Sub-Indicator: Coastal Wetland Fish

Overall Assessment

Status: Fair (2020-2022)

Trends:

10-Year Trend (2013-2022): Unchanging

Long-term Trend (2011-2022): Unchanging

Rationale: Coastal wetland fish status for the basin as a whole is based on the most recent, (2020-2022), Index of Biotic Integrity (IBI) scores of Coastal Wetland Monitoring Program sites that are regularly sampled every five years. Benchmark sites are those sampled upon request to monitor sites before, during and after restoration, treatment, etc. Only the data from a benchmark site's regular sampling year are included in the IBI calculations. The majority of scores from 2011-2022 (70.2%) as well as the majority of scores from 2020-2022 (67.5%) are not in degraded categories (Figure 1 and Figure 2a). Trends are based on the average IBI of all sites sampled each year. Over the 10-year period between 2013 and 2022, 12.0 to 19.7% (long-term, 9.0 to 19.7%) of wetlands were in the reference score category with no directional trend over time in the proportion of reference quality sites. No temporal trend was evident for each condition category nor mean IBI scores for all lakes (Figure 2 and Figure 3). Over the 10-year period, 14.7 to 31.8% of Great Lakes wetlands were mildly impacted, 26.4 to 35.3% (long-term, 26.3-36.0%) were moderately impacted, 18.2 to 32.4% were moderately degraded, and 2.7 to 16.7% were degraded.

Lake-by-Lake Assessment

Lake Superior

Status: Good (2020-2022)

10-Year Trend (2013-2022): Improving

Long-term Trend (2011-2022): Improving

Rationale Status is based on most recent IBI scores within the denoted time period. The majority of scores from 2011-2022 (88.1%, n=42) as well as all scores from 2020-2022 (100%, n= 16) are not in degraded categories (Figure 4 and Figure 5a). None of the scores from 2020-2022 (0%) are in the degraded category. Trends are based on the average IBI of all randomly selected sites sampled each year (2013-2022, n=69; 2011-2022, n=83). Over the 10-year period between 2013 and 2022, 0 to 62.5% of Lake Superior wetlands were in the reference category, 12.5 to 50.0% of Lake Superior wetlands were mildly impacted, 11.1 to 60.0% were moderately impacted, 0 to 27.3% were moderately degraded, and 0% (long-term, 11.1 to 20.0%) were degraded. After 2012, no wetlands were in the degraded category, and from 2020 to 2022, no wetlands were in the degraded or moderately degraded categories.

Lake Michigan

Status: Fair (2020-2022)

10-Year Trend (2013-2022): No Trend

Long-term Trend (2011-2022): No Trend

Rationale: Status is based on most recent IBI scores within the denoted time period. The majority of scores from 2011-2022 (64.8%, n=74) as well as the majority of scores from 2020-2022 (51.6%, n=31) are not in degraded categories (Figure 6 and Figure 7a). Trends are based on the average IBI of all sites sampled each year (2013-2022, n=117; 2011-2022, n=144). There is a lack of a temporal trend in the proportion of any condition category during both time periods, and year-to-year variation was high over both time periods (Figure 7b). Over the 10-year period, 0 to 50% of Lake Michigan wetlands were in the reference score category, 0-50% were mildly impacted, 0 to 66.7% were moderately impacted, 0 to 50% were moderately degraded, and 0 to 21.1% were degraded. Given the interannual variability and the lack of clear directional changes in conditions, the 10-year and long-term trend for coastal wetland fish in Michigan is assessed as No Trend.

Lake Huron (including St. Mary's River)

Status: Fair (2020-2022)

10-Year Trend (2013-2022): No Trend

Long-term Trend (2011-2022): No Trend

Rationale: Status is based on most recent IBI scores within the denoted time period. The majority of scores from 2011-2022 (85.2%, n=149) as well as the majority of scores from 2020-2022 (86.7%, n=68) are not in degraded categories (Figure 8 and Figure 9a). Trends are based on the average IBI of all sites sampled each year (2013-2022, n=234; 2011-2022, n=285). Over the 10-year period between 2013 and 2022, 15.8 to 40.0% of Lake Huron wetlands were in the reference score category with no temporal trend in the proportion of reference quality sites. The lack of a temporal trend over the years was consistent for each condition category (Figure 9b). Over the 10-year period, 13.8 to 44.4% of Lake Huron wetlands were mildly impacted, 11.1 to 36.8% (long-term, 9.5 to 36.8%) were moderately impacted, 0 to 27.6% were moderately degraded, and 0 to 9.1% (long-term, 0 to 10.0%) were degraded. Given the interannual variability and the lack of clear directional changes in conditions, the 10-year and long-term trends for coastal wetland fish in Lake Huron are assessed as No Trend.

