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For the attention of:
Animal Welfare Commission
Scottish Government: Animal Health and Welfare
RSPCA Assured Science Group/Technical Advisory Group
Cross-Party Group on Animal Welfare

Opinion on the use of thermal treatments to delouse Atlantic Salmon, *Salmo salar*

To whom it may concern,

Please note the following is my personal expert opinion and does not reflect the opinion or views of my employer.

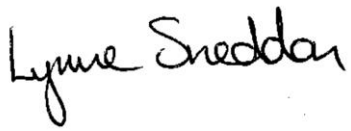
Atlantic salmon farming has increased over recent years and due to the high stocking density of sea-caged adults there is a high prevalence of disease including infestation by salmon lice, *Lepeophtheirus salmonis* (Overton et al. 2019). These lice can cause large sores and make the fish more vulnerable to secondary infections and thus seriously reduce health and welfare. Treatment has previously employed chemotherapeutants (e.g. hydrogen peroxide) to kill salmon lice but since 2015 there has been an increase in the use of mechanical (physical) and thermal (heat) methods (Overton et al. 2019). The Thermolicer® and Optilicer® treats salmon by exposing them to high temperatures which kills the lice (temperatures above 30°C and typically 34°C and above; Overton et al. 2019; Gismervik et al. 2019; Nilsson et al. 2019). These temperatures sit outside the natural temperature range Atlantic salmon inhabit or can tolerate. Elliot and Hurley (1997) determined the lower and upper temperature limits for growth of Atlantic salmon as 6.0°C and 22.5°C, with 15.9°C as the optimum temperature for growth. Salmon shows signs of stress at approximately 22°C and that the upper lethal limits were between 25° and 28°C (Anttila et al., 2014; Elliott & Elliott, 2010; Garside 1973). Further, I was the first to show that fish have nociceptors, nerve endings that respond to painful stimuli (Sneddon 2002), and demonstrated that a closely related salmonid species, the rainbow trout, *Oncorhynchus mykiss*, possessed nociceptors that responded to temperatures that would give rise to pain in humans (Sneddon 2003; Sneddon et al. 2003). These nociceptors are strikingly similar to those found in mammals including humans (Sneddon 2018; 2019) and those on the skin and cornea of the eye are excited by temperatures from 29°C and above (Ashley et al. 2006; 2007). Therefore the Thermolicer® and Optilicer® exposes Atlantic salmon to painful temperatures. Behavioural studies have demonstrated that Atlantic salmon exposed to temperatures above 28°C perform abnormal behaviours and lose equilibrium (the ability to maintain an upright position) which is a precursor to mortality (Gismervik et al. 2019; Nilsson et al. 2019). Tissue injuries in gills, eyes, brain, nasal cavity and thymus were recorded in Atlantic salmon exposed to water temperatures of 34 - 38 °C (Gismervik et al. 2019). Therefore, the high temperature treatment exposes Atlantic salmon to painful temperatures resulting in altered behaviour and damage which could lead to mortality. Indeed there are cases where the use of the Thermolicer resulted in the mortality of 96,000 salmon (Holen et al. 2019) and these heat methods result in greater mortality rates than other treatments (Overton et al. 2019).

The Farm Animal Welfare Council (FAWC) stipulates in their five freedoms that farmed animals should have “Freedom from pain, injury or disease” and “Freedom from fear and distress”. FAWC also state in their recent report farmed fish have “the capacity to experience pain” (FAWC 2014) and RSPCA (2018) agrees with this opinion in their report on the welfare standards of farmed Atlantic salmon stating “fish need to be protected from pain”. The Thermolicer® and Optilicer® expose Atlantic salmon to painful temperatures, result in injuries and this process is likely to cause fear and distress. Further the Animal Welfare Act (2006) states clearly that harm should be prevented and welfare promoted.

Therefore, in my expert opinion and based upon scientific studies from other laboratories, both of these thermal treatment methods contravene the FAWC five freedoms, the RSPCA (2018) welfare standards for farmed Atlantic salmon and the Animal Welfare Act (2006) resulting in harm and poor welfare and should not be employed within the Atlantic salmon farming industry.

I would be very grateful if you could please consider my opinion within your respective organisations.

Yours faithfully,



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