International Salmon Farmers Association (ISFA) Report to NASCO 2024

1. Sustainability as a premise for further development and growth of salmon aquaculture

In a changing world with a growing population, increasing animal protein demand, and limited freshwater- and land resources, limited wild fish reserves, and food systems being challenged by climate change - and with an unfulfilled potential in our vast ocean - growth in aquaculture protein production is considered key to address future food demand and to secure future (needed) jobs and value creation (OECD, 2016; FAO 2021).

The ISFA members work to support the UN´s Sustainable Development Goals (SDGs) and thereby acknowledge that sustainability is not limited to ecological measures – but needs to fulfil ecological, social and governance dimensions simultaneously. Based on comparison of ESG-related key performance indicators (KPI) such as use of antibiotics, animal welfare, deforestation, water use, workers safety, climate footprint salmon producers perform well and reach higher scores in general in comparison with other animal proteins producers (poultry, cattle, pork, dairy) (Coller FAIRR protein producer index, www.fair.org).

Whereas aquaculture has high scores compared to other animal proteins, the aquaculture industry acknowledges the need for all food systems to further reduce impact, and use of resources and has continuous focus on areas such as further reducing carbon emissions, sustainable and sufficient feed resources, animal welfare for farmed fish and reuse of nutrient effluents (collect and recycle uneaten feed and fish faeces). However, in this NASCO forum we will focus on interactions between wild and farmed salmon.

Whilst being a low-impact protein product on a global scale and compared to other farmed animal proteins, there are potential negative ecological effects from salmon aquaculture of more local and regional nature that need to be addressed. Transmittance of salmon lice and escaped fish are regarded as the two factors with the largest potential negative effects from aquaculture on wild salmon. It is our common responsibility to protect nature and biodiversity where we operate. Hence, the aquaculture industry continues to commit to solving these challenges through collaboration, contribute to and improving knowledge, financing research, implementation of new technology and new management practices.

As will be described in the following, whilst the challenges are not fully solved, efforts continue to pay off and pave the way for more sustainable production of farmed salmon in co-existence with wild salmon.

2. Compliance to International goals in the 'Guidance on Best Management Practices (BMP)

Certification secures increased compliance to Best Practice, Sustainability and Transparency: A steadily increasing share of salmon farms of the ISFA members are certified according to recognized, third party certifications such as ASC, Global GAP (mainly Europe), and BAP (mainly North America). These certifications comprise criteria including requirements to minimize impacts on the local ecosystem and biodiversity, requirements to minimize disease outbreaks, and maximise food safety, animal health and welfare, employer health and safety etc., and are thereby in line with – though, even more extensive – than the BMPs and local regulations.

Sustainability reports (Voluntary for most members of the ISFA) increasingly used by salmon farmers to communicate openly about sustainability issues, and their strategies for improvements.

Increased collaboration between farmers for area management approach: Farm management methods such as area or zone management, site rotation and fallowing are effective tools to uphold

healthy localities in regards of disease and nutrient excess in general and have been employed by most fish farmers for some time.

Specific BMPs on escapes (confinement): Focus on combined preventive measures & efforts to reduce risk from escape events. Most important preventive measures are training of personnel, continuous video monitoring of fish and nets and improved production technology and technical standards for aquaculture installations. In some cases divers and/or ROV are used for inspection during operations to ensure that no escapes occur. As is exemplified with official data from production of Atlantic salmon in Norway (Figure 1) there is a clear trend demonstrating reduced numbers of escaped farmed salmon despite the major increase in biomass during the same time period (Data source: Norwegian Fisheries Directorate), and the relative numbers of escaped fish vary around 0.01 percent most recent years. Whilst moving in the right direction, further reduction is needed in the total number of escaped salmon to reach the goal of zero escapes.

Besides preventive measures, reporting of escape incidents are mandatory. When reporting causes for escapes are described in an open access database for learning purposes and future improvements (fiskeridir.no). Further, fish farmers are responsible for removal / fishing out escaped fish when incidents occur. Based on funding from the industry; Salmon rivers are monitored to quantify escaped salmon, and when critical thresholds are reached, special efforts are made for removal from rivers to further prevent potential negative influence in rivers.

