Key Site 68: Green Bay, Wisconsin, and Bay de Nocs, Michigan

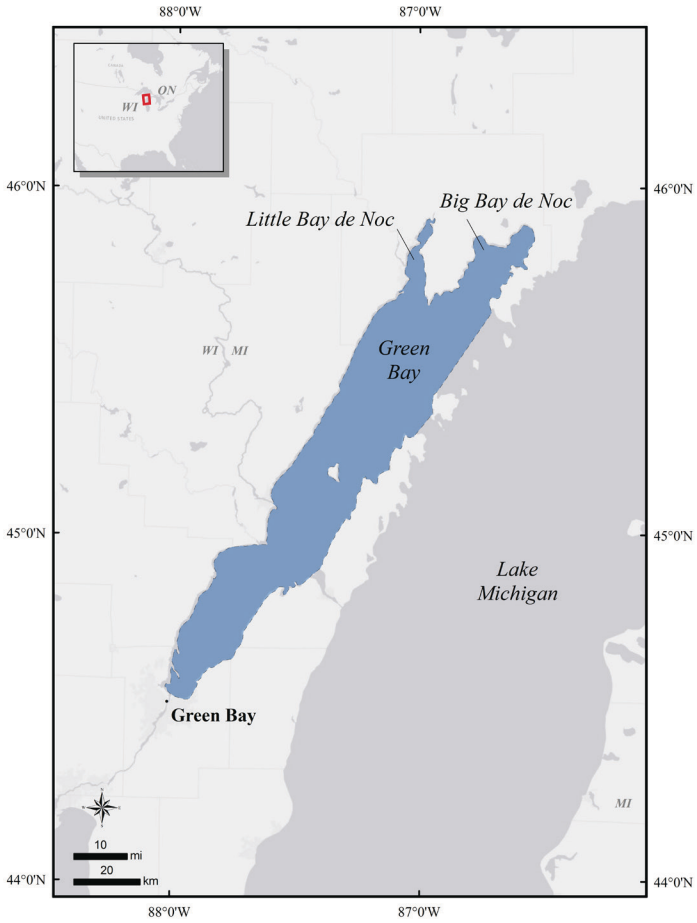
Location: 45°15'25"N, 87°17'39"W

Size: 3934 km^2

Description: Lake Michigan is one of the Laurentian Great Lakes and the only Great Lake located entirely within the United States, bounded by the states of Illinois, Indiana, Michigan, and Wisconsin, USA. Waters within Green Bay, Little Bay de Noc, and Big Bay de Noc constitute this key site. Major shipping ports within this key site include Green Bay, Sturgeon Bay, and Marinette, Wisconsin, and Menominee and Escanaba, Michigan. Smaller ports include Oconto, Suamico, Dyckesville, Little Sturgeon, Egg Harbor, Fish Creek, Ephraim, Sister Bay, Ellison Bay, Gills Rock, and Washington Island (four ports), Wisconsin, along with Gladstone and Nahma, Michigan. For more detailed information about waterfowl in the Great Lakes region and the benthic community, limnology, and geomorphology of Green Bay and Lake Michigan, see Prince et al. (1992), National Oceanic and Atmospheric Administration (2006), Nalepa et al. (2009), Madenjian et al. (2015), Yurista et al. (2015), Rowe et al. (2017), De Stasio et al. (2018), and Harris et al. (2018).

Precision and Correction of Abundance Estimates Presented: Abundance estimates are based on the peak number of all species of sea duck observed during aerial surveys of waterbirds conducted during fall through spring (i.e., September–May) 2009–2014 (Kenow et al. 2021) and aerial surveys of waterfowl conducted during November and December 2017 and December 2018 by the Wisconsin Department of Natural Resources (DNR; Wisconsin DNR 2019). Observed counts were adjusted by species-specific or species group detection rates estimated for aerial fixed-wing surveys by Hodges et al. (2008) for coastal surveys in Alaska. Observed and visibility-adjusted abundance estimates, as well as distribution maps, by month, are included in Appendix 1.

Biological Value: This site is important for a variety of sea ducks during fall migration and likely during spring migration, with limited use during winter when habitat becomes limited or unavailable due to ice cover. Common Goldeneye (*Bucephala clangula*)



constitutes the largest proportion of sea ducks within this key site, followed by merganser species (*Mergus* spp.) and Bufflehead (*Bucephala albeola*), with lesser numbers of Long-tailed Ducks (*Clangula hyemalis*) and scoter species (*Melanitta* spp.) observed during fall and early winter. Information regarding spring use of this site is lacking, but high use of this area was documented among radiomarked Long-tailed Ducks during April (Fara 2018).

Aerial survey data (Kenow et al. 2021, Wisconsin DNR 2019) indicate that Common Goldeneye was the most abundant species during fall migration, with total numbers estimated at roughly 33,000 birds (September–November, 2011–2018) when corrected for visibility (Hodges et al. 2008). Lesser numbers of fall migrating sea ducks included merganser species (~7500 est. birds), Bufflehead (~5900 est. birds), and Long-tailed Ducks (~2000 est. birds). White-winged Scoters (*Melanitta deglandi*) were infrequently encountered during fall surveys and were the only scoter species observed. The combined fall density estimate for all surveys in

this key site was 26.4 sea ducks/km^2, with individual survey estimates ranging from 0 (September 12–13, 2011; Kenow et al. 2021) to 126.0 (November 3, 2017; Wisconsin DNR 2019) sea ducks/km^2 when adjusted for visibility (Hodges et al. 2008).

