Atlantic Salmon Stressor Analysis – Norway

The stressor analysis is done by the Norwegian Scientific Advisory Committee for Atlantic Salmon (SACAS) after Forseth et al. (2017)[1]. The 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. 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. In Northern Norway, the status of the salmon stocks is better than in western and central Norway. 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. 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. There is a risk that this threat is underestimated due to lack of knowledge. 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 the other threats to Atlantic salmon. 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. Pink salmon has increased in numbers and distribution, but knowledge of effects on Atlantic salmon populations is poor, and the future development is uncertain. The risk of increased negative impacts by pink salmon in the future is still moderate even though extensive measures are being implemented. The parasite *G. salaris* and acid rain are threats that at present affect Atlantic salmon to a small extent due to successful measures. 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.

[1] 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.

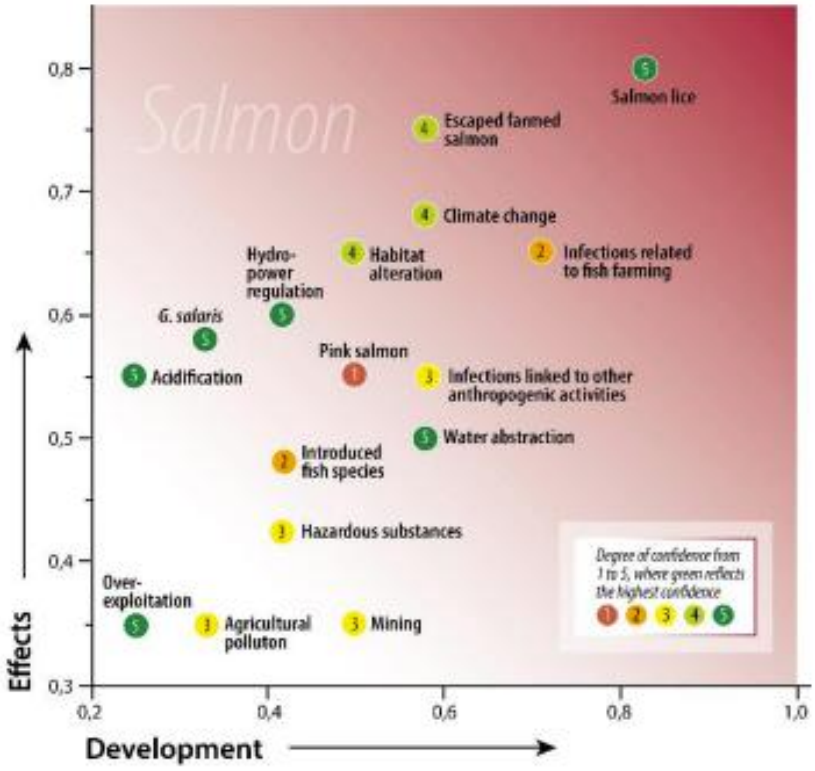

Figure 1: Ranking of 16 impact factors considered in 2023, according to their effects on wild Atlantic salmon stocks, and the likelihood of a further negative development. Confidence for the assessment of effect by each threat is indicated by the colour of the markers, where green indicates the highest confidence level and red the lowest (From SACAS 2024).

Table 1. Classification (with scoring) and the criteria for classification og the different anthropogenic impact factors along the effect (a) and development (b) axes for Atlantic salmon in Norway in 2023 (SACAS 2024).

Effect axis: Characteristics considered	POINTS AND CRITERIA	Hydropower production	Water abstraction (other than hydropower)	Acidification	Agriculture	Hazardous substances	Mining	Overexploitation	Salmon lice	Infections related to fish farming	*Gyrodactylus salaris*	Infections related to other activities	Escaped farmed salmon	Climate change	Habitat alterations channelisation etc.)	Pink salmon	Other introduced species than pink salmon
1 Number of affected populations	1: <51, 2: 51-100, 3: 101-200, 4: > 200	3	1	1	1	1	1	1	4	4	1	2	4	3	4	3	2
2 Geographical distribution:	1: Local 2: Scattered 3: Regional 4: National	2	2	3	3	2,5	2	2	3,5	3,5	2	3	3,5	4	4	3,5	2,5
3 Reduction in returning adults Typical effects due to reduced production capacity, or reduced freshwater or sea survival	1: Small reduction < 10 % 2: Moderate reduction 10-25 % 3: Large reduction 25-75 % 4: Very large reduction > 75 %	2	2	3	1	2	1	2	2,5	1	4	2	1,5	1,5	1	1	1
4 Number of lost or critically endangered populations in nature	1: None, 2: 1-5, 3: 6-20, 4 > 20	3	2	3	1	1	1	1	3	1	3	1	4[2]	1	1	1	1
5 Implemented mitigation measures That have reduced the effects or likelihood that populations will be critically endangered or lost	1: Extensive, with large effects 2: Many, with good effects 3: Few, or measures with small effects 4: Very few or no, or measures without net effect	2	3	1	1	2	2	1	3	3,5	1,5	3	2	4	3	2,5	3
Sum (of maximum 20)		12	10	11	7	8,5	7	7	16	13	11,5	11	15	13,5	13	11	9,5
Compiled relative effect (0-1)		0,60	0,50	0,55	0,35	0,43	0,35	0,35	0,80	0,65	0,58	0,55	0,75	0,68	0,65	0,55	0,48
Knowledge, agreement / combined confidence in the assessment		3,3/5	3,3/5	3,3/5	2,2/3	2,2/3	2,2/3	3,3/5	3,3/5	1,2/2	3,3/5	2,2/3	2,3/4	2,3/4	3,2/4	1,1/1	2,1/2

[2] For escaped farmed salmon, lost or critically endangered populations defined according to very poor status in the quality norm for genetic integrity.

Development axis: **Characteristics considered:**	**POINTS AND CRITERIA**	Hydropower production	Water abstraction (other than hydropower)	Acidification	Agriculture	Hazardous substances	Mining	Overexploitation	Salmon lice	Infections related to fish farming	*Gyrodactylus salaris*	Infections related to other activities	Escaped farmed salmon	Climate change	Habitat alterations channelisation etc.)	Pink salmon	Other introduced species than pink salmon
1 Potential for effective measures (projection of present situation)	1: Extensive and very effective measures are planned 2: Several and very effective measures are planned 3: Some effective measures, or measures with small effects are planned 4: Few or no effective measures are planned	2	4	1	2	2	2,5	1	3	3.5	1	2,5	2,5	3	3	2,5	3
2 Likelihood of further production losses (projection of present situation)	1: Low 2: Moderate 3: High 4: Very high	2	2	1	1	2	2,5	1	4	3	1,5	2	2	3	2	2,5	1
3 Likelihood of additional populations becoming critically endangered or lost (projection of present situation)	1: Low 2: Moderate 3: High 4: Very high	1	1	1	1	1	1	1	3	2	1,5	1	2,5	1	1	1	1
Sum (of maximum 12)		5	7	3	4	5	6	3	10	8,5	4	7	7	7	6	6	5
Compiled development (0-1)		0,42	0,58	0,25	0,33	0,42	0,50	0,25	0,83	0,71	0,33	0,58	0,58	0,58	0,50	0,50	0,42