Lake Erie (including St. Clair-Detroit River Ecosystem)

Status: Poor (2020-2022)

10-Year Trend (2013-2022): No Trend

Long-term Trend (2011-2022): No Trend

Rationale: Status is based on most recent IBI scores within the denoted time period. The majority of scores from 2011-2022 (66.1%, n=56) as well as the majority of scores from 2020-2022 (77.8%, n=18) are in degraded categories (Figure 10 and Figure 11a). Trends are based on the average IBI of all sites sampled each year (2013-2022, n=81; 2011-2022, n=102). There is a lack of a temporal trend in the proportion of any category during both time periods and a high level of variation in the proportion of sites that fall into the degraded categories each year (Figure 11b). Over the ten10-year period, 0% (long-term, 0 to 10.0%) of Lake Erie wetlands were in the reference score category, 0 to 33.3% were mildly impacted, 0 to 40.0% were moderately impacted, 11.1 to 66.7% (long-term, 10% to 66.7%) were moderately degraded, and 0 to 66.7% were degraded. Given the interannual variability and the lack of clear directional changes in conditions, the 10-year and long-term trends for coastal wetland fish in Lake Erie are assessed as No Trend.

Lake Ontario (including Niagara River and International section of the St. Lawrence River)

Status: Fair (2020-2022)

10-Year Trend (2013-2022): No Trend

Long-term Trend (2011-2022): No Trend

Rationale: Status is based on most recent IBI scores within the denoted time period. The majority of scores from 2011-2022 (65.6%, n=125) as well as the majority of scores from 2020-2022 (58.6%, n=58) are not in degraded categories (Figure 12 and Figure 13a). Trends are based on the average IBI of all sites sampled each year (2013-2022, n=189; 2011-2022, n=241). During the 10-year period between 2013 and 2022, 0 to 16.7% of Lake Ontario wetlands were in the reference score category with no temporal trend in the proportion of reference quality sites. The lack of a temporal trend over the years was consistent for each condition category (Figure 13b). Over the 10-year period, 10.0 to 33.3% (long-term, 4.5 to 33.3%) of Lake Ontario wetlands were mildly impacted, 15.0 to 64.7% were moderately impacted, 8.3 to 50.0% were moderately degraded, and 0 to 13.3% were degraded. Given the interannual variability and the lack of clear directional changes in conditions, the 10-year and long-term trends for coastal wetland fish in Lake Erie are assessed as No Trend.

Status Assessment Definitions

Good: No wetlands are in the degraded categories but instead fall within reference conditions, mildly impacted, or moderately impacted.

Fair: The majority of the wetlands are not in the degraded categories.

Poor: The majority of the wetlands are in the degraded categories.

Undetermined: Data are not available or are insufficient to assess condition of the ecosystem components.

Trend Assessment Definitions

Improving: This metric increased in score for the majority of the sites.

Unchanging: This metric did not substantially change for the majority of the sites.

No Trend: A sufficient amount of data are available, but the trend is not statistically Improving or Deteriorating due to high variability in the data.

Deteriorating: This metric decreased in score for the majority of the sites.

Undetermined: Metrics do not indicate a clear overall trend, or data are not available to report on a trend.

Endpoints and/or Targets

An endpoint for this sub-indicator will be established based on fish communities of reference systems. Data are being evaluated for patterns by lake, ecoregion, wetland type, and vegetation zone. An endpoint for this sub-indicator is not possible at this time as the data are still being collected and analyzed.

