Threats to sea trout in Norway

Photo: Eva B. Thorstad

Short summary

The Norwegian Scientific Advisory Committee for Atlantic Salmon has earlier shown that sea trout in many watersheds in Norway is in a poor state, except in Northern Norway, where sea trout is in a better state than the rest of the country. For the first time, we have now assessed the threats from human activities to sea trout. Salmon lice from aquaculture farms is the largest threat to sea trout. The impact of salmon lice is so large, and covers such large geographical area, that this threat alone has been and will be the determining factor for the future development of sea trout. To improve the situation, the salmon lice infestation pressure from fish farms must be considerably reduced. Climate change is the second largest threat. 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.

The full report is published in Norwegian: https://brage.nina.no/nina-xmlui/handle/11250/3093719

Norwegian Scientific Advisory Committee for Atlantic Salmon

The Norwegian Scientific Advisory Committee for Atlantic Salmon is appointed by the Norwegian Environment Agency to evaluate status of salmon and sea trout and importance of different threats, and to give science-based catch advice and advice on other issues related to management of wild salmonids.

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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Extended summary

Background and methods

The Norwegian Scientific Advisory Committee for Atlantic Salmon has earlier shown that sea trout in many watersheds in Norway is in a poor state, except in Northern Norway, where sea trout is in a better state than the rest of the country. The committee has developed a classification system to rank the threats from human activities to Atlantic salmon (**figure 1**, Forseth et al. 2017). The assessment of threats to Atlantic salmon is updated annually. The same system is now for the first time used to assess the major threats to sea trout. For each human impact factor, the *effects* (**figure 1**) are assessed in terms of number of affected populations, reduction in production capacity in affected populations, number of critically endangered or lost populations, and implemented mitigation measures (**table 1**). In addition, the *development* (**figure 1**) is assessed in terms of likelihood that the human activity will result in further reductions in population size or loss of populations in the future (**table 1**).

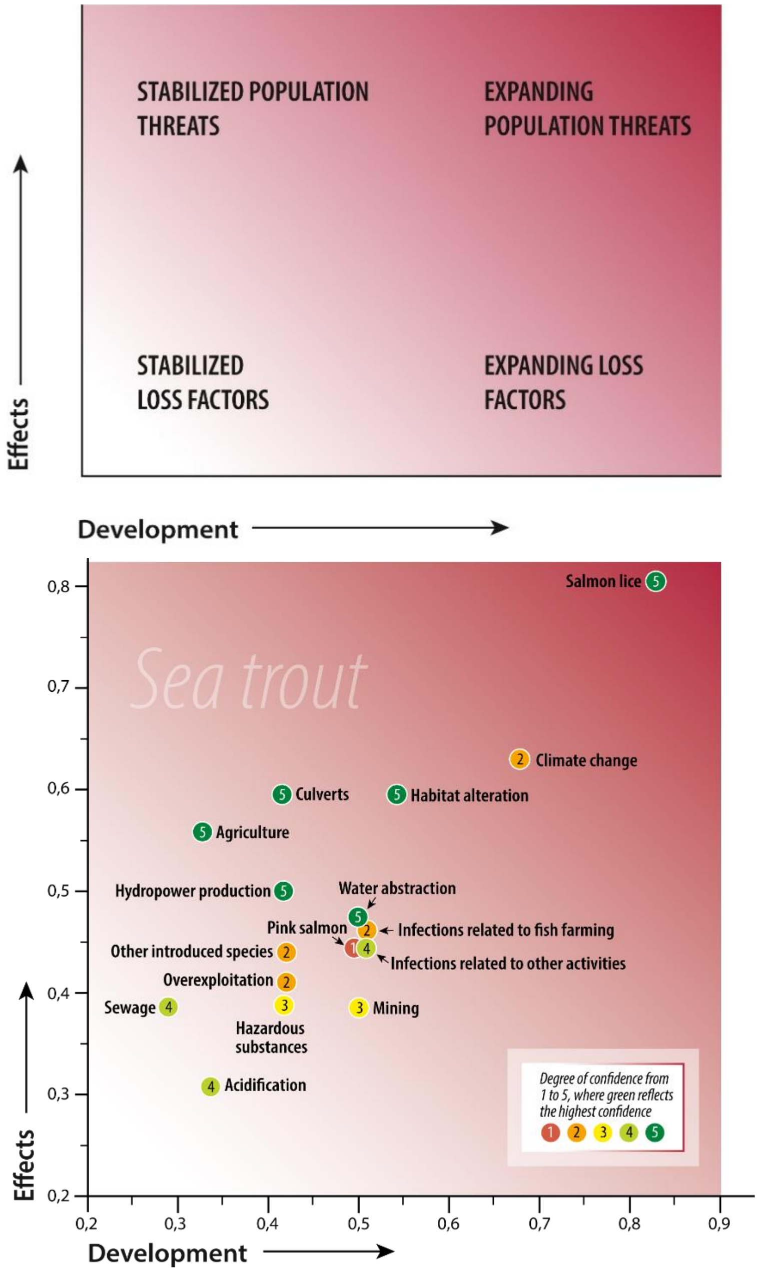

Figure 1.

