salmon and the reduced harvestable surplus.

- **The threat assessment for sea trout has also been updated in this report. Salmon lice from aquaculture farms is by far the largest threat to sea trout.**

Salmon lice from farms are by far the biggest threat to sea trout and considered a non-stabilized population threat (figure 5). Sea trout are severely affected by salmon lice infestations in many watersheds in large parts of the country. The risk of stocks being critically endangered or lost due to salmon lice is high due to a lack of efficient measures.

- **Climate change is the second largest threat to sea trout**

Climate change is the second largest threat to sea trout, with a high risk of further negative effects in the future. Culverts, channelisation, other habitat alterations, and agriculture are also threats to sea trout, but to a smaller extent than salmon lice and climate change. Hydropower production, water abstraction for other purposes than power production, and infectious diseases also have a significant negative impact on sea trout.

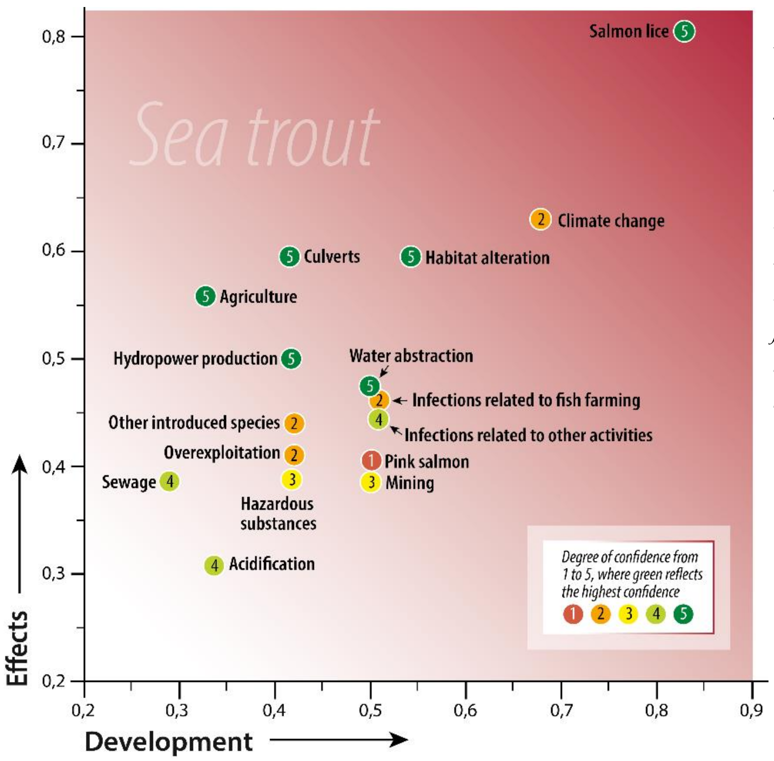

Figure 5. *Ranking of 16 impact factors considered in 2023, according to their effects on sea trout stocks, and the likelihood of a further negative development. Confidence for the assessment of effect by each threat is indicated by the color of the markers, where green indicates the highest confidence level and red the lowest. Note that water abstraction, infections related to fish farming and other infections have the same assessment for development (0.5), but the symbols are spread out for graphical visibility.*

Scientific publications from the Norwegian Scientific Advisory Committee for Atlantic Salmon

Falkegård, M., Lennox, R.J., Thorstad, E., Einum, S., Fiske, P., Garmo, Ø., Garseth, Å., Skoglund, H., Solberg, M., Utne, K.R., Vollset, K.W., Vøllestad, L.A., Wennevik, V. & Forseth, T. 2023. Predation of Atlantic salmon across ontogenetic stages and impacts on populations. Canadian Journal of Fisheries and Aquatic Sciences doi: 10.1139/cjfas-2023-0029.

Fiske, P., Forseth, T., Thorstad, E.B., Bakkestuen, V., Einum, S., Falkegård, M., Garmo, Ø.A., Garseth, Å.H., Skoglund, H., Solberg, M., Utne, K.R., Vollset, K.W., Vøllestad, A. & Wennevik, V. 2024. Novel large-scale mapping highlights poor state of sea trout populations. Aquatic Conservation: Marine and Freshwater Ecosystems 34: e4067.

Forseth, T., Fiske, P., Gjøsæter, H. & Hindar, K. 2013. Reference point based management of Norwegian Atlantic salmon populations. Environmental Conservation 40: 356-366.

Forseth, T., Barlaup, B.T., Finstad, B., Fiske, P., Gjøsæter, H., Falkegård, M., Hindar, A., Mo, T.A., Rikardsen, A.H., Thorstad, E.B., Vøllestad, A. & Wennevik, V. 2017. The major threats to Atlantic salmon in Norway. ICES Journal of Marine Science 74: 1496-1513.