Sub-Indicator Purpose

The purpose of this sub-indicator is to track the trends of Great Lakes coastal wetland ecosystem health by measuring the composition of fish communities, and to infer suitability of habitat and water quality for Great Lakes

coastal wetland fish communities.

Ecosystem Objective

This sub-indicator supports General Objective #5 of the 2012 Great Lakes Water Quality Agreement stating that waters of the Great Lakes should "support healthy and productive wetlands and other habitats to sustain resilient populations of native species."

Sub-indicator work supports Annex 7 of GLWQA which calls for restoration and maintenance of the diversity of the fish community of Great Lakes coastal wetlands while indicating overall ecosystem health. Significant wetland areas in the Great Lakes system that are threatened by urban and agricultural development and waste disposal activities should be identified, preserved and, where necessary, rehabilitated. This sub-indicator supports the restoration and maintenance of the chemical, physical and biological integrity of the Great Lakes basin and beneficial uses dependent on healthy wetlands (Annex 1 GLWQA).

Coastal wetland habitats are critical spawning, nursery, forage, and shelter areas for many fish species of ecological and economic importance. Conservation of the remaining coastal wetlands and restoration of previously destroyed and degraded wetlands are vital actions for restoring the Great Lakes ecosystem. This sub-indicator can be used to report progress toward such an objective.

Methods

Coastal wetland fish communities are monitored by the Great Lakes Coastal Wetland Monitoring Program (GLCWMP), which uses consistent methods across the whole Great Lakes Basin. Fish are sampled using three replicate fyke nets of 4.8 mm mesh in each major plant zone (wet meadow, *Typha spp.*, *Phragmites*, Lily, *Schoenoplectus spp.*, etc.) in each wetland for one net-night (Uzarski et al., 2005; Uzarski et al. 2017). Sampling locations correspond with macroinvertebrate and water quality sampling. The timing of sampling corresponds with the maturity of the vegetation in each system (no earlier than mid-June and no later than August due to migration patterns of the fish communities). Dominant vegetation zones were identified because different zones support different fishes (Uzarski et al. 2005). There are two sizes of fyke nets that can be used depending on depth: 0.5-m x 1-m opening and 1-m x 1-m opening. The smaller nets are placed in water that is 0.20-0.5 m deep and the larger fyke nets are placed in water that is greater than 0.50 m deep. The leads are 7.3 m long with 1.8 m long wings. Nets are haphazardly placed a minimum of 20 m apart in each vegetation zone. The fyke nets are placed perpendicular to the vegetation zone being sampled, so that fish swimming within the vegetation zone are captured. Any fish collected that are 20 mm or longer are identified to species and counts are recorded per net.

The Great Lakes Coastal Wetland Consortium (GLCWC) developed indices of biological integrity (IBIs) in 2002 and protocols were finalized in 2008 (GLCWC 2008). The GLCWMP Index of Biotic Integrity (IBI) was developed based on measures of richness and abundance, percent non-native species, functional feeding groups, and other species-level parameters. The current version of the GLCWMP IBI developed by Cooper et al. (2018) can be used for evaluation in bulrush, cattail, water lily, and submerged aquatic vegetation zones.

The GLCWMP IBI was the metric of focus for this report for both the status and trends evaluation.

Discussion

Since the 2022 SOGL report, the 10-year and long-term trends of coastal wetland fish communities of four Great Lakes and their major tributaries - Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario – have changed from Unchanging to No Trend, a designation that is new as of this reporting period. Due to high interannual variability of IBIs, a temporal trend of condition cannot be confidently assessed for these lakes. Variability may be due to the fact that different sites are sampled every year. Comparisons could be made between sampling events of individual sites, however some sites cannot be sampled in their assigned year due to water levels, access issues, timing, and other challenges. Changing water levels, with record or near-record highs seen in 2019 and 2020, and subsequent habitat changes may drive the high variability in IBIs throughout the 10-year and long-term periods. The Status of Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario have not changed since the last reporting period.

Lake Superior coastal wetland conditions have improved since the SOGL 2022 report, with 0% of coastal wetland fish IBI scores in the Degraded or Moderately Degraded categories. The Status of Lake Superior has changed from Fair to Good, and the 10-year and long-term trends have been designated as Improving, albeit tentatively due to the most obvious improvements being seen in relatively recent years.

