FISHTREAT: A novel, sustainable medicinal dosing system for fish farms

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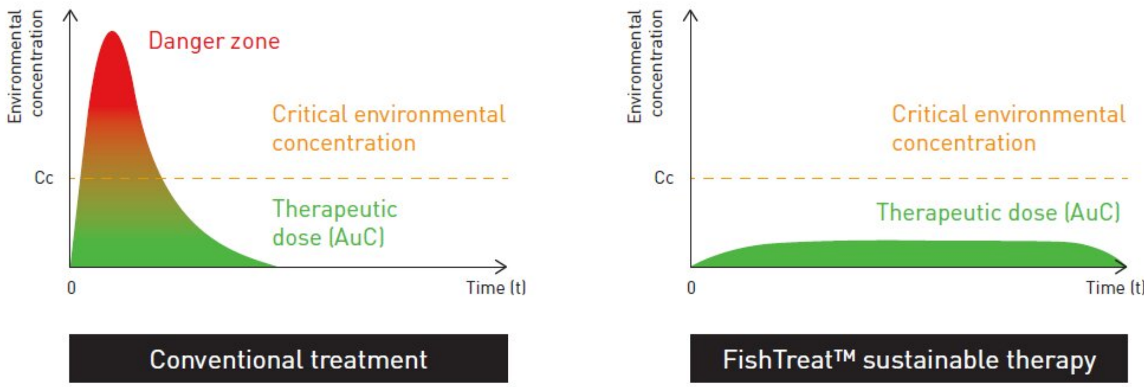
One of the main challenges for salmonid aquaculture is the threat of parasitic infestations from sea lice such as Lepeophtheirus salmonis. Credit: Wikimedia

One of the main challenges for salmonid aquaculture is the threat of parasitic infestations from sea lice such as Lepeophtheirus salmonis. These parasites have been shown to survive for more than 190 days post attachment to the host fish, and during this lifetime can produce more than 10 broods (egg strings), each containing approximately 150 eggs per string. (Heuch et al., 2000). The problem with sea lice infestations is that they can cause stress to the host fish, cause skin lesions and secondary infections, can infect wild populations of salmonids and in some cases, can cause death of the fish (particularly smaller smolt stages).

Furthermore, there are legal requirements to maintain sea lice infestations below a certain limit. There are also significant economical and societal drivers to control sea lice infestations. Traditionally, control of sea lice has relied on the use of veterinary medicinal products (VMPs) to treat the fish. Some of the VMPs that have been used to treat salmonids have been implicated with possible adverse effects on non-target organisms, i.e., severe negative ecosystem impacts, and/or a threat to other commercially important species such as shrimp and lobsters (Samuelsen et al., 2014; Macken et al., 2015). This has led to a reduction in the quantities being used recently compared with the situation only a few years ago where tons of VMPs were being used annually to treat the fish.

Sea lice prevention strategies have recently been steering towards passive implementation e.g. cleaner fish, sea lice skirts, thermolicer or flushing. However, these methods are not without their own problems. Drawbacks of some mechanical methods are related to ethical concerns over fish stress during treatment. Some techniques have also resulted in accidental mass fish kills representing significant economic losses to the fish farm. Ethical considerations of using cleaner fish has also been highlighted with recent estimates that 50 million cleaner fish die each year in Norway.



FISHTREAT can significantly reduce the amount of veterinary medicinal products (VMP) that is needed to elicit an effect on the sea lice which also means that the amount of VMP being lost to the surrounding area is minimized. Credit: NIVA

But sea lice are not without their own survival strategies. A recent development in the evolution of sea lice has resulted in the prevalence of transparent adult sea lice. Consequently, cleaner fish and laser detection systems are not as successful in detecting and removing them from the fish. The short generation time from juvenile to adult sea lice is further exacerbating the evolutionary development of pigment free lice. Therefore, although there are significant resources being used to develop non-medicinal treatment systems, it is anticipated that there will be a continued need to use VMPs to treat sea lice. There are, however, the concerns about the possible effects of VMPs on non-target and/or commercially important organisms, so intelligent strategies are highly recommended for dosing the fish with VMPs to minimize any possible environmental impact. An example of one such strategy is using well boats to treat the fish and subsequently treating the effluent before releasing it to the sea. However, this still means that the fish suffer extreme stress from being removed from the fish pens and being held for a duration in a confined environment. There is also the risk of mass fish kills if there is a problem with the treatment process, and there are also concerns of disease transfer associated with their use (Lyngstad et al., 2015).

A more promising technique to treat fish with VMPs has recently been developed by scientists at the Norwegian Institute for Water Research (NIVA). These scientists have been investigating the effects of VMPs on the environment for over a decade and understand the significant risks that they pose to non-target organisms. So, they have developed a system called FISHTREAT which is based on a passive dosing technique. The FISHTREAT system can significantly reduce the amount of VMP that is needed to elicit an effect on the sea lice which also means that the amount of VMP being lost to the surrounding area is minimized. The principle of the FISHTREAT system is that by understanding the physico-chemical properties of different molecules it is possible to technically upload the medicine into an appropriate material such as nylon, which when placed into the fish pen enables a sustained release to treat the fish.

Unlike the current methods of applying quantities of VMPs through fish feed or in bath treatments, it is possible to maintain a therapeutic dose within the fish pen over an extended period of time which is far below the level expected to cause an effect on the environment. The NIVA scientists have recently been awarded a Norwegian and Chilean patent for the invention and there are patents pending in Europe and North America. They are now looking towards an industrial partnership to develop this invention into a commercially viable product for use in salmonid aquaculture. However, FISHTREATis not limited to this one form of aquaculture and could be relevant for all types of disease control within other aquaculture industries.

More information: P A Heuch et al. Egg production in the salmon louse [Lepeophtheirus salmonis (Kroyer)] in relation to origin and water temperature, *Aquaculture Research* (2003). DOI: 10.1046/j.1365-2109.2000.00512.x

Ailbhe Macken et al. Benzoylurea pesticides used as veterinary medicines in aquaculture: Risks and developmental effects on nontarget crustaceans, *Environmental Toxicology and Chemistry* (2015). DOI: 10.1002/etc.2920

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