GREAT LAKES FISHERY COMMISSION

Project Completion Report[1]

Feasibility of using strobe lights to direct sea lamprey movement

by:

Kim T. Fredricks[1]
William D. Swink[1]
Larry Montouri[2]

[1]National Biological Service
Lake Huron Biological Station
Millersburg, Michigan 49759

[2]Flash Technology
Brentwood, TN 37024

June 1996

---

[1]Project completion reports of Commission-sponsored research are made available to the Commission's Cooperators in the interest of rapid dissemination of information that may be useful in Great Lakes fishery management, research, or administration. The reader should be aware that project completion reports have not been through a peer review process and that sponsorship of the project by the Commission does not necessarily imply that the findings or conclusions are endorsed by the Commission.

Completion Report

Feasibility of using strobe lights to direct sea lamprey movement

Kim T. Fredricks[1]
William D. Swink[1]
Larry Montouri[2]

[1]National Biological Service
Lake Huron Biological Station
Millersburg, Michigan 49759

[2]Flash Technology
Brentwood, TN 37024

June 1996

Introduction

Sea lampreys (Petromyzon marinus) are known to respond to light. Most migrations of spawning-phase sea lampreys occur at night, which implies a natural aversion to light (Purvis et al. 1985; Steir and Kynard 1986). European river lampreys (Lampetra fluviatilis) also avoid light. The upstream migration of river lampreys in the Kymijoki River, Finland stopped at the site of a newly constructed bridge equipped with bright lights that illuminated the entire river bed (Tuunianen et al. 1980). However, light can also attract lampreys (Sterba 1962; Purvis et al. 1985). European river lampreys that developed secondary sexual characteristics were attracted to light (Sterba 1962). A two compartment trap in the Cheboygan River, Michigan caught significantly more upstream migrating, spawning-phase sea lampreys on the illuminated side than on the darker side (Purvis et al. 1985). As the lampreys became more sexually mature they were more strongly attracted to the light (Purvis et al. 1985).

Fish may either be attracted or repelled by flashing or constant intensity lights. Generally fish are repelled by strobe lights (Nemeth and Anderson 1992). Flash Technology has tested their flash heads under a variety of conditions and with several fish species (). In all cases, fish were repelled by strobe lights.

In this pilot study, we sought to determine if lampreys, like other species, could be guided into areas, such as traps, with strobe lights. If sea lampreys behave as other fish species, then perhaps strobe lights could be used to improve trapping efficiency or as a repellent to prevent them from entering streams.

Objective

- To determine if strobe lights elicit avoidance behavior in upstream migrating sea lampreys.

Methods

Outdoor tank test

A round, 6.4-m diameter tank was filled with Lake Huron water to a maximum depth of 1.8 m. A small amount of fresh water was added to the tank during the test. Sixty spawning-phase female sea lampreys were placed in the tank and allowed to acclimate for one hour. At the end of the acclimation period, the lampreys were grouped near the outflow pipe.

An Aquatic Guidance Lighting 4100 flash head was placed in the tank, about 2.4 m from the group of lampreys. The strobe was directed at the lampreys and turned on medium intensity and maximum flash rate. In a second daylight trial, the animals were forced to swim before the strobe was turned on.

Additional testing was done during the late evening hours beginning just after sunset (about 2100 h to about 2330 h). There were some clouds, but no moon or other ambient light. The strobe was initially directed at the group of lampreys attached to the tank. The lampreys were also forced to swim and a variety of flash rates and intensities were tried.

Raceway tests

Because the outdoor tests were inconclusive, we decided to try additional tests in the raceway to simulate more stream like conditions. A 20 m section of the raceway

was divided into a current generating area and a trapping area (Figure 1). Two identical traps were placed upstream from the holding area, which was about 1.8 m long. Trolling motors were placed directly behind two traps to boost the current. The trap was 3 m long and entry was gained by movement through a wire funnel. Current in each trap ranged from about 0.15 to 0.2 m/s. All tests were conducted in complete darkness. A dim red light was used to make observations after the gate on the holding pen was opened. The flash head was placed in one of the traps, offering the lampreys a choice of a lighted or darkened trap.

A total of 6 trails were conducted in the raceway. A group of 20 female spawning-phase sea lampreys was used during each trial and each group was used only once. All lampreys were dark adapted for about 16 to 20 h before use. To begin each test, 20 lampreys were placed in the holding area and allowed to acclimate for 1 hour. After the acclimation period, the strobe light was turned on to maximum intensity, medium flash rate and the holding pen gate was opened. During the first 4 trials, the flash head was oriented perpendicular to flow. During the last two trials, the flash head was oriented downstream, parallel to the flow.