Upper graph: The classification system developed to rank different anthropogenic impacts to Norwegian Atlantic salmon and sea trout 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.*

Lower graph: Ranking of 16 impact factors considered in 2022, according to their effects on sea trout populations, 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.*

There are at least 1251 watersheds holding sea trout in Norway. The classification of state of sea trout from the previous assessment (Norwegian Scientific Advisory Committee for Atlantic Salmon 2022) provided data from these watersheds that could be used in the present assessment of threats. In addition, scoring was done based on relevant scientific articles, Norwegian reports, other public documents, and the expert judgment of members of the committee. Scoring for each impact factor is given in **table 1**. For the assessment, we define sea trout as trout moving into saltwater for parts of their life. This means that we consider a sea trout population as lost if the migration route to the sea is blocked, or if survival at sea is so low that the migratory part of the population is lost. A watershed with a lost sea trout population can still have resident trout, but anadromy has been lost.

Confidence in the assessment of effect for each human impact is given based on a scoring of how well the impact is documented, i.e., the knowledge level, and the level of agreement in the documentation. Both knowledge level and agreement are scored and combined into an overall confidence level, on a five-point scale from low to very high.

Major threats to sea trout – Results of the assessment

Salmon lice from aquaculture farms is by far the largest threat to sea trout (**figure 1**). Sea trout are severely affected by salmon lice infestations in many watersheds in large parts of the country (**figure 2**). High salmon lice levels also affect sea trout in parts of the country where sea trout until now have had a better state than in the rest of the country. The impact of sea trout is so large and covers such large geographical area that this threat alone has been and will be the determining factor for the development of sea trout. To improve the situation for sea trout, the salmon lice infestation pressure from fish farms must be considerably reduced. Current mitigation measures are insufficient to hinder expansion of negative impacts in the future.

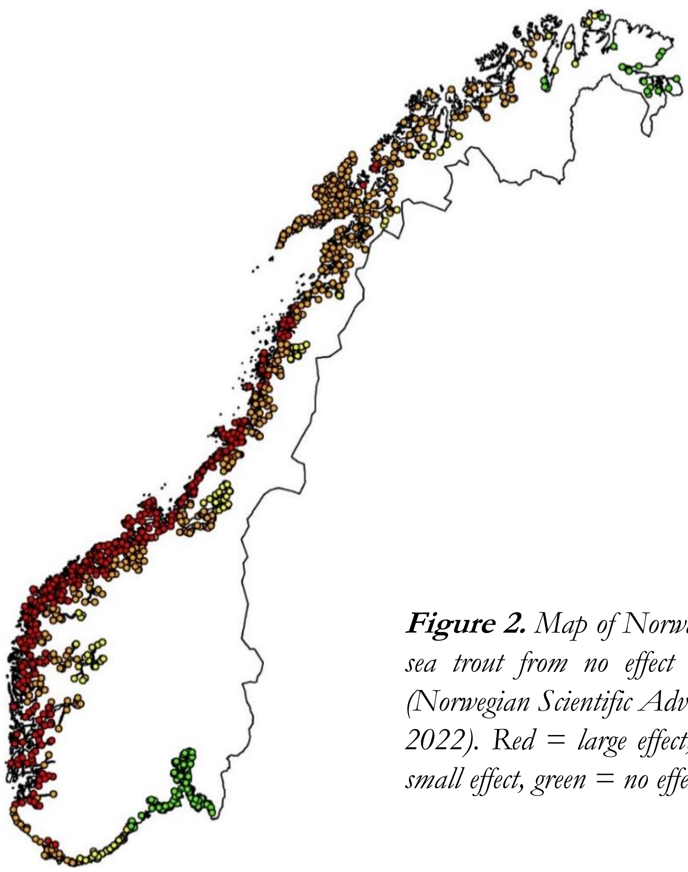

Figure 2. *Map of Norway showing the effect of salmon lice on sea trout from no effect to large effect in 1222 watersheds (Norwegian Scientific Advisory Committee for Atlantic Salmon 2022). Red = large effect, orange = moderate effect, yellow = small effect, green = no effect.*

Climate change is the second largest threat to sea trout. Climate change is assessed as a non-stabilised population threat, but to a smaller extent than salmon lice. Climate change is like salmon lice assessed as an expanding threat, which means sea trout is affected to the extent that populations may be critically endangered or lost in nature, and there is a high likelihood these threats will cause further reductions of sea trout in the future (**figure 1**). Culverts, channelisation, other habitat alterations, and agriculture are also threats to sea trout, but to a smaller extent than salmon lice and climate change (**figure 1**). The risk of further expansion of the negative effects of habitat alterations is relatively large, whereas the risk of a further expansion due to agriculture and culverts is smaller. Hydropower production, water abstraction for other purposes than power production, and infectious diseases also have a significant negative impact on sea trout. There is an underexploited potential for improving conditions for sea trout related to all these threats.