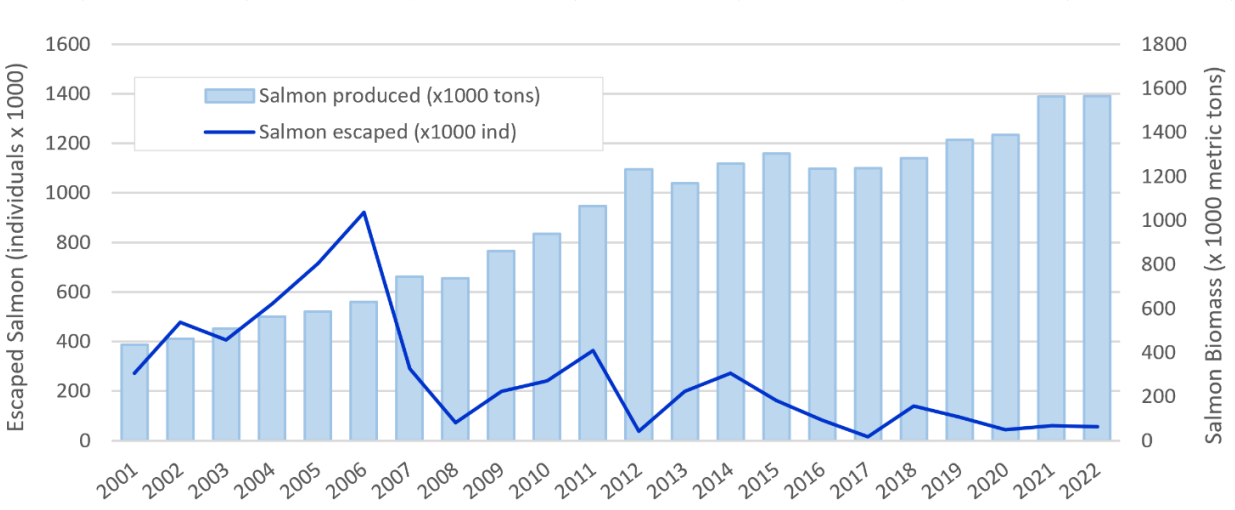

Figure 1: Total number of farmed Atlantic salmon escaped (blue line) in relation to biomass produced (light blue bar) in Norwegian salmon farming. (The peak in escapes during 2006 is majorly from the extreme weather event "Narve"). Data source: Norwegian Directorate of Fisheries. Data retrieved 08. April, 2024.

Specific BMPs on salmon lice: Focus on preventing infection and reducing transfer of lice between wild and farmed salmon. Effective salmon lice management is of absolute importance for the welfare of the farmed fish, to avoid transfer of lice between sea cages and localities, and to avoid potential negative impact on wild salmon. All farmers monitor and report on sea lice at all farms.

The common focus for all salmon farmers is to firstly prevent, control and reduce, and avoid treatment when possible. Secondly; when needed, treatments for de-licing are increasingly non medical (to avoid impact on non-targeted species and avoid development of resistance to treatment). More specifically:

Preventive and control measures: Mandatory counts/monitoring of lice levels on farmed fish, automatic counts and control/removal of lice (AI/Video, laser), biological control of lice levels (use of cleaner fish, use of natural feed ingredients that are repelling to lice) prolonged production phase in closed systems on land or in sea followed by transfer of large post smolt to grow-out entities to shorten production time in sea cages (reduce exposure and thereby risk), collaboration and area or

zone planning at sea transfer, site to site coordinated sea lice management activities and site rotation and fallowing, use of new sea-based production technology for grow-out (submersible entities, semi-closed and closed production technology), etc.

Treatment against lice: Decrease in medicinal treatments, increased use of non-medicinal tools, such as use of freshwater or tempered water treatment and "hosing" with low pressure water ("mechanical removal") in well boats or in closed systems. When medicinal treatment is applied, medicine must be prescribed, and the use is performed by trained veterinarians. Use of treatment/medicine is reported accordingly (to government regulators and stakeholders).

Reducing risk with lower trigger level / thresholds for lice on farmed fish during smolt migration: To prevent the spread of sea lice and sea-lice larvae between farming sites, and from farmed fish to wild salmon smolts, there are mandatory and maximum thresholds for the amount of adult female lice per farmed fish at production sites. Licence holders must take measures to reduce sea lice levels below this threshold when exceeded. For salmon producing countries in the North Atlantic the thresholds vary somewhat, but all have in common that the maximum number of mature female lice is drastically reduced just before and during smolt migration periods. For instance, according to "code of good practice" Scotland recommends de-licing above 1 adult female louce in general, and 0.5 in smolt migration periods (Anon 2015). The Faroe Islands recently reduced the threshold from 1.5 mature female lice per fish (Gislason, 2018) to 1 mature female louse in general and 0.5 during wild salmon smolt migration (Løgtingslóg, 2023). Norway has the strictest standard with 0.5 adult female lice in general and 0.2 lice per fish during the smolt spring migration period (Ministry of Trade, Industry and Fisheries, 2012).

