HABITAT USE BY WATERFOWL WINTERING IN NARRAGANSETT BAY, RHODE ISLAND

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ABSTRACT

Coastal habitats are being increasingly impacted by urbanization, particularly in estuaries that contain or are near urban and industrial centers. Increased development in close proximity to the shore has the potential to negatively impact populations of estuarine wildlife. For example, coastal areas near urban centers often provide habitat for wintering waterfowl, but little is known of the effects of urbanization on wintering waterfowl, or even of the habitat characteristics that influence waterfowl distribution in urban estuaries. In this study, we use energetic and modeling approaches to examine habitat use by wintering waterfowl in Narragansett Bay, RI, an urban estuary in the northeast U.S. The impetus for this research was the need for information about the effects of habitat and landscape characteristics, including those related to human disturbance, on habitat use by wintering waterfowl in an urban estuary.

In the first and second studies, we propose a model to estimate daily energy expenditure (DEE) of wintering buffleheads (*Bucephala albeola*) at six habitats that afford differing degrees of protection from exposure. Bufflehead had DEE that ranged from 46.9 – 52.4 kJ/hr, and their energetic costs of thermoregulation comprised as much as 28% of the total DEE. In the first study, we present a model for calculating energy-based carrying capacities for waterfowl wintering in coastal and estuarine habitats. We then use the model in the second study to calculate carrying capacities under several foraging scenarios. We found that energy-based carrying capacities varied from 20 – 320 birds per site per winter, and showed a

trend towards decreasing with increasing mean daily energy expenditure ($r^2 = 0.57$, $P = 0.08$). At each site, we observed bufflehead abundances that were much lower than our estimated carrying capacities (mean 7.3 – 37.4 birds per site), which suggested that there may be other natural or human induced factors that are acting to limit waterfowl populations at these sites.

In the third and fourth studies, we examined patterns of habitat utilization by wintering waterfowl in Narragansett Bay and attempted to identify factors that may be influencing waterfowl distribution. First, we identified four habitat types (rocky headland, shallow cove, open water, and salt marsh) used by the 17 species of waterfowl that inhabit the Bay. Using abundance-weighted principal component analysis, we identified candidate habitat characteristics that may affect waterfowl distribution including adjacent residential development, vegetated land or salt marsh in a 100 m radius around the habitat, tall forested buffer that may provide protection from prevailing winds, and prey energy density. We then used these characteristics to model waterfowl habitat use at 32 wintering sites in Narragansett Bay chosen along a gradient of urbanization. Hunting activity and habitat characteristics (e.g., habitat area, shoreline configuration, prey density) explained 13 – 27% of the variation in waterfowl abundance and species richness among sites, but landscape characteristics (e.g., surrounding residential development, vegetated land, or wetland surrounding the sites and the extent of wetland edge) explained an additional 1 – 26%. Wetland area, proportion of vegetated upland, and the extent of residential development were the most common variables entering

into the models; most species were more abundant in landscapes with more wetland and vegetated upland and less residential development.

In the fifth study, we applied our model to Harlequin ducks *Histrionicus histrionicus*, a small sea duck listed as an endangered population in Canada that uses several coastal wintering sites in southern New England. The model, which incorporates the degree of hunting activity at a site, site location, the energy density of mollusk prey, and the extent of developed land around a site, correctly predicted the presence of ducks at only 3 of the 12 known Harlequin sites. We then used logistic regression analysis to examine additional habitat characteristics that may be influencing Harlequin use at these sites as well as 12 adjacent sites of similar geomorphology but that did not support wintering Harlequins. We identified 1) the proportion of residential, commercial, and industrial land use within a 100 m radius of the perimeter of the site, and 2) distance to the nearest harlequin duck wintering site as characteristics potentially affecting habitat use by Harlequins in southern New England.

Our findings suggest that urbanization may be among the factors affecting habitat use by waterfowl wintering in urban estuaries, and should be considered in conservation strategies for waterfowl that use coastal habitats in urban North Atlantic estuaries. However, further studies will also be needed to investigate the impact of residential development on habitat utilization in the context of direct human disturbance such as hunting activity.