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Autumn waterbird migration over Lake Superior: Numbers, species, and timing

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ABSTRACT

The Great Lakes are used as a migratory corridor and for feeding by tens of thousands of waterbirds each spring and fall, yet little species-specific information is available regarding numbers, seasonal timing, and connectivity along the route. The objective of this study was to use land-based surveys to quantify fall migration at two important landmarks in Lake Superior for an assemblage of waterbirds from three orders (Anseriformes, Gaviiformes, and Podicipediformes). Both the Keweenaw Peninsula (KP) and Whitefish Point (WP) showed a temporal pattern of high numbers (peaking at 9000 and 16,000, respectively) in the first 3 h after dawn and a decline (dropping to 1000 and 5000, respectively) over the following 5 h, although the decline was far more abrupt at KP than at WP. Fall totals for WP were nearly 85,000 individual waterbirds, and for KP about 34,500. Species abundance rankings were generally similar for both locations, with the most common species being long-tailed duck (*Clangula hyemalis*), red-necked grebe (*Podiceps grisegena*), greater scaup (*Aythya marila*), and red-breasted merganser (*Mergus serrator*). Most species were far more numerous at WP than at KP, with long-tailed ducks being 65 times more numerous. A notable exception was redhead (*Aythya americana*), which was 33% more numerous at KP than at WP. We suggest that during the fall, Lake Superior acts as a geographic funnel concentrating waterbirds from northwest to southeast and that details of the composition, timing and amplitude of this phenomenon are important considerations for any nearshore Great Lakes development.

Introduction

Hundreds of thousands of waterbirds (Anseriformes, Gaviiformes, and Podicipediformes) migrate through eastern North America, including the Great Lakes, each spring and fall. Because these lakes lie between a vast breeding range in Canada and Alaska and their non-breeding range in the southeastern United States, many waterbirds use the Great Lakes as a corridor for migration (Perkins, 1964, 1965; Stout, 1995). Despite the knowledge that Lake Superior is an important migratory corridor, little is known about species composition, total numbers, timing, or connectivity across Lake Superior. One reason for this is the difficulty observing and identifying birds traveling day and night over vast areas of water at high speeds. Although radar data can be used to show that migratory birds do cross the Great Lakes in large numbers, radar cannot usually distinguish species (Diehl et al., 2003). While there is evidence that some species of waterbirds do not rely on aquatic landscape features such as rivers during migration (O'Neal et al., 2015), many ducks and other waterbirds do concentrate at points in response to projecting landmasses in large water bodies, including the Great Lakes (Bergman and Donner, 1964; Johnsgard, 1987; Smith et al., 2015; Svardson, 1953). Such flight concentrations provide the opportunity to use projecting shorelines as survey locations for counts of migrating waterbirds and to begin to understand the details of these mass movements. Here we use key points along the southern shore of Lake Superior to quantify mass fall movement of waterbirds across the Great Lakes, as they move from their breeding to wintering grounds.

In Lake Superior, waterbird surveys have been carried out for decades at Whitefish Point Bird Observatory (WP), Michigan, although very few of these data have been published (although see Devereaux and Mason, 1985, Ewert, 1982). WP data, coupled here with 2014 survey data from the Keweenaw Peninsula (KP), the approximate east-west midpoint in the lake, allow us to estimate the number of each species that pass key points in eastern Lake Superior as well as to begin to address the following questions about waterbird use of this important fall flyway: 1) what is the species-specific timing of these migration movements? 2) to what degree are flight paths species-specific? and 3) to what degree does eastern Lake Superior act as a "funnel," aggregating waterbirds from northwest to southeast and concentrating them near the outflow of the lake near Whitefish Point? An improved understanding of these phenomena can be used to inform the protection, management and development of Lake Superior waters and nearshore areas,

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including assessing risks from climate change (Mortsch, 1998; Price and Root, 2000), oil pipelines (Matheny, 2014), and wind farm design and siting (Desholm and Kahlert, 2005; Langston, 2013), all of which could impact seasonally concentrated populations of waterbirds. Waterbirds are relatively long-lived in comparison to passerines, and their populations are therefore more sensitive to anthropogenic mortality than birds with higher fecundity (Sæther and Bakke, 2000).

Methods

Study areas

We surveyed migrating waterbirds at two sites (Fig. 1). Hebard Park is located on the north shore of the Keweenaw Peninsula (KP) 5 km west of Copper Harbor (47° 28′ 43.08″ N, 87° 57′ 06.96″ W). Whitefish Point Bird Observatory (WP) (46° 46′ 13.56″ N, 84° 57′ 19.92″ W) is at the northern tip of the eastern edge of the Upper Peninsula of Michigan. The shoreline at the KP count site runs almost due east-west and is approximately 3 m above lake level, while the observation site at WP is at the tip of a projecting sand spit approximately 1.5 m above lake level. These sites were chosen because they offer projecting points of land into Lake Superior and/or have a history of waterbird counts (Binford, 2006).