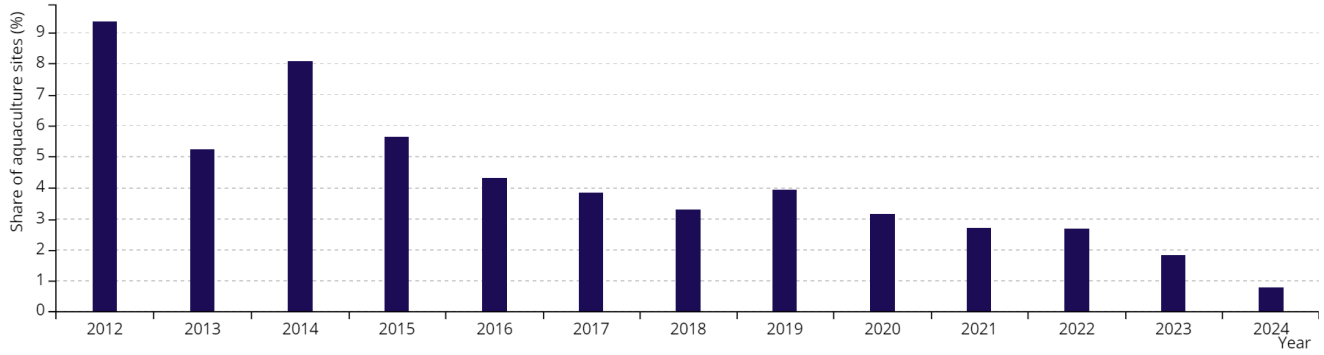

Figure 2. Percentage of aquaculture sites above the lice thresholds in average per week indicates an overall reduction in lice levels on farm level. Based on mandatory weekly reported lice counts in Norway. Source: BarentsWatch Fish Health (https://www.barentswatch.no/en/fishhealth)

3. Shared responsibility & joint efforts: Call for action and collaboration to increase knowledge on impacts and possible mitigations for strengthening our wild salmon populations

Stock levels of wild Atlantic salmon have been declining for several decades across the North Atlantic, and ISFA shares the concerns with NASCO and other stakeholders for this development. All members of ISFA respect and act on their responsibility for further reducing potential negative impacts from salmon aquaculture on wild salmon populations and through constant and knowledge-based improvement of management practices. Hence, we actively and constantly seek to contribute with new knowledge, finance research and initiate collaboration. Examples are:

The Salmon Scotland Wild Fisheries Fund (www.wildfisheriesfund.co.uk) supporting the **West Coast Smolt Tracking Project**, which aims to develop understanding of the migratory patterns of wild Atlantic salmon on the west coast of Scotland so that they can be better protected from the threats they face in the marine phase

Salmon Tracking (SALT), a collaboration between research and industry partners, funded directly and indirectly (Norwegian Seafood Research Fund; www.fhf.no/fhf/about-fhf-english/) through the salmon industry sector, aiming at improving the level of knowledge about the wild resources of

salmon and sea trout in the «Vestlandet" region in Norway and to close knowledge gaps to improve management of salmon farming.

As well as practical financial support to organisations and research in the marine environment, the salmon farming sector have an increased commitment to work more collaboratively with wild salmon conservation, environmental NGOs, landowners by wild salmon rivers, anglers, hunting and fishing associations to contribute to conservation efforts in the freshwater stage, to enhance riverine habitats, repopulate rivers and to increase knowledge on river specific population dynamics for a further understanding of factors involved for wild salmon to thrive in their fresh water habitat (and how to strengthen the local populations)
(www.wildfisheriesfund.co.uk; https://oysterriverenhancement.org/;
https://www.nootkasound.info/projects; https://www.salmontracking.no/;
https://www.anadrom.no/om-oss).

