Environment, Climate Change and Land Reform Committee

Environmental impacts of salmon farming

Written submission from OneKind

OneKind welcomes the ECCLR Committee's inquiry into the environmental impacts of salmon farming. There is significant overlap between the environmental impacts and mitigation measures identified in the Scottish Association for Marine Science (SAMS) report and the welfare of farmed salmon. This includes the impact of parasites and diseases, their treatment, the use of cleaner fish, and triploid fish. We therefore consider it important to address environmental and welfare issues in tandem. Key welfare concerns as they link with environmental impacts are outlined below.

Consideration of the welfare of farmed salmon must be kept within the context that fish are sentient beings. This means that they are capable of feeling pain and suffering. Their ability to feel pain is evidenced by their possession of nociceptors, receptors which are activated by exposure to noxious stimuli, and their changes in behaviour and/or physiology in response to a painful stimulus[1].

1. Sea lice and sea lice management

As noted in the SAMS report, sea lice cause "*severe damage*" (p. 11, para 1) to farmed salmon, and are *"a fish welfare concern*" that "*requires treatment for this reason*" (p. vi). Sea lice damage salmon welfare in multiple ways, by causing:

- **Fin erosion and skin lesions.** Sea lice cause injuries to fish because they feed on the tissues and blood of salmon, causing fish to develop lesions and/or loose scales.
- **Stress.** Research has shown that infection with high numbers of sea lice can lead to increased levels of the stress hormone cortisol in infected fish, up to 21 days after infection[2]. Chronic stress can compromise welfare through a number of ways, such as decreasing growth rate[3] and causing fish to be more susceptible to further infection.
- **Reduced swimming capability.** Sea lice have been shown to hinder swimming capability in pink salmon[4], with individuals infected with sea lice having reducing swimming endurance. This causes problems for the fish, for example through hindering their ability to escape aggressive interactions or successfully obtain food.
- **Imbalanced water and salt levels.** Sea lice damage the skin of salmon, reducing the efficacy of the skin as a barrier, meaning that more water leaks from the fish, causing an imbalance in internal water and salt levels[5].

[1] Sneddon (2015): "Pain in aquatic animals"

[2] Mustafa et al. (2000): "Effects of sea lice (*Lepeophtheirus salmonis Kröyer*, 1837) infestation on macrophage functions in Atlantic salmon (*Salmo salar* L.)"

[3] McCormick et al. (1998) Repeated acute stress reduces growth rate of Atlantic salmon parr and alters plasma levels of growth hormone, insulin-like growth factor I and cortisol

[4] Brauner et al. (2012): "Physiological consequences of the salmon louse (*Lepeophtheirus salmonis*) on juvenile pink salmon (*Oncorhynchus gorbuscha*): implications for wild salmon ecology and management, and for salmon aquaculture

[5] Thorstad et al. (2015) Effects of salmon lice Lepeophtheirus salmonis on wild sea trout Salmo trutta—a literature review

As well as directly causing the above negative impacts, sea lice can also harm salmon through acting as vectors to transmit Infectious Salmon Anaemia (ISA)[6], and potentially other diseases, to salmon. Sea lice also have the potential to significantly weaken fish, making them more susceptible to diseases.

In addition to causing a direct negative impact on the welfare of farmed salmon, the various treatment practices can have profoundly negative consequences too, as described below. Given this, we believe that the emphasis on future research in this area should be on sea lice prevention through, for example, the use of sea lice "snorkel" barriers[7].

2. Treatment of parasites and diseases

As well as impacting the environment, treatment of parasites and diseases can have a detrimental impact on fish welfare. FOI data[8] shows that "treatment" was the most frequently cited reason for the cause of mortality events between January 2016 and September 2017. The below table highlights four treatments that have compromised fish welfare.

Treatment	Method	Welfare Concern	Example
Thermolicer	Uses warm water to remove sea lice.	The warm water may cause severe harm, or death, to the fish.	In 2016, 95,000 fish were killed during the use of thermolicer[9]
Azamethiphos (Salmosan®)	Fish are exposed to Salmosan® using a bath treatment.	Bath treatments require crowding, which can cause stress. Salmosan® has been shown to cause fish balance problems[10].	Salmosan® was listed as a cause of mortality when over 30,000 salmon died on one site[11].
Hydrogen Peroxide	Exposed using a bath treatment.	Using a chemical irritant compromises the welfare of fish. It can cause them stress[12], often to the point that the fish die.	More than 60,000 salmon were killed during treatment for amoebic gill disease[13]
SkaMic	Using brushes and soft jets of water to remove sea lice.	Can harm and remove the scales of fish.	On one site, fish were descaled following the use of SkaMic[14].