Coastal wetlands trap, process, and remove nutrients and sediment from Great Lakes nearshore waters and recharge groundwater supplies. However, over half of all Great Lakes coastal wetlands have been destroyed by human activities, and many remaining coastal wetlands suffer from anthropogenic stressors such as excessive nutrient and sediment loading, habitat fragmentation, invasive species, shoreline alteration and infilling, and water level control, as documented by a binational Great Lakes-wide mapping and attribution project (Albert and Simonson 2004; Ingram and Potter 2004).

Wetland sampling was conducted no earlier than mid-June and no later than August due to migration patterns of the fish communities.

Given the importance of coastal wetlands and the continued threat to these ecosystems, the Great Lakes Restoration Initiative (GLRI) funds the GLCWMP; this group monitors water quality and the status of plant, anuran, bird, fish, and invertebrate communities in wetlands across the Great Lakes Basin in the US and Canada. Under the GLCWMP, approximately 200 wetlands have been sampled annually for at least one taxonomic group, with approximately 100 of those sampled to assess fish communities each year. A total of 109 wetlands were sampled for fish in 2011, 100 in 2012, 94 in 2013, 106 in 2014, 113 in 2015, 103 in 2016, 93 in 2017, 101 in 2018, 104 in 2019, 69 in 2020, 105 in 2021, and 102 in 2022. This report focused on the sites that were selected as part of the statistically designed sampling scheme; in total 1,004 sampling events at 513 different sites. As of 2022 130 fish sampling events have taken place in Lake Erie, 351 in Lake Huron, 159 in Lake Michigan, 257 in Lake Ontario, and 107 in Lake Superior (Table 2). As of 2022, nearly 100% of the medium and large (> 4 hectares), hydrologically-connected coastal wetlands in the Great Lakes have been sampled.

An average of 9 and 13 fish species were collected in Canadian and U.S. Great Lakes coastal wetlands, respectively between 2011 and 2022 (Table 1). These data include sites that may benefit from restoration, and some had very few species. However, wetlands with the highest richness had as many as 27 (CA) or 31 (US) fish species. The average number of non-native fish species per wetland was approximately 1, though some wetlands had as many as 7 (CA and US). There are several wetlands in which only native fish species were caught in fyke nets, although some non-native fish are adept at net avoidance (e.g. Common Carp). Non-native species lists were compiled by lake from the Great Lakes Aquatic Nonindigenous Species Information System (GLANSIS).

Total fish species captured did not differ greatly by lake, averaging 11 to 13 species per wetland across lakes (Table 2). Lake Ontario wetlands had the lowest maximum number of species (25) and Lake Michigan had the

highest maximum number of species caught (31). Lake Huron and Lake Superior wetlands averaged the lowest mean number of non-native fish taxa (0.5 and 0.6), and Lake Erie averaged the highest (1.8). All other lakes had a similar average number of non-native fish species per wetland, roughly 1 species.

Richness of invasive species is particularly important in the Fish IBI, as it is one of two metrics that is used in all zone types, the other being percent richness of tolerant taxa (Cooper et al. 2018). Species that contribute to the non-native species richness metric commonly include Common Carp (*Cyprinus carpio*), Round Goby (*Neogobius melanostomus*), Alewife (*Alosa pseudoharengus*), Goldfish (*Carassius auratus*) and Tubenose Goby (*Proterorhinus semilunaris*). Many of these are also tolerant to human disturbance like agricultural input and urban development. This is likely why sites near Green Bay (urban hub), Saginaw Bay (agricultural hub), and western Lake Erie (urban and agricultural hub) consistently score poorly (Figures 6, 8 and 10).

Fish communities in the Great Lakes appear to be shaped more by regional variations in land-use than particular wetland type. Utilizing GLCWMP data, Diller et al. 2022 determined that fish community composition varied significantly with seasonal changes and regional changes in water quality. Cyprinids, which include shiners, chubs, daces, and carps showed highest diversity in wetlands with the best water quality across the basin. Fluctuations in water depth also shares a link with fish community composition. Lake Huron fish abundance and alpha diversity have been shown to have a positive correlation with water depth in bulrush (*Schoenoplectus* sp.) dominated wetlands (Langer et al. 2018).

