Sea lice management

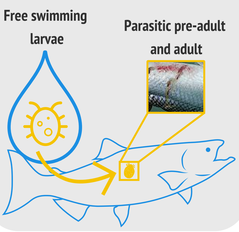
Comparison of prevention and treatment methods against the salmon parasites *Lepeophtheirus salmonis* and *Caligus elongatus*.

Background

Sea lice

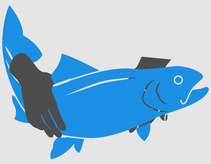
Larval stages are dispersed through the water. Parasitic pre-adult and adult stages attach onto salmon and feed on mucous, skin and tissues.

Sea lice cause open wounds, a lower immune capacity and can cause death



Reduction in natural defences

The mucous layer present on the skin of fish is their natural protection against external parasites, including sea lice.



Common practices during salmon farming require the fish to be handled. Handling damages the fish's protective mucous, making them more vulnerable to sea lice.

Costs

Between 2012 and 2017, 10,130 delousing treatments occurred in Norway[1].

Sea lice have cost US$4.36 billion from 2013 to 2019 to the salmon farming industry[2].

Site selection

Some areas have higher sea lice infection rates than others.

In 2012, sea lice levels in Shetland were on average >250% higher than the report level of a weekly average of 3 adult females per fish, whereas Orkney had very low rates[3].

Note: since 2019, the report level is a weekly average of 2 adult females per fish

Careful selection of new farm locations using oceanographic modelling is needed to prevent farms being established in areas with known or likely sea lice infestations.

Fallow periods can greatly reduce the risk of recurring sea lice infestations, especially if co-ordinated amongst groups of farms.

Prevention

	Functional feed	Sea lice trap	Deep lights / feeding	Sea lice skirts	Snorkel nets	Electrical fence
How it works	Feed which contains ingredients that thicken the mucus layer, promote healing or repel copepods	Traps are placed around the pens which attract sea lice away from salmon using light and odorant	Salmon are attracted to depths without sea lice with light or feed	A fabric which covers the top of the net which prevents sea lice larvae from entering the sea pens	Salmon are forced to stay below the sea lice depth line using nets. They can only surface in one area to fill their swim bladder	Electrical pulses are transmitted through the water and inactivate lice before they attach onto salmon
Effectiveness	20% effective[4]	In lab studies: 8% delousing, 20% effective in trapping unattached adults and 70% effective in trapping larvae[5]	Effectiveness generally low as fish surface to fill swim bladder. Lights ineffective during the day[6,7]	Sea lice skirts have been found to be 30-80% effective[9,10]	Site dependent: 0-75% effective[11]	New technology, results are promising, 50-80% effective[12]
Mortality risk	No risk known	No risk known	No risk known	No risk known	No risk known	No risk known
Injury risk	No risk known	No risk known	No risk known	No risk known	Increase in snout injuries[11]	No risk known
Other welfare concern	No concern known	No concern known	Salmon prefer to swim at the surface. This method alters natural behaviours[8]	Oxygen can become depleted when using sea skirts. Monitoring water quality is important[10]	Snorkel nets can affect salmon behaviour and prevent access to optimal water conditions[11]	No concern known
Environmental impact	No impact known	No impact known	No impact known	No impact known	No impact known	No impact known

Treatment

	Cleaner fish	Hydrogen peroxide	Chemotherapeutic	Laser	Thermolicer/ Optilicer	Mechanical
How it works	Cleaner fish are housed in the same sea pens as salmon and eat sea lice that are on the salmon	Infected salmon are exposed to hydrogen peroxide at concentrations which kill sea lice	Infected salmon are exposed to chemical via baths or feed	An underwater camera detects sea lice and a laser kills them	Salmon are pumped through heated/cooled water. Sea lice fall off	Salmon are pumped through water jets. Sea lice are dislodged
Effectiveness	Effectiveness is limited and depends on the species, the time and density of stocking and cleanliness of the nets[13]	7.5-99% effective depending on: duration, concentration and previous treatments[16]	13-96% effective depending on: duration, concentration and previous treatments[14]	Research found no effectiveness[23]	19-100% effective on mobile lice; not effective on attached lice[1,19]	82-100% effective on mobile lice; effect on attached lice uncertain[1]
Mortality risk	Up to 100% of cleaner fish[15]	Mortality can be over 50%[17]	Mortality can be over 10% and on rare occasions, over 50%[4]	No risk known	Mortality can be over 25%[1]	Mortality can be over 10%[1]
Injury risk	Aggression between cleaner fish and salmon can lead to injuries for both salmon and cleaner fish[14]	Gill lesions and gill necrosis. Damaged mucous layer[18]	Gill damage[20]	No risk known	Cold water: injuries to skin and eyes. Injuries to fins during treatments >10 min[24]	Scale loss is very common[1]
Other welfare concern	Welfare of cleaner fish is often poor (lack of feed, enrichment) and cleaner fish can be subject to aggression[15]	Physiological and oxidative stress. Decreased resistance to disease[19]	Stressful procedure. Lethal to surrounding animals[21]	No concern known	Warm water: colliding with tank, loss of equilibrium. Cold water: loss of movement, disrupted feeding[25]	Stressful procedure[1]
Environmental impact	Some cleaner fish are wild caught. This depletes wild populations[14]	No impact known	Environmental pollution[22]	No impact known	No impact known	No impact known

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