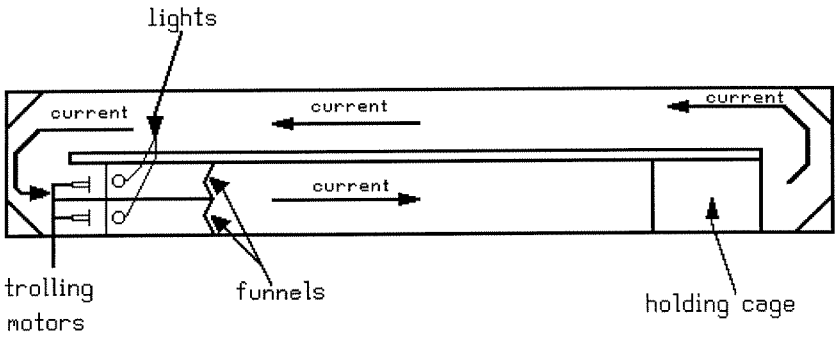

Figure 1. Raceway at the Lake Huron Biological Station. The test area is located in the bottom portion of the figure.

Results and Discussion

Outdoor tank tests

During both the daylight test and the evening tests, the lampreys were largely unresponsive to the strobe light, particularly if they were attached to the sides of the tank or the outflow pipe. If the lampreys were forced to swim, they seemed to avoid the strobe light at the lowest intensity and highest flash rate.

Our conclusion from this test was that the lampreys might respond to the strobe, but only if they were already moving. If the animals were attached, they were never startled by the strobe and remained attached, even when the flash head was placed in the midst of the group.

Raceway tests

During trial 1 the strobe was placed in the left trap at the most upstream part. Flow rate was balanced in both traps and varied from 0.13 to 0.18 m/s. At the end of the trial, 10 lampreys were in the left (lighted) trap, 1 was in the right (darkened) trap, 3

were between the holding area and the traps, and 6 remained in the holding area.

In trial 2, the flash head was moved to the right trap. Flow rates were balanced and ranged from 0.12 to 0.17 m/s. The lighted trap held six lampreys and the darkened trap held four lampreys at the end of the trial. Ten lampreys remained in the holding area.

The light remained in the right trap during trial 3. Flow rates were the same as in trial 2 and water temperature was 9.3 °C. At the end of the trial, eight lampreys were in the darkened trap, seven in the lighted trap, one in the raceway, and five in the holding area. (One extra lamprey was used in this trail).

During trial 4, the light was moved to the left trap. Flow rates ranged from 0.14 to 0.18 m/s in both traps. Water temperature was 7.2 °C. Eight lampreys were trapped in the lighted trap, six were caught in the darkened trap, three were between the traps and the holding area, and three remained in the holding area.

During the final two trials, the light was oriented parallel to the flow; the flash head was in the right trap in trial 5 and in the left trap in trial 6. Flow rates ranged from 0.14 to 0.17 m/s in trial 5 and 0.15 to 0.18 in trial 6. Water temperature was 7.2 °C. Seven lampreys were caught in the darkened trap in trial 5, one was in the lighted trap, and 12 remained in the holding area. In trial 6, only two lampreys moved, one animal was recovered in each trap, and 18 remained in the holding area.

From the raceway tests, we conclude that indirect lighting by the strobe attracted the lampreys more than it repelled them. However, lampreys seemed to avoid a direct strobe light at the low intensity and highest flash rate. This avoidance response was

not as pronounced as in teleost fishes, which indicates that the strobe might not be useful as a barrier to block migration. The strobe might still be of use in directing lampreys into traps, but neither observation can be confirmed until further testing is done with free swimming animals in a natural setting. The limitated laboratory tests do not completely rule out a response by sea lampreys to the strobe light that might be useful for improved trapping at physical barriers. Any further testing should be conducted in the field in a stream with a physical barrier, a natural spawning run of sea lampreys, and paired observations that will allow for more conclusive testing.

References

Nemeth, R.S. and J.J. Anderson. 1992. Response of juvenile Coho and Chinook salmon to strobe and mercury vapor lights. North American Journal of Fisheries Management. 12:684-692.

Purvis, H.A., C.L. Chudy, E.L. King, and V.K. Dawson. 1985. Response of spawning-phase sea lampreys (Petromyzon marinus) to a lighted trap. Great Lakes Fishery Commission Technical Report 42:15-25.

Steir, K., and B. Kynard. 1986. Movement of se-run sea lampreys, Petromyzon marinus, during the spawning migration in the Connecticut River. U.S. National Marine Fisheries Service Fishery Bulletin 84:749-753.

Sterba, G. 1962. Die Neunaugen (Petromyzonidae). Handbuch Binnenfischerei Mitteleuropas, 3B:263-352. (translated from German by R.W. McCauley, 138 p).

Tuunianen, P., E. Ikonen, and H. Auvinen. 1980. Lampreys and lamprey fisheries in Finland. Canadian Journal of Fisheries and Aquatic Sciences 37: 1953-1959.