Extreme water level fluctuations have recently impacted our research efforts. In 2020, only two Lake Michigan Sites were able to be sampled due to a combination of flooded vegetation zones and the Covid-19 pandemic (Figure 7b). Water level fluctuations (i.e., higher highs and lower lows) are predicted to intensify (Segleniks and Temguoua 2022), emphasizing the need for further research to determine the exact impacts on Laurentian Great Lakes fisheries.

Fish movement to and from multiple wetlands and pelagic areas affects the observed community structure. Because of this, it can be difficult to pinpoint fishery habitat degradation in a specific wetland. This is likely a contributing factor to more consistent scores within regions and across years (Figure 1 and Figure 2b).

There are a number of carp introductions that have the potential for substantia l impact on Great Lakes fish communities, including coastal wetlands. Goldfish (*Carassius auratus*) are common in some shallow habitats, and they occurred along with Common Carp young-of-the-year in many of the wetlands sampled along Green Bay. In addition, there are several other carp species, e.g., Grass Carp (*Ctenopharyngodon idella),* Bighead Carp (*Hypophthalmichthys nobilis)* and Silver Carp (*Hypophthalmichthys molitrix)* that escaped aquaculture operations and are now in the Illinois River and migrating toward the Great Lakes through the Chicago Sanitary and Ship Canal. To prevent the spread of these species into the Great Lakes, from 2002 to 2011 electrical barriers were constructed in the CSSC. One Bighead Carp and one Silver Carp have been found on the Great Lakes side of the barrier, both in the 2010s. Three big head carp were captured in Lake Erie, but all before the year 2000 (Chapman et al. 2021). Grass carp have now been collected in all Great Lakes except Lake Superior, and reproduction of grass carp has been documented in Lake Erie tributaries (Chapman et al. 2021). Black carp (*Mylopharyngodon piceus*) has also rapidly expanded in range up the Mississippi River and is likely to reach tributaries near the Great Lakes. It has been predicted that in the event of a one-time containment failure releasing <100 juvenile or young fish could result in establishment of this species in the basin (Smyth and Drake 2022). All of these species attain large sizes rapidly, some are planktivorous, but also eat snails and mussels, while the grass carp eats vegetation.

Non-native carp species represent yet another substantial threat to food webs in wetlands and nearshore habitats with macrophytes (U.S. Fish and Wildlife Service (USFWS) 2002). If these carp species become established in the Great Lakes, they could negatively impact the status of coastal wetland fish communities by both competing with native fish for resources and by degrading the habitat. The effect that the introduction of these species will have on

the coastal wetland fish health is difficult to predict because it will depend on their population densities, distribution, and a variety of other factors.

Linkages

Linkages to other sub-indicators in the indicator suite include:

- Hardened Shorelines – Physical modifications to the shoreline have disrupted coastal and nearshore processes, flow and littoral circulatory patterns, altered or eliminated connectivity to coastal wetlands/dunes, and have altered nearshore and coastal habitat structure.
- Along many coastal wetlands, residential development has altered wetlands by nutrient enrichment from fertilizers and septic systems, shoreline alterations for docks and boat slips, filling, and shoreline hardening. Shoreline hardening can completely eliminate wetland vegetation, which results in degradation of fish habitat. It appears that when a wetland becomes affected by human development, the fish community changes to that typical of a warmer, and more southerly wetland.
- Mechanical alteration takes a diversity of forms, including diking, ditching, dredging, filling, and shoreline hardening. With all of these alterations, non-native species may be introduced by construction equipment or in introduced sediments. Changes in shoreline gradients and sediment conditions are often adequate to allow non-native species to become established.
- Land Cover – Agriculture degrades wetlands in several ways, including nutrient enrichment from fertilizers, increased sediment deposition from erosion, increased rapid runoff from drainage ditches, introduction of non-native species (reed canary grass), destruction of inland wet meadow habitats by plowing and diking, and addition of herbicides. In the southern lakes, Saginaw Bay, and Green Bay, agricultural sediments have resulted in highly turbid waters which support few or no submerged plants.
- Physical modifications to the shoreline have disrupted coastal and nearshore processes, flow and littoral circulatory patterns, altered or eliminated connectivity to coastal wetlands/dunes, and have altered nearshore and coastal habitat structure. Urban development degrades wetlands by hardening shoreline, filling wetland, adding a broad diversity of chemical pollutants, increasing stream runoff, adding sediments, and increased nutrient loading from sewage treatment plants. In most urban settings, almost complete wetland loss has occurred along the shoreline. Thoma (1999) and Johnson et al. (2006) were unable to find coastal wetlands on the U.S. side of Lake Erie that experienced minimal anthropogenic disturbances. According to Seilheimer and Chow-Fraser (2006; 2007), there has been accelerated loss of wetland fish habitat in Lake Ontario, Lake Erie and Lake Michigan near urban areas and agriculture.
- Impact of Aquatic Invasive Species – Non-native species are introduced in many ways. Some were purposefully introduced as agricultural crops or ornamentals, later colonizing in native landscapes. Others came in as weeds in agricultural seed. Increased sediment and nutrient enrichment allow many of the worst aquatic weeds to out-compete native species. Many nuisance non-native species are either prolific seed producers or reproduce from fragments of root or rhizome. Non-native animals have also been responsible for increased degradation of coastal wetlands. Common and grass carp reproductive and feeding behavior results in loss of submerged vegetation in shallow marsh waters.
- Precipitation Amounts in the Great Lakes Basin/Tributary Flashiness – Change in atmospheric temperature will potentially affect the number of extreme storms in the Great Lakes region which will, in turn, affect coastal wetlands; extreme storms will affect riverine systems mostly through increased sediment movements and nutrient loading, particularly in flashy modified watersheds. Williams and

King (2020) found increases in both rainfall quantity and intensity in the Western Basin of Lake Erie from 1975-2017. While tracking phosphorus loads in the Maumee River, they found that due to modern conservation practices, phosphorus concentration decreased, but with increasing heavy rain, phosphorus discharge levels increased.

- Water Levels – Water level change has strong influences on Great Lakes habitat and biological communities associated with coastal wetlands. Lake levels have a major influence on undiked coastal wetlands and are basic to any analysis of wetland change trends; water levels also directly influence the vegetation structure. From 2011-2019, as water levels in the Great Lakes were increasing to a record high, coastal wetlands shifted landward and saw reduction in vegetation zone length (Anderson et al. 2023). This reduction in vegetation zone length in turn affects the available habitat for fish, particularly in regard to native emergent vegetation like *Schoenoplectus* sp. where diversity is higher (Langer et al. 2018). It is predicted that by 2040-2049, a 0.44 m increase will be seen in Lake Michigan and Huron (Kayastha et al. 2022).
- This sub-indicator links directly to the other sub-indicators in the Habitats and Species category, particularly the other coastal wetlands-related sub-indicators. Individual IBIs, such as the fish IBI used in this assessment, are useful as independent indicators, but evaluation of this indicator in combination with the other coastal wetland indicators is key to an overall assessment of Great Lakes coastal wetland health. This is because the different sub-indicators function and indicate anthropogenic disturbance at different spatial and temporal scales and have varying resolution of detection. See greatlakeswetlands.org/Sampling-protocols for details on indicator metrics.

Assessing Data Quality

Data Characteristics	Agree	Neutral or Unknown	Disagree	Not Applicable
Data are documented, validated, or quality-assured by a recognized agency or organization	X			
Data are from a known, reliable and respected generator of data and are traceable to original sources	X			
Geographic coverage and scale of data are appropriate to the Great Lakes Basin	X			
Data obtained from sources within the U.S. are comparable to those from Canada	X			
Uncertainty and variability in the data are documented and within acceptable limits for this sub-indicator report	X			
Data used in assessment are openly available and accessible	Yes	Data can be found here: www.greatlakeswetlands.org		

Notes on Accessing Data

Data can be accessed at www.greatlakeswetlands.org by requesting an account at the top of the webpage. The level of access being requested and description of how the data will be used is required.