Surveys

Surveys were conducted from 15 August 2014 through 15 November 2014. Fall migrating birds at KP and WP are generally flying east or southeast, respectively, following the shoreline 0.4 km to 2.5 km offshore. Identical survey methods were used at both sites, allowing us to directly compare numbers of individuals and daily peaks. Surveys began at sunrise and lasted for 8 h, 7 days per week. Sunrise occurs somewhat earlier to the more eastern WP compared to KP with a 13 minute difference on 15 Oct. 2015. A single observer at each site scanned the horizon from east to west with 10 × 42 binoculars for flocks or individual birds, and then used a 20–60× spotting scope to count and identify the birds when necessary. Counts were not done in foggy weather or when a steady rain was falling. The majority of migrating waterbirds fly between 1 and 30 m above the water but we counted all flying waterbirds visible above the surface of the water. At both WP and KP, only a tiny percentage (i.e., <0.5%) of observed birds land on the water, and these birds were noted but not included in count numbers. The observers (KP: L. Dombroski, J. Youngman; WP: E. Ripma) all have years of experience identifying waterbirds in flight at migration concentration points along the Great Lakes. Data recorded included species, number of individuals, general flight direction, and date; data were tallied by hour past sunrise.

Results

Overall numbers of birds and species composition

In fall 2014, the total count of east/southeast bound loons, grebes and ducks was 84,959 at WP while the total count at KP was about 40% of that or 34,431 (Table 1). We detected 29 species of waterbirds at WP and 28 at KP. At WP, the five most common species in order of abundance were long-tailed duck (*Clangula hyemalis*), red-necked grebe (*Podiceps grisegena*), greater scaup (*Aythya marila*), red-breasted merganser (*Mergus serrator*) and bufflehead (*Bucephala albeola*); these five accounted for 76% of all birds passing WP. At KP, the five most common species in order of abundance were red-necked grebe, red-breasted merganser, redhead (*Aythya americana*), common loon (*Gavia immer*) and greater scaup and these five accounted for 52% of all birds passing KP. Extremely rare species (<10 individuals) recorded at WP and/or KP included canvasback (*Aythya valisineria*), harlequin duck (*Histrionicus histrionicus*) and Pacific loon (*Gavia pacifica*).

Of the five possible *Aythya* species observed and positively identified at KP (i.e., redhead, greater scaup, canvasback, ring-necked duck (*Aythya collaris*), and lesser scaup (*Aythya affinis*), all but greater scaup and redhead were extremely scarce at KP, accounting for less than a thousandth of the total seasonal count. Therefore, it is likely that the 1243 ducks assigned to scaup species were actually nearly all greater scaup, and the 3402 *Aythya* sp. were either greater scaup or redheads. Consequently, the KP counts for greater scaup and redhead were very likely higher than shown in Table 1.

Nearly every species that was abundant at both locations was far more abundant at WP compared to KP, consistent with our fall funneling hypothesis that proposes that birds accumulate from northern and northwestern to southeastern Lake Superior. However, even when only considering positively identified individuals, the pattern of abundance between KP and WP for redheads is exceptional, with this species being much more common at KP than WP.

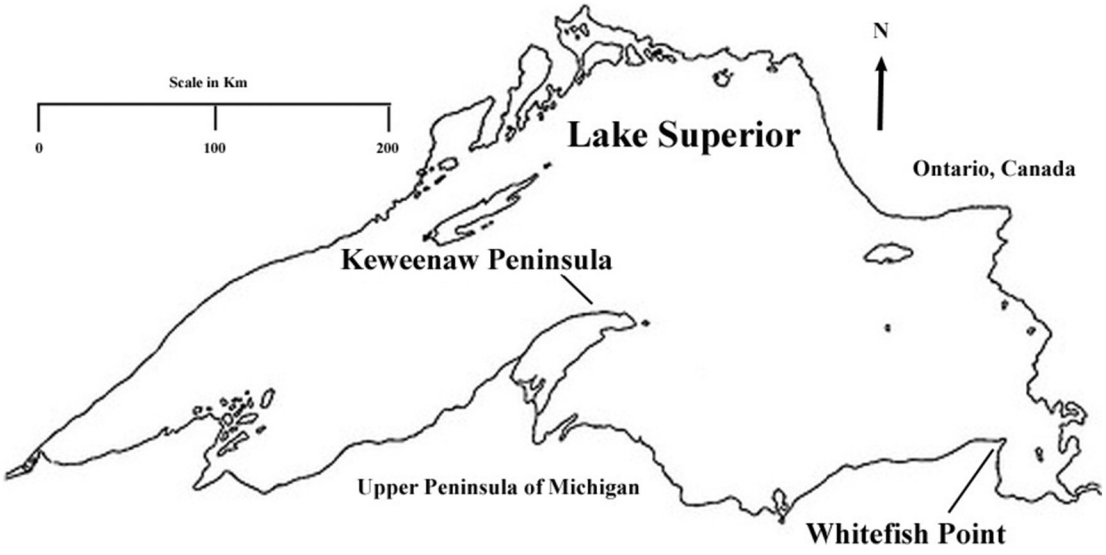

Fig. 1. Map of Lake Superior and survey sites at Keweenaw Peninsula and Whitefish Point, Michigan.

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