In parallel with the salmon industries responsibility to constantly reduce their impact – we also urge all stakeholders to acknowledge and address all impacts / pressures that can be mitigated. *We cannot overlook the fact that the wild salmon populations are influenced by an interaction of many anthropogenic and natural biological and physical factors – in both freshwater and marine environment – and that the decline shows synchrony across the North Atlantic including areas where aquaculture of salmon is absent. This indicates that more knowledge is needed – and that some impact factors that could (should) be mitigated are underestimated?*

For instance, a large scale meta-analysis comprising over 350 000 migrating salmon, from releases at eight locations along Ireland's South and West coasts covering a 9-year period (2001 to 2009) was undertaken. The analysis indicated the observed level of marine mortality attributable to sea lice is small in absolute terms (approximately 1%, e.g. an odds ratio 1.14:1 in favour of groups treated for lice). The study concludes at the levels found lice induced mortality is unlikely to influence the conservation status of stocks and is neither a significant driver of marine mortality. It is further emphasized that in evaluating marine mortality of salmon it is important to recognize that over time the level of lice-induced mortality is a minor component and has remained relatively constant at approximately 1%, *whereas the other mortality factors have increased substantially leading to a drop in the survival of Atlantic salmon over the study period from the region of 20% to <5%* (Jackson et al. 2013).

A recent review also points at a possible underestimated impact of concern relating to marine mortality: Large ocean-areas shared by all North Atlantic salmon lack surveillance outside the Exclusive Economic Zones and in remote northern regions, giving "easy access" for illegal, unreported, and unregulated (IUU) fisheries exploitation at sea. IUU fisheries as a likely impact factor is supported by indications such as: 1) A flatline of adult abundance and 2) a reduction in adult mean size, which are common characteristics of many overexploited fish stocks, as is the case for salmon and 3) adult returns to rivers with no obvious local impacts (little or no human habitation, no hydropower, undammed, remote from salmonid aquaculture sites) and insignificantly affected by climate change or acid rain and pollution, have also declined or collapsed since 1985 across the North Atlantic (thus pointing at common factors at sea) (Dadswell et al., 2021).

Relevance of ecosystem approach and difficulty in isolating effects from farm-derived lice from other sources of lice and other sources of impact: *At the strict thresholds for lice levels in farms as described, the welfare of farmed fish is not directly affected. However, compliance of strict lice threshold require control and at times de-licing, which have major implications for fish welfare and survival of farmed salmon*. A large-scale analysis of farm site lice levels and infestations levels of surrounding wild salmonid populations based on nationwide data in Norway from 2012 to 2020, demonstrated a lack of association between farm site lice-levels and infestations levels of surrounding wild salmonid populations. Thus, non-compliance to lice threshold did not result in an increase in severely infested wild fish, and successful compliance to strict lice thresholds in farms did not significantly reduce infection levels on wild fish. This indicates a lack of environmental effectiveness

of strict lice regulations (Figure 3; Larsen and Vormedal, 2021), and indications that more knowledge is needed on wild fish contribution to lice and other physical and biological factors affecting infestation levels on wild fish. And whereas strict lice regulations did result in reduced lice levels in *fish farms*, the unintended effects of these regulations on the welfare and survival of farmed fish (due to compliance and de-licing) were extensive (Figure 3. Larsen and Vormedal, 2021).

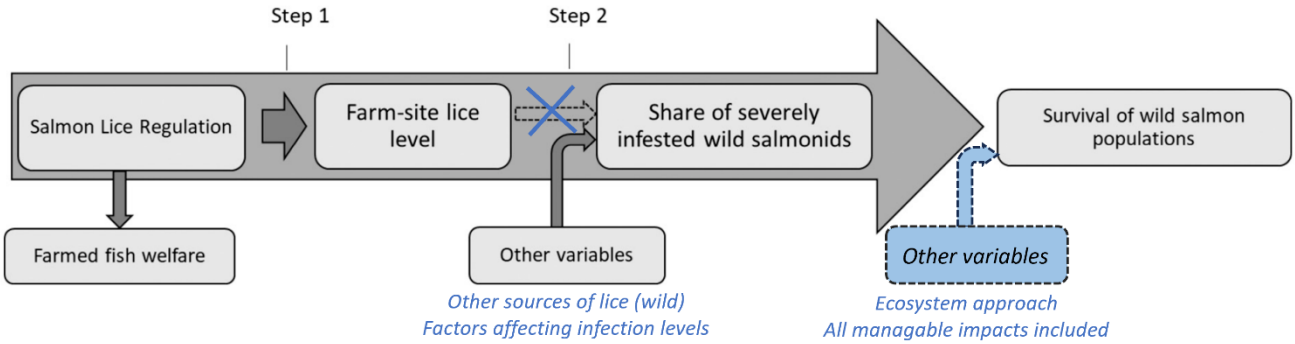

Figure 3: Environmental effectiveness of salmon lice regulation with thresholds 0.2 / 0.5 lice per fish. Excerpt from Larsen and Vormedal, 2021. Blue box, cross and text are added in this report for illustration purposes.