Data Limitations

This sub-indicator can only be used where there is sufficient water depth to use fyke nets. Annually approximately 200 sites are sampled by the GLCWMP, but on average only around 100 are sampled for fish. There are a number of sites sampled only by bird and anuran crews, because these crews can complete their site sampling more quickly and thus have the capacity to sample more sites than do the fish, macroinvertebrate, and vegetation crews. Therefore, ecosystem health cannot be assessed for all sampled wetlands using fish IBIs. Furthermore, fish IBIs have been developed for a subset of monodominant vegetation zones in coastal wetlands, including *Typha*, *Schoenoplectus*, submerged aquatic vegetation (SAV), and water lily. Fish IBI scores can only be calculated for wetlands where fish were captured in these vegetation stands. Additionally, fyke nets may not be equally effective for capturing all species and size classes of wetland fish (Clement et al. 2014).

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Table 2. The number of distinct sites sampled, number of sampling events, number of sampling events related to IBI scores, total fish species and non-native species found in Great Lakes coastal wetlands and summary statistics by lake for sites sampled from 2011 through 2022. Currently the CWMP has fish IBIs developed for bulrush (*Schoenoplectus* spp.), cattail (*Typha* spp.), lily (*Brasenia* spp., *Nuphar* spp., *Nymphaea* spp.), and submerged aquatic vegetation (SAV; primarily *Myriophyllum* spp., *Ceratophyllum* spp., *Chara* spp., and *Najas* spp.; Cooper et al. 2018). Researchers associated with the CWMP are planning to establish fish IBI scoring systems for wetlands

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Figure 2. The count of all sites that fall into each IBI category based on the coastal wetland fish community each year between 2011 and 2022 for A) most recent sampling events (not including site revisits), n=446 and B) all sampling events (including site revisits), n=855. Overall Status is based on 2020-2022 data in Figure 2A. The most recent sampling event range extends from 2011 to 2022 because some sites were not sampled every 5 years due to a number of reasons (e.g., access issues, vegetation zone size too small to sample, lack of inundated vegetation).

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Figure 3. The mean IBI score for all sites sampled (including site revisits) in Lakes Erie and Ontario (A), Lakes Michigan and Huron (B), and Lake Superior (C) from 2011 to 2022, error bars show 95% confidence interval. The highest possible score is 5 which indicates reference conditions, and lowest possible score is 1 which indicates degradation.

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Figure 5. The count of all Lake Superior sites that fall into each IBI category based on the coastal wetland fish community each year between 2011 and 2022 for A) most recent sampling events (not including site revisits), n=42 and B) all sampling events (including site revisits), n=83. Lake Superior Status is based on 2020-2022 data in Figure 5A. The most recent sampling event range extends from 2011 to 2022 because some sites were not sampled every 5 years due to various reasons (e.g., access issues, vegetation zone size too small to sample, lack of inundated vegetation).

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Figure 6. The condition of coastal wetland fish communities from 2011 to 2022 across Lake Michigan.

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Figure 7. The count of all Lake Michigan sites that fall into each IBI category based on the coastal wetland fish community each year between 2011 and 2022 for A) most recent sampling events (not including site revisits), n=74 and B) all sampling events (including site revisits), n=144. Lake Michigan Status is based on 2020-2022 data in Figure 7A. The most recent sampling event range extends from 2011 to 2022 because some sites were not sampled every 5 years due to various reasons (e.g., access issues, vegetation zone size too small to sample, lack of inundated vegetation).

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Figure 8. The condition of coastal wetland fish communities from 2011 to 2022 across Lake Huron.

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Figure 9. The count of all Lake Huron sites that fall into each IBI category based on the coastal wetland fish community each year between 2011 and 2022 for A) most recent sampling events (not including site revisits), n=149 and B) all sampling events (including site revisits), n=285. Lake Huron Status is based on 2020-2022 data in Figure 9A. The most recent sampling event range extends from 2011 to 2022 because some sites were not sampled every 5 years due to various reasons (e.g., access issues, vegetation zone size too small to sample, lack of inundated vegetation).