Aerial survey data (Wisconsin DNR 2019) indicate that Common Goldeneye was the most abundant species observed during winter within this site, with preliminary total numbers estimated at 11,500 birds (December 2017) when corrected for visibility (Hodges et al. 2008). Bufflehead (~3700 est. birds) was the only other species to exceed 1000 birds in total during winter. The estimated density for this survey was 57.8 sea ducks/km^2 when adjusted for visibility (Hodges et al. 2008).

Few sea ducks were present at this site during September, and only a few small concentrations were located near Big Bay de Noc, Michigan. Sea duck numbers increased in October and were widely distributed throughout the key site with no major concentrations apparent. Peak counts occurred in November with the largest concentrations of sea ducks occurring south of Marinette, Wisconsin, and Menominee, Michigan, with smaller concentrations evenly distributed throughout the rest of the key site. Sea duck counts decreased in December and it is likely that very few sea ducks remained at this site through winter due to ice cover. Without spring counts, it is difficult to determine how important this key site may be to spring migrating sea ducks; however, radiomarked Long-tailed Ducks used this site throughout April (Fara 2018), and anecdotal reports from fishermen and biologists indicate that many sea ducks use this site from ice-out through early May.

Sensitivities: Waterfowl and other waterbirds are sensitive to human disturbance, mostly small vessel and/or shipping traffic during migration and the wintering period on the Great Lakes (Prince et al. 1992). By-catch from commercial fishing operations is of concern, as Ellarson (1956) estimated that by-catch of Long-tailed Ducks in large mesh gill nets could reach 100,000 individuals (see also Baldassare 2014). Commercial fishing operations have declined dramatically over the last 50 years in Michigan (Michigan DNR 2019), but commercial and tribal fishing operations still occur north of Grand Haven, Michigan (Michigan Department of Technology, Management and Budget 2013). Commercial fishing operations in Wisconsin have also declined. The Wisconsin DNR has placed emphasis on supporting commercial operations through science and data, but by-catch estimates for Wisconsin waters of Lake Michigan are outdated (Wisconsin DNR 2017). Although entrapment methods have for the most part changed from gill nets to trap nets, there is still concern about by-catch of Common Loons (*Gavia immer*; Johnson et al. 2004), and perhaps other waterbirds including sea ducks.

Food resource availability and aquatic functions in Lake Michigan appear to be changing due to invasive and introduced species (Nalepa et al. 2009), and shifts in food web dynamics have had a negative effect on the health of predatory fish species (Pothoven et al. 2001, Madenjian et al. 2006, Nalepa et al. 2009, Mandenjian et al. 2015) and perhaps waterfowl. Food resource availability and quality could also be influenced by contamination from industrial activities, urban development, and agricultural practices that occur near the lakeshore or within the Lake Michigan watershed (U.S. Environmental Protection Agency 2008).

Type E botulism (*Clostridium botulinum*) outbreaks occur periodically in Lake Michigan and have been associated with the mortality of more than 100,000 birds throughout the Great Lakes since the 1960s, including sea ducks (Chipault et al. 2015). Outbreaks of type-E avian botulism have been a common occurrence in northern Lake Michigan since the early 2000s (Lafrancois et al. 2011, Chipault et al. 2015), in contrast to Green Bay where avian botulism outbreaks have not been documented in recent decades. Botulism outbreaks were last documented in Green Bay during 1964–1966 and in 1983 (Zuccarino-Crowe 2009) and occurred prior to dreissenid mussel (*Dreissena* spp.) and round goby (*Neogobius melanostomus*) invasions.

Lake Michigan, including Green Bay, has been identified as a suitable location, with above adequate wind resources, for nearshore and offshore wind energy development (Beiter et al. 2017). Although no offshore wind energy sites have been developed within the Lake Michigan basin, there is a potential for negative effects to sea ducks and other birds through displacement and/or direct mortality (Arnett et al. 2007).

Extensive ice cover during severe winters can have a strong effect on the presence, survival, distribution, and movements of sea ducks and waterbirds that winter on Lake Michigan (Ellarson 1956, Prince et al. 1992). Green Bay is completely ice covered during a typical winter (U.S. Department of Commerce 2020).

Potential Conflicts: Disturbance associated with small vessel and shipping traffic, potential for near-shore and offshore wind energy development, and effects from commercial fishing operations remain potential conflicts at this site.

Status: This key site encompasses nine state priority Important Bird Areas (IBAs). Areas within Michigan are the Snake Island (Big Bay de Noc) IBA (Audubon 2017a), Round Island (Bay de Noc) IBA (Audubon 2017b), St. Vital Island IBA (Audubon 2017c), Ogontz Bay Marshes IBA (Audubon 2017d), and Little Bay de Noc (including Portage Marsh and Aronson Island sandbar) IBA (Audubon 2017e). Areas within Wisconsin are the Seagull Bar IBA (Audubon 2017f), Lower Peshtigo River IBA (Audubon 2017g), Green Bay West Shore Wetlands IBA (Audubon 2017h), and Lower Green Bay Islands–Bay Beach Wildlife Sanctuary IBA (Audubon 2017i). The open waters of Lake Michigan, including Green Bay, Big and Little Bay de Nocs, and connecting waterbodies are managed by the states of Wisconsin and Michigan for this key site, but oversight is provided by the United States government to regulate navigation, interstate commerce, access, contamination, and water quality and use. Due to their sovereignty from federal and state governments, tribal nations also provide input on the management and utilization of Lake Michigan resources, including governance through the Chippewa Ottawa Resource Authority and the Great Lakes Indian Fish and Wildlife Commission (Hall and Houston 2014). Uplands surrounding this key site are managed by a variety of parties including federal, state, county, city, and private land owners.

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Common Goldeneyes. Photo: Tim Bowman.