Environmental, biotic, and sampling effects on genetic estimates of adult sea lamprey abundance in Great Lakes tributaries

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August 2021

ABSTRACT:

Sea lamprey (Petromyzon marinus) are a harmful invasive species in the Great Lakes, and a large annual control and assessment program is dedicated to reducing their population size. Sea lamprey assessment is performed using larval electrofishing surveys as well as adult trapping for mark-recapture estimation of the number of adult sea lamprey entering streams to spawn. These assessment data are used to estimate the abundance of adult and larval sea lamprey populations over time to evaluate the effectiveness of control efforts. The number of successfully spawning adults is not currently assessed. Trapping and mark-recapture abundance estimates are conducted in a small number of index streams compared to the number of streams where larval assessment is conducted. In this study, we evaluated the utility of several genetic estimates of abundance as complementary tools to assess the abundance of spawning adults in Great Lakes tributaries.

Effective breeding size and minimum number of spawners were estimated for larval cohorts from 18 Great Lakes tributaries using SNPs generated from RADcapture sequencing. We used these data to evaluate the effects of environmental, biotic, and sampling factors on estimates of effective breeding size (Nb) and the minimum number of spawning adults (Ns). Associations between mark-recapture estimates and estimates of Nb and Ns from genetic data were also examined. Simulations were conducted to evaluate the precision and accuracy of Nb and Ns estimates as sample size, number of SNPs, and true Nb in the population increased. We found that the number of larvae collected and genotyped, a sampling factor, was a significant predictor of empirical Nb estimates; however, there was no statistically significant correlation between mark-recapture estimates and Nb or Ns. Simulations indicated that sample size and the number of SNP loci become increasingly important as true Nb increases. Additionally, the different methods of estimating Nb have different biases. The Chao method of calculating Ns had less bias than the jackknife method when true Nb is large. Overall, our results highlight the utility of Nb and Ns by providing insight into sea lamprey spawning populations, further demonstrate the complicated relationship between Nb and census size, and highlight the importance of representative sampling in empirical data sets.