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Is depth selection by lake trout morphotypes a genetic trait?

Frederick W Goetz², Shawn Sitar³, Michael Seider⁴

²University of Wisconsin - Milwaukee, School of Freshwater Sciences 600 East Greenfield Ave., Milwaukee, WI 53204

³Michigan Department of Natural Resources, Marquette Fisheries Research Station, 484 Cherry Creek Rd., Marquette, MI 49855

⁴U.S. Fish & Wildlife Service, Ashland Fish & Wildlife Conservation Office 2800 Lake Shore Drive East, Ashland, WI 54806

December 2021

ABSTRACT:

Leans and siscowets are two lake charr ecomorphs in Lake Superior that can be differentiated based on morphometry and physiology. In the wild they are also separated bathymetrically with leans inhabiting shallow depths and siscowets being deep-water forms. Using common garden hatchery rearing, some phenotypic differences between these two ecomorphs have been shown to have a genetic basis; however, it is unclear if differences in their depth selection behavior is heritable. To address this, popup satellite archival tags (PSATs) were used to determine depth and temperature profiles of lean and siscowet ecomorphs reared for 9 years in the common garden study and were compared with bathythermal data obtained from PSATs deployed on wild leans and siscowets captured and released in Lake Superior. From PSAT data, wild lean ecomorphs inhabited depths <50 m throughout the year and showed modest (mean=13 m) vertical movements. Wild siscowets exhibited four depth patterns: deep (>80 m), shallow (<10 m), extreme vertical movements (>80-0 m), and high frequency vertical movements centered around 100-125 m depths. Wild siscowets were the most stenothermal with habitat temperatures generally 3-5oC but not exceeding 12oC. Wild leans were found as low as 0oC (January-March) and up to 15oC (July-September). The siscowet shallow depth patterns suggest foraging at the surface at certain times of the year that could involve prey (insects and fish) associated with Langmuir cells. The timing and duration of the extreme vertical movements exhibited by siscowets did not appear to be associated with time of day (i.e., not diel vertical movements) and may be described as opportunistic movements bringing individuals towards the surface for foraging. Siscowet high frequency vertical movements occurred primarily in June and could be reproductive behavior at spawning sites. Hatchery leans and siscowets from the common garden study were tagged with PSATs and released at a shallow (33 m) and deep (112 m) site in southern Lake Superior. Regardless of the release site, tagged siscowets remained deep after release and those released to the shallow site gradually descended throughout the deployment to even greater depths. All tagged hatchery siscowets exhibited extensive vertical movements as observed in wild siscowets. Most of

the tagged leans remained less than 50 m after deployment and exhibited smaller vertical movements. However, a few hatchery leans exhibited similar behavior as siscowets when released to the deep site. Overall, the depths and temperatures occupied by the two hatchery-reared ecomorphs were significantly different throughout the deployment and reflected those of wild leans and siscowets, indicating that differences in depth selection behavior are heritable to some extent. It has been hypothesized that deep water lake charr ecomorphs evolved from shallow water forms. While the behavior to descend to greater depths might initially have been a result of phenotypic plasticity, it appears that it may now be genetically assimilated.