Any debate over the use of treatments for diseases and parasites should therefore include consideration of the welfare implications of such treatment, with the aim of minimising suffering.

[6] Nylund et al. (1994) "Mechanisms for transmission of infectious salmon anaemia (ISA)"
[7] Stien et al. (2016) 'Snorkel' sea lice barrier technology reduces sea lice loads on harvest-sized Atlantic salmon with minimal welfare impacts
[8] Mortality data at fish farms 2016/2017 https://beta.gov.scot/publications/foi-17-02089/
[9] http://www.bbc.co.uk/news/uk-scotland-38966188
[10] http://salmosan.net/product-data/
[11] Fish Health Inspectorate "Publication of case information: 2017" http://www.gov.scot/Topics/marine/Fish-Shellfish/FHI/CaseInformation/caseinfo2017
[12] Bowers et al. (2002): "The effects of hydrogen peroxide on the stress response of Atlantic Salmon (*Salmo salar*).
[13] http://www.telegraph.co.uk/news/2016/11/18/thousands-of-fish-poached-alive-in-lice-treatment-bungle-that-co/
[14] Fish Health Inspectorate "Publication of case information: 2017" http://www.gov.scot/Topics/marine/Fish-Shellfish/FHI/CaseInformation/caseinfo2017

3. Use of cleaner fish

The SAMS report describes the use of cleaner fish as an "*attractive option*" of treating sea lice (p. 114, para 6). Whilst it may appear preferable to chemical treatments, we have concerns over the use of cleaner fish that were not raised in the SAMS report.

Firstly, the welfare of cleaner fish is often compromised. Being stocked with salmon creates welfare issues in itself, with salmon showing aggression towards wrasse[15], and even consuming them. There have also been cases where wrasse have caused harm to salmon. In one incident in 2010, ballan wrasse caused eye damage to a number of salmon, causing fish to bleed to death[16].

In addition, disease and parasite treatments can cause welfare problems for cleaner fish. For example, the Fish Health Inspectorate reported that treatment using hydrogen peroxide caused stress to the wrasse, leading to an outbreak of furunculosis[17]. Cleaner fish are also treated as disposable, with wrasse being killed after each production cycle[18].

The welfare implications of using wild-caught cleaner fish are also poorly understood and more research on this is needed. There is also a concern that cleaner fish can spread pathogens and parasites to farmed salmon, as noted in the report (p. 116, para 1). A report by the Norwegian Scientific Committee for Food and Environment on disease transmission by cleaner fish concluded that:

"the disease status of wild-caught cleaner fish is, in general, poorly known. Translocations of such fish may result in the introduction of new pathogens to farmed salmonids."[19]

This highlights the potential role that cleaner fish have as vectors for pathogens and parasites to farmed salmon. Such transmission has the potential to cause further damage to farmed salmon.

4. Use of triploid fish

The SAMS report suggests that one way to reduce the impacts escaped salmon have on wild populations is the use of triploid fish (p. 91, para 3). We are concerned about the use of triploid fish, as they often encounter greater welfare issues than diploids. There has been research that shows that triploid Atlantic salmon are more likely to have spinal deformities[20], are more vulnerable to temperature stress[21], and, when mixed with diploid salmon, are more likely to face aggression from others than their diploid counterparts[22]. Triploid salmon therefore often have increased mortality

[15] Deady et al. (1995): The use of cleaner-fish to control sea lice on two Irish salmon (*Salmo salar*) farms with particular reference to wrasse behaviour in salmon cages
[16] Viking Fish Farms Ltd (2013): Use of Wrasse in Sea Lice Control
[17] Fish Health Inspectorate Publication of Case Information http://www.gov.scot/Topics/marine/Fish-Shellfish/FHI/CaseInformation
[18] CIWF and WSPA report "Closed waters: the welfare of farmed Atlantic Salmon, Rainbow Trout, Atlantic Cod and Atlantic Halibut".
[19] Nowegian Scientific Committee for Food and Environment. "Risk assessment of fish health associated with the use of cleaner fish in aquaculture"
[20] Fjelldal and Hansen (2010): "Vertebral deformities in triploid Atlantic salmon (*Salmo salar L.)* underyearling smolts"
[21] Fraser et al. (2012): "Welfare considerations of triploid fish"
[22] Carter et al. (1994): "Food consumption, feeding behaviour, and growth of triploid and diploid Atlantic salmon, *Salmo salar* L., parr"

compared to diploids[23]. This means that triploid fish often suffer more than diploids. For these reasons, OneKind opposes the use of triploid fish.

[23] Cotter et al. (2002) Comparison of freshwater and marine performances of all-female diploid and triploid Atlantic Salmon