Depth and temperature preferences of Lake Ontario salmonids using novel pop-off data storage tags

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ABSTRACT:

Efforts to restore Atlantic salmon (Salmo salar, ATS) and lake trout (Salvelinus namaycush, LT) in Lake Ontario have been occurring for more than 25 years, but progress has been slow and many potential impediments have been identified. Managers and anglers have expressed concern that Atlantic salmon and lake trout may compete with the popular Chinook salmon (Oncorhynchus tshawytscha, CS) and this weakens support for restoration efforts. Unfortunately, behaviour, movements and distribution (BMD) of adult fish in the open lake are poorly studied which limits our ability to assess interactions and potential competition among salmonid species. To address this, we tagged 118 Lake Ontario salmonids (88 wild caught LT, CS, ATS, rainbow trout (Oncorhynchus mykiss, RBT) and brown trout (Salmo trutta, BT), and 30 hatchery-reared LT and ATS) with pop-off data storage tags (pDST) that provided depth and temperature of fish at 70-sec intervals for up to 15 months. pDSTs offer a means of providing unprecedented detail on behaviours and habitat selection in wild fishes, but until recently have been limited to the marine environment, and usually coupled with satellite technology. Of 38 pDST tags returned, 23 were from wild-caught fish (26%) and yielded useful data whereas 14 were from hatchery-reared fish we opportunistically tagged that appear to have been unable to acclimate to life in the wild and died days to weeks after release. The amount of data for ATS was not sufficient to carry out statistical analysis, and the project has focused on LT and CS mainly. CS occupied warmer and shallower waters during the summer than did lake trout and their depth niche breadth was much larger. They achieved greater niche breadth in part because they were much more active vertically, cumulatively traveling 103±1 m hour-1 during summer (model-estimated median), whereas most lake trout were relatively inactive vertically (7±1 m hour-1). In each of our analyses, lake trout exhibited more inter-individual variation than did Chinook salmon, particularly driven by some individual lake trout that spent considerable time making forays into warmer, shallower waters. Preliminary

bioenergetics modeling for LT and CS in Lake Ontario using pDST data showed that LT would do well under increased temperature scenarios with best performance when bloater (Coregonus hoyi) is incorporated in the diet, an extirpated species that is currently undergoing reintroduction, whereas CS would only do well in the scenarios that include bloater and small temperature increases < ~0.8°C. These results suggest that elevated temperatures are likely to affect LT positively if their temperature use remains the same, likely because the cold hypolimnetic waters preferred by LT will remain available, while the more dynamic vertical behaviour of CH may expose them to supra-optimal temperatures more frequently. This project illustrates the utility of pDSTs to collect high frequency, year-round depth and temperature data for salmonids in the Great Lakes, which is necessary to understand habitat use and overlap to more accurately model the bioenergetics of these iconic species. The results demonstrate the different foraging tactics used by these two species in the Great Lakes and reflect their distinct life histories.