GREAT LAKES FISHERY COMMISSION

2021 Project Completion Report[1]

Use of an artificial stream to monitor avoidance behavior of larval sea lamprey in response to TFM and niclosamide

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by:

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ABSTRACT:

The lampricide 3-trifluoromethyl-4-nitrophenol (TFM) has been used in liquid form to control larval sea lamprey (*Petromyzon marinus*) in Great Lakes tributaries since the late 1950s. In the 1980s a dissolvable TFM bar was developed as a supplemental tool for application to small tributaries as a deterrent to larvae seeking water not activated with TFM. The size, mass, and number of bars needed in some streams, as well as the location of the streams, limit the utility of a TFM bar. The development and use of an alternative niclosamide bar has the potential to use fewer bars to achieve similar results. However, the use of a niclosamide bar is dependent upon its larval deterrent capability compared to the TFM bar. In this study, we developed a laboratory-scale, simulated stream fluvarium with several avoidance areas including two side channels and a seep. The objective was to evaluate the deterrent capabilities of TFM and niclosamide. We found sea lamprey to have similar behavioral responses, with both TFM and niclosamide having similar capabilities to prevent sea lamprey from seeking refuge in side channels and seep avoidance areas. TFM-treated side channels and seep increased sea lamprey occupancy in the main channel 2.56 times more than the untreated-controls (95% CI 1.63 – 4.14) whereas niclosamide-treated side channels and seep increased sea lamprey occupancy of the main channel 2.68 times more than the untreated-controls (95% CI 1.72 – 4.32). These responses indicate a niclosamide bar would effectively prevent sea lamprey escapement into freshwater during a lampricide treatment at concentrations unlikely to harm aquatic organisms.

RESEARCH HIGHLIGHTS:

- An artificial stream constructed with two side channels and a seep to represent fresh water refugia demonstrated that larval sea lamprey were able to avoid the lampricide and survive by escaping into the fresh water during a simulated TFM treatment.
- An artificial stream with a TFM treatment in the main channel and TFM treatments in the side channels and the seep increased main channel occupancy 2.56 times more than the untreated-control groups.
- An artificial stream with a TFM treatment in the main channel and niclosamide treatments in the side channels and the seep increased main channel occupancy 2.68 times more than the untreated-control groups.
- TFM and niclosamide were found to be equally effective at preventing larval sea lamprey from escaping the main channel TFM treatment. The potential benefits of a niclosamide bar may warrant further research.

SUMMARY STATEMENT:

This research was conducted under Task 1 (General Technical Assistance: Assist States, GLFC, DFO, USFWS, Health Canada, and EPA in matters regarding lampricides, including analysis of vendor lampricide production samples) of the Technical Assistance Agreement between the U.S. Geological Survey and the Great Lakes

Fishery Commission as a result of discussions at a Lampricide Control Task Force meeting. The goal of the research was to determine the potential utility of a niclosamide bar for preventing larval sea lamprey from escaping into untreated water during lampricide stream treatments. TFM is a selective sea lamprey toxicant when applied at treatment levels; therefore, TFM bars, which contain 23% TFM, are typically applied in small tributaries to achieve a TFM concentration at or slightly above the minimum lethal concentration for the specific water chemistry of the system being treated. Niclosamide is a more potent and non-selective toxicant that could significantly reduce the mass of bars required to be transported and applied in remote locations if it is determined that sea lamprey have a similar avoidance response to niclosamide as they do to TFM. This research was conducted to determine if niclosamide has similar deterrent capacity as TFM when applied at concentrations that would not be harmful to non-target organisms. The specific objectives and summary results from the research are as follows:

1 Evaluate the avoidance behavior of larval sea lampreys to TFM concentrations at typical treatment levels compared to untreated UMESC well water in a simulated stream with two freshwater side channels and one freshwater seep.
Summary result: This study objective was met. Larval sea lamprey demonstrated the ability to escape the TFM treated main channel in the artificial stream by moving in to the untreated freshwater side channels and seep.

2 Evaluate the avoidance behavior of larval sea lampreys to TFM concentrations at typical treatment levels in the main channel of the avoidance stream compared with two side channels and one seep that contain TFM at typical treatment levels to simulate the presence of a TFM bar in the side channels.
Summary result: This study objective was met. Larval sea lamprey occupancy in the main channel of the artificial stream was 2.56 times more when the side channels and seep were treated with TFM compared to the untreated-control group.

3 Evaluate the avoidance behavior of larval sea lampreys to TFM concentrations at typical treatment levels in a the main channel of the avoidance stream compared with two side channels and a seep that contains niclosamide (12-h LC01 for rainbow trout) to simulate the presence of a niclosamide bar in the side channels.
Summary result: This study objective was met. Larval sea lamprey occupancy in the main channel of the artificial stream increased 2.68 times when the side channels and seep were treated with niclosamide compared to the untreated-control groups.

DELIVERABLES:

Peer-reviewed publications:

Nicholas Schloesser, Mike Boogaard, Todd Johnson, Courtney Kirkeeng, Justin Schueller, Richard Erickson, Use of an artificial stream to monitor avoidance behavior of larval sea lamprey in response to TFM and niclosamide, Journal of Great Lakes Research, Volume 47, Issue 4, 2021, Pages 1192-1199, ISSN 0380-1330, https://doi.org/10.1016/j.jglr.2021.04.015.

Schloesser, N.A., Erickson, R.A. 2021. Data Release: Use of an artificial stream to monitor avoidance behavior of larval sea lamprey in response to TFM and Niclosamide. U.S. Geological Survey. Data Release. https://doi.org/10.5066/P9CNU24G.

Presentations:

Schloesser, N.A. 2020. Larval Sea Lamprey Avoidance of Lampricides. Oral presentation at the Sea Lamprey Annual Workshop, January 22, 2020, Traverse City, Michigan