A MULTISCALE APPROACH TO BREEDING HABITAT MODEL DEVELOPMENT AND EVALUATION FOR THE COMMON LOON, GAVIA IMMER, IN NEW HAMPSHIRE, USA

BY

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ABSTRACT

The common loon (*Gavia immer*) is considered an emblematic and ecologically important example of aquatic-dependent wildlife in North America. The northern breeding range of loons has contracted over the last century, presumably as a result of habitat degradation from human disturbance and lake shore development. The common loon population in New Hampshire is distributed throughout the state and experiences a wide range of lake-specific habitats, water quality conditions, and varying levels of human disturbance. Identifying critical habitat that supports and enhances individual fitness for loons is an important component of loon conservation management. I used an empirical landscape-habitat modeling approach to evaluate the relationship between landscape pattern and composition surrounding lakes and water quality measures associated with common loon presence and productivity. A demographic response design along with occupancy rates were used to assess common loon breeding habitat quality by comparing nest success and long-term average productivity of loons living in varying habitats at over 200 nest sites across New Hampshire. I developed a human disturbance index (HDI) for a subset of nest sites based on boating traffic, public access, distance to human structures, and percent developed shoreline. I used a multi-scale approach to evaluate the association of common loons and breeding habitat at multiple scales within three natural physiographic ecoregions of New Hampshire. These multiple scales reflect loon-specific biologically relevant extents, such as common loon territories, home ranges and lake-landscape influences. Ecoregional multi-scale models were developed and compared to single-scale models to evaluate model performance in distinguishing common loon breeding habitat. The presence of islands, lower total phosphorous, increasing lake size and elevation, decreasing developed shoreline and road

density within 150 m surrounding nests, were found to be significant factors related to common loon presence and higher nest productivity. Increasing HDI values were found to have a statistically significant negative relationship with nest productivity. Based on information-theoretic statistics, multi-scale models outperformed single scale models within each of the three ecoregions. These ecoregional results suggest common loons are selecting breeding habitat at multiple scales and differentially based on the varying landscape conditions loons encounter across New Hampshire.