Feasibility of acoustic telemetry to estimate spawning site fidelity of cisco in western Lake Superior

Hondorp, D.W.[2], D.L. Yule[3]; T.A. Hayden[4], S.F. Colborne[5], M.R. Lowe[4], and D Gorsky[6]

[2] U.S. Geological Survey-Great Lakes Science Center; 1451 Green Rd., Ann Arbor, MI 48105
[3] U.S. Geological Survey-Lake Superior Biological Station; 2800 Lake Shore Dr., Ashland, Wisconsin 54806
[4] Michigan State University; 11888 Ray Road, Millersburg, MI 49759
[5] Quantitative Fisheries Center, Department of Fisheries and Wildlife, Michigan State University
[6] U.S. Fish & Wildlife Service; 1101 Casey Rd., Basom, NY 14013

May 2024

ABSTRACT:

Acoustic telemetry could provide a useful tool for testing hypotheses about stock structure and interactions of Cisco (*Coregonus artedi*) in western Lake Superior provided that Cisco can be captured, tagged, and released in good physiological condition. A field experiment involving release of acoustic-tagged Cisco into a positional array was planned to determine if the two methods available for sampling spawning Cisco—short-set gill net and midwater trawling—are viable methods for obtaining fish in good condition or if they differ with respect to their effects on Cisco behavior and survival. Unfortunately, the project was delayed multiple years due to the early onset of winter in 2019, which led to the cancellation of field operations in 2019 before positional array deployment was completed and before Cisco could be sampled and tagged, as well as due to the COVID pandemic which prevented resumption of project activities in 2020. These events interfered with project execution to the extent that we were unable to fully address the original objectives, which were to determine 1) if behavior and survival of adult acoustic-tagged Cisco after release varies with capture method (gill nets vs. midwater trawls), 2) estimate the receiver spacing necessary to achieve 90% detection efficiency of acoustic-tagged individuals on the Madeline Island spawning ground given different assumptions about receiver detection range and cisco behavior (e.g., residency at spawning sites), and 3) estimate spawning site fidelity and the spatial scale of homing behavior for Cisco captured, tagged, and released at Madeline Island. We managed to sample and tag Cisco in October 2021, but limited availability of large vessel time earlier in the year prevented us from deploying receivers prior to fish release, which was necessary to achieve the first objective. Given this limitation, we changed our study objectives to: 1) describe physical condition of Cisco sampled from midwater trawls and gill nets based on visual observation, 2) determine if positional array performance in 2019-20 was sufficient to achieve objective #1 of the original proposal, 3) describe seasonal movements of surviving acoustic-tagged Cisco in western Lake Superior and provide a minimum estimate of spawning site fidelity, and 4) estimate the receiver spacing necessary to achieve 90% detection efficiency of acoustic-tagged individuals on the Madeline Island spawning ground given different assumptions about receiver detection range and cisco behavior (Objective #2 of the original proposal). Results of analyses designed to address these new objectives generated information applicable to future fish telemetry studies in western Lake Superior. For example, the poor physical condition and apparent low survival of acoustic-tagged Cisco captured in gill nets during 2021 suggested that trap nets, trawls, or angling should be used to obtain Cisco for future telemetry studies. Testing of our positional array in

2019-20 suggested our original positional array design would have provided the information needed to evaluate effects of capture method on post-release survival and behavior of acoustic tagged Cisco, but calm seas were required to obtain optimal array performance. We also were able to determine that at least some Cisco from the Madeline Island population exhibit spawning site fidelity, with individuals residing on the spawning ground for an average of 34 days during November and December of the 2022 spawning season. The protracted residence time of Cisco on the Madeline Island spawning ground (30+ days) suggests that future studies do not require expensive, high-density receiver arrays to estimate Cisco spawning fidelity, although future work will be necessary to evaluate the assumptions of simulation models designed to determine optimal receiver spacing.