The knowledge of impacts of salmon lice, culverts, agriculture, hydropower development water abstraction and other habitat alterations is very good, hence the confidence of the assessment is very good (**figure 1**). Alien pink salmon is a new threat to sea trout and other salmonids, and the assessment is given with low confidence due to the lack of knowledge of effects. The impacts of overexploitation, infections related to fish farming, climate change and other alien species than pink salmon are also uncertain. Overexploitation is difficult to assess because of poor quality of the catch statistics in some fisheries, and because populations sizes are not estimated and compared with spawning targets for each of the watersheds.

References

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.

Norwegian Scientific Advisory Committee for Atlantic Salmon 2022. Classification of the state of sea trout in 1279 watersheds. Temarapport number 9, 170 pp. In Norwegian.

Norwegian Scientific Advisory Committee for Atlantic Salmon 2022. Assessing the threats to sea trout. Temarapport number 12, 37 pp. In Norwegian

Table 1. *Scores given for each human impact affecting sea trout along the effect and development axis. For each of the axes, sum of scores and compiled relative effect (proportion of maximum number of points possible) are given. Knowledge level for effects and level of agreement in the documentation are combined into an assessment of confidence for each of the human impacts, on a five-point scale from 1 = low to 5 = very high.* ***Figure 1*** *is a graphic illustration of the compiled relative effects and confidence of assessments.*

Effect axis: Characteristics considered	**POINTS AND CRITERIA**	Hydropower production	Water abstraction (other than hydropower)	Acidification	Agriculture	Sewage	Hazardous substances	Mining	Overexploitation	Salmon lice	Infections related to fish farming	Infections related to other activities	Climate change	Habitat alteration (channelisation, embankments etc.)	Other introduced species than pink salmon	Pink salmon	Culverts
1 Number of affected populations	1: <150, 2: 151-300, 3: 301-600, 4: > 600	2	1	1	3	2	1	2	2	4	2	2	4	3	2	2	3
2 Effects on production	1: Small reduction < 10%	2	2	1	2	1	1	1	1,5	3	1	2	1	2	1	1	1,5
Typical effect on a population in terms of reduced production capacity, smolt production or sea survival	2: Moderate reduction 10-29%																
	3: Large reduction 30-75%																
	4: Very large reduction > 75%																
3 Number of lost or critically endangered populations in nature	1: None, 2: 1-15, 3: 16-50, 4 > 50	2	2	1	2	1	2	1	1	2,5	1	1	1	2	1	1	2
4 Implemented mitigation measures	1: Extensive, with large effects	2	2,5	2	2	2	2	2	2	3	3	3	4	2,5	3	3	3
(i.e., measures that reduce effect on production or likelihood that populations will be critically endangered or lost)	2: Many, with good effects																
	3: Few, or measures with small effects																
	4: Very few or no, or measures without net effect																
Sum (maximum 16)		8	7,5	5	9	6	6	6	6,5	12,5	7	8	10	9,5	7	7	9,5
Compiled relative effect (0-1)		0,50	0,47	0,31	0,56	0,38	0,38	0,38	0,41	0,78	0,44	0,50	0,63	0,59	0,44	0,44	0,59
Knowledge, agreement / combined confidence in the assessment		3,3/5	3,3/5	2,3/4	3,3/5	2,3/4	2,2/3	2,2/3	1,2/2	3,3/5	1,2/2	2,3/4	2,1/2	3,3/5	2,1/2	1,1/1	3,3/5

Table 1 *continues*

Development axis: Characteristics considered	POINTS AND CRITERIA	Hydropower production	Water abstraction (other than hydropower)	Acidification	Agriculture	Sewage	Hazardous substances	Mining	Overexploitation	Salmon lice	Infections related to fish farming	Infections related to other activities	Climate change	Habitat alteration (channelisation, embankments etc.)	Other introduced species than pink salmon	Pink salmon	Culverts
1 Potential for effective measures (projection of present situation)	1: Extensive and very effective measures are planned 2: Several and effective measures are planned 3: Some effective measures, or measures with small effects are planned 4: Few or no effective measures are planned	2	3	2	2	1,5	2	2,5	3	3	3	4	3	3,5	3	2,5	2,5
2 Likelihood of further production losses (projection of present situation)	1: Low 2: Moderate 3: High 4: Very high	2	2	1	1	1	2	2,5	2	4	2	3	3	2	1	2,5	1,5
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	1	3	1	1	2	1	1	1	1
Sum (maximum 12)		5	6	4	4	3,5	5	6	6	10	6	8	8	6,5	5	6	5
Compiled development (0-1)		0,42	0,50	0,33	0,33	0,29	0,42	0,50	0,50	0,83	0,50	0,67	0,67	0,54	0,42	0,50	0,42