

Sea lice and predation stress: science has a solution

Keep seals away from salmon to mitigate or eliminate sea lice, AGD and ISA.

Research has linked an increase in sea lice attachment to elevated levels of plasma cortisol, a hormone produced by fish in response to stress. Stressed fish are not only more susceptible to sea lice attachment – they actually attract lice.

GenusWave, an innovative technology company serving the aquaculture industry, has developed cutting-edge solutions to impossible problems, Targeted Acoustic Startle Technology (TAST), prevents predation and the stress that comes from predatory seals. Reduce stress and the levels of sea lice infestation will decline as well. TAST has the potential to significantly mitigate lice infestation on salmon farms, based on recent science.

Research, published in 2021, has discovered "... a link between the plasma cortisol concentration and the *L. salmonis* copepodid

infestation level." (Delfosse & Pageat, 2021).

In fact, sea lice are able to detect cortisol and adjust their swimming direction to make a straight line for the closest salmon that is stressed and vulnerable. Research now makes it clear that plasma cortisol is one of the key ingredients to managing sea lice. Eliminate predation stress with TAST - which decreases cortisol - and a corresponding reduction in sea lice will follow.



Targeted Acoustic Startle Technology (TAST)

TAST is a breakthrough technology developed by a team of world-class marine biologists from the Scottish Oceans Institute at the University of St Andrews, one of the foremost institutions for marine mammal research in the world.

TAST's effectiveness and environmental compliance has been documented in multiple peer-reviewed and published research papers, which show that:

- TAST is effective and remains effective - no habituation;
- The startle signal is species-specific - no impact on salmon or non-target species; and
- TAST does not harm, harass or disturb marine mammals - no habitat exclusion.

TAST produces a specific sound to elicit an acoustic startle reflex in a target species. Repeated elicitation of the startle reflex activates a predator's innate flight response and subsequent avoidance behaviour. TAST is like a dog whistle - in reverse.

TAST is approved as an acoustic device for use on Aquaculture Stewardship Council (ASC) certified farms and is compliant with the standards of the US Marine Mammal Protection Act (MMPA).

TAST has been successfully deployed on salmon farms on the west coast of Scotland and in the Finnmark region of Norway. In January, a farm in Scotland was losing over 1,000 fish a week to seals and an outbreak of AGD was spreading. Within days of a TAST deployment,



GENUSWAVE

the predation losses were cut to almost zero and the AGD health crisis ended two months later. The salmon were happier and healthier.

Stress increases mortality

Salmon's acute sense of smell enables them to detect the presence of seals, even at a distance, causing predation stress and cortisol production. Seals cause chronic stress events just by swimming near fish farms – all day, every day. And seal populations are increasing.

As increased levels of cortisol and adrenaline are released, salmon's immune system is compromised, antibody production is slowed, and susceptibility to sea lice infestation, bacterial disease and various pathogens increases.

Stressors, combined together, overwhelm a salmon's immune system to the point of failure.

Salmon farms in Maine in 1992–1993 reported that outbreaks of Hitra, a cold-water bacterial disease, started and had the greatest impact on pens attacked by seals, and those pens had a 4%-5% increase in mortality from Hitra. "Stress increases mortality" (Nash and Iwamoto, 1999).

Sea lice: changing the outcome

Mucus is the salmon's first line of defence against parasites and pathogens. Reducing cortisol and creating an environment conducive to producing more mucus interferes with the ability of sea lice to target salmon as a host, disrupting the host identification and host attachment process.

According to numerous studies, "host identification and host attachment are critical steps for ectoparasites with free-living life stages, such as *L. salmonis*" (Fields et al., 2018; Tucker et al., 2000b).

In fact, research has found "... a copepodid is more attracted to and swims towards a stressed salmon..." and "...the antimicrobial peptide cathelicidin-2 present in Atlantic salmon skin and mucus is a molecular host associated cue for the salmon louse *L. salmonis*, as it is detected by the parasite which can then modify its swimming behaviour." (Núñez Acuña et al., 2018)

It is instructive to note that feed companies with extensive research budgets have made the connection between mucus production and sea lice. Most notably, Skretting has formulated specific feed additives that increase mucus production. Their research shows a 20% reduction in sea lice infestation. There are two ways to increase mucus: feed additives, or reducing stress.

Infectious salmon anaemia (ISA)

Infectious salmon anaemia (ISA) is a contagious viral disease in salmon that attacks the cell layer (endothelium) that covers the



inside of blood vessels and the heart. Stress could be the hidden trigger that converts a harmless variant of the ISA virus into disease. Ole-Bendik Dale an aquatic biosafety section leader at the Norwegian Veterinary Institute, previously warned that "The harmless HRP0 virus can easily mutate to HRPdel". Predation stress may trigger mutation. Eliminate predation stress and a possible trigger for an ISA outbreak is removed.

Amoebic gill disease (AGD)

Stress also contributes to AGD because of the release of adrenaline and the increase in cortisol, which can cause changes to the cellular structure of the gills. Elevated blood flow associated with stress allows increased oxygen uptake for respiration but also increases the permeability of the gills to water and ions.

Acute stress also reduces the salmon's ability to maintain water and ion homeostasis, limiting the capacity to osmoregulate and, over long periods of stress, risking osmotic shock and death.

The light at the end of the tunnel may be an oncoming train: current solutions may make sea lice worse

The same research that revealed the link between plasma cortisol concentration and the *L. salmonis* copepodid infestation level also discovered that: "...current lice management strategies may, paradoxically, increase re-infestation risk by handling or otherwise stressing the salmon." (Delfosse & Pageat, 2021)

After a sea lice treatment, salmon are stressed, cortisol levels are up, and every fish on the farm is sending out a signal inviting sea lice to come and attach, just when they are most vulnerable.

Many current solutions may remove sea lice but also strip away mucus, making the salmon more vulnerable.

Growing salmon without predation stress can help prevent sea lice before they identify and attach themselves.

TAST can help improve salmon's immuno-response to parasites and pathogens by removing predator-induced stress. Then salmon can better survive the stressors in their marine environment and better able to use their natural defences to prevent sea lice attachment.

A healthy salmon is a more profitable salmon

Back to basics: what is good for fish health and welfare is good for business. Settled science suggests that sea lice, infectious salmon anaemia (ISA), amoebic gill disease (AGD), and other parasites, pathogens, and biological diseases linked to stress, can be mitigated or eliminated by reducing stress. The farther away the predators are kept, the lower the stress levels for the salmon.

"Any response...to stress requires the expenditure of energy that would otherwise be utilized for maintaining normal body functions such as growth, digestion, osmoregulation, disease resistance, healing and reproduction. Think of energy as a pie with only so many pieces; stress consumes a portion of the animal's energy..." (Barton & Iwama, 1991. Schreck, 1982)".

Stressed salmon use their energy for stress - not growth. Without stress from predators, salmon will grow faster and healthier. Salmon develop a better colour, texture, taste and mouthfeel. A healthy fish means a happy customer.

Implementing TAST to reduce stress helps farmers protect their fish and their business. Growing salmon without predation stress provides significant and measurable improvements in fish health.

Steven Alevy is a Managing Partner of Genuswave. ●

”
Plasma
cortisol is
one of the
the key
ingredients
to managing
sea lice

Opposite from top: Common seal; Sea lice attached to salmon; Genuswave TAST device
Above: Salmon