A similar lack of association between farm lice levels of Atlantic salmon and infestation levels on two species of wild Pacific salmon was reported from a large-scale analysis encompassing data from four regions in British Colombia, Canada and during 2016 – 2021. No statistically significant associations were found between lice levels in fish farms and juvenile, migrating wild Pacific salmon in the same area, indicating that lice infestation levels on wild salmon cannot be explained solely by infestation pressure from farm-derived lice, and other relevant environmental, physical and biological factors should be evaluated (DFO, 2023). These findings indicate the complexity of the ecosystem, and the difficulty in distinguishing between lice sources (lice form wild fish and lice from farms) and difficulty in estimating effects from (farm derived-) lice on wild populations.

These findings collectively underline the importance of including all factors that can be mitigated in our common efforts to secure healthy wild salmon populations and using an ecosystem approach to reach that common goal (and focus should be both on freshwater and the marine phase of the life cycle of wild salmon (Thorstad et al., 2021, Gillson et al., 2022).), and in such a way accomplish knowledge based management that secures wild stocks as well as good fish welfare and sustainability in salmon aquaculture.

The International Salmon Farmers Association (ISFA) is an umbrella organization comprised of national and regional associations from around the world. ISFA members share a common vision and dedication to helping our farmers and industry professionals produce healthy food, revitalize coastal communities and build vibrant businesses.

4. References

Anon 2015. Code of Good Practice, Chapter 4: Seawater Lochs. Scottish Finfish Aquaculture. www.thecodeofgoodpractice.co.uk

Dadswell M, Spares A, Reader J, McLean M, McDermott T, Samways K, Lilly J. 2021. The decline and impending collapse of the Atlantic salmon (Salmo salar) population in the North Atlantic Ocean: a review of possible causes. Rev Fish Sci Aquac. https:// doi. org/ 10. 1080/ 23308 249. 2021. 19370 44

DFO. Association between sea lice from Atlantic Salmon farms and sea lice infestations on wild juvenile Pacific Salmon in British Columbia. DFO Can. Sci. Advis. Sec. Sci. Resp. 2022/045; 2023

Food and Agriculture Organization of the United Nations (FAO). Strategic Framework 2022 -31. 39 p.; 2021.

Gillson JP, Basic T, Davison PI, Riley WD, Talks L, Walker AM, Russell IC. 2022. A review of marine stressors impacting Atlantic salmon *Salmo salar*, with an assessment of the major threats to English stocks.

Gislason, H., 2018. Statistical modelling of sea lice count data from salmon farms in the Faroe Islands. J. Fish Dis. 41, 973–993

Jackson D, Cotter D, Newell J, McEvoy S, O'Donohoe P, Kane F, McDermott T, Kelly S & Drumm A. 2013. Impact of Lepeophtheirus salmonis infestations on migrating Atlantic salmon, Salmo salar L., smolts at eight locations in Ireland with an analysis of lice-induced marine mortality. Journal of Fish Diseases 36, 273–281.

Larsen and Vormedal 2021. The environmental effectiveness of sea lice regulation: Compliance and consequences for farmed and wild salmon. Aquaculture. 2021;532(6):736000.

Løgtingslóg (Parliamentary Act) nr. 29 (2023) https://logir.fo/Kunngerd/75-fra-28-06-2016-um-yvirvoku-og-talming-av-lusum-a-alifiski. In Faroese.

Ministry of Trade, Industry and Fisheries. Forskrift om bekjempelse av lakselus i akvakulturanlegg [Regulation on control of salmon lice in aquaculture facilities] (FOR-2012-12-05-1140). In Norwegian; 2012

OECD. 2016. The Ocean Economy in 2030. OECD publishing. 252 p.

Thorstad EB, Bliss D, Breau C, Damon-Randall K, Sundt-Hansen LE, Hatfield EMC, Horsburgh G, Hansen H, Maoileidigh ON, Sheehan T, Sutton SG. 2021. Atlantic salmon in a rapidly changing environment – Facing the challenges of reduced marine survival and climate change. Aquat Conserv Mar Freshw Ecosyst 31(9):2654–2665