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Figure 10. The condition of coastal wetland fish communities from 2011 to 2022 across Lake Erie.

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Figure 11. The count of all Lake Erie sites that fall into each IBI category based on the coastal wetland fish community each year between 2011 and 2022 for A) most recent sampling events (not including site revisits), n=56 and B) all sampling events (including site revisits), n=102. Lake Erie Status is based on 2020-2022 data in Figure 11A. The most recent sampling event range extends from 2011 to 2022 because some sites were not sampled every 5 years due to various reasons (e.g., access issues, vegetation zone size too small to sample, lack of inundated vegetation).

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Last Updated

State of the Great Lakes 2025 Report

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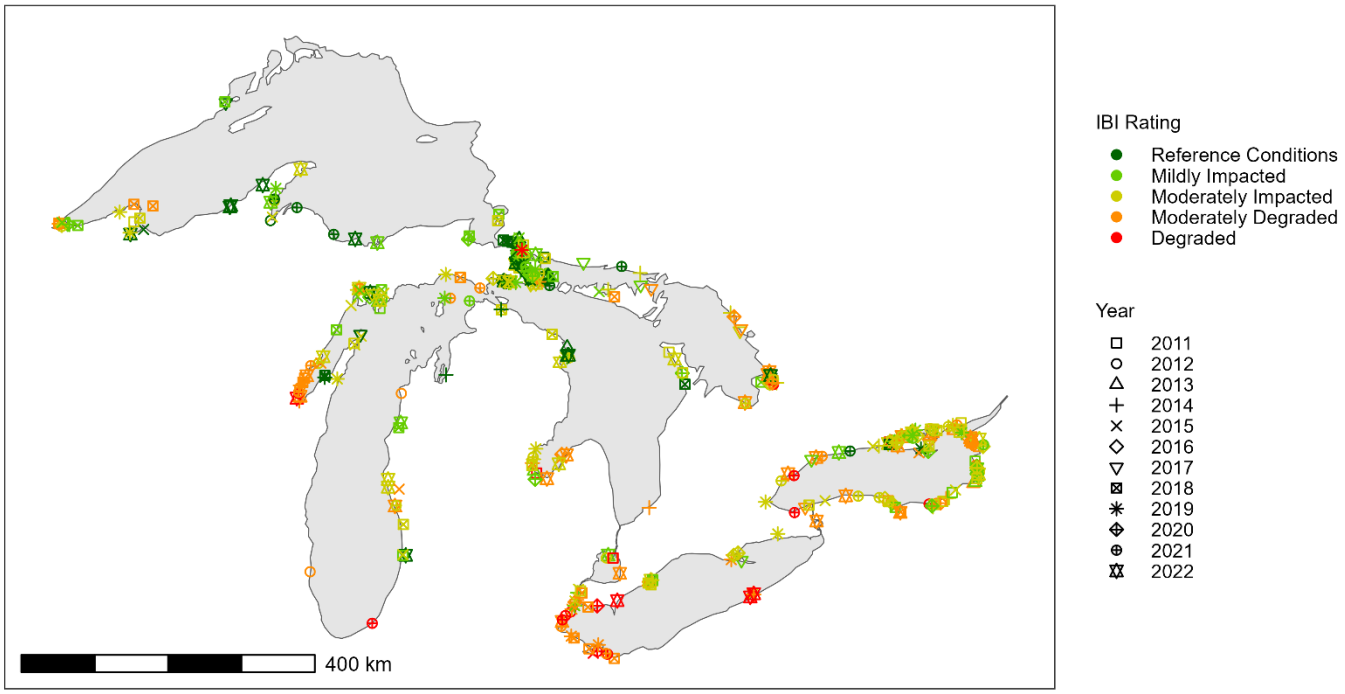
Source: Great Lakes Coastal Wetland Monitoring Program (CWMP), Uzarski et al. 2017.

			Total Fish Taxa				*Non-native Taxa*			
Country	*# Sites*	*# Samples*	*Mean*	*Max*	*Min*	*St. Dev.*	*Mean*	*Max*	*Min*	*St. Dev.*
Canada	187	367	9.7	27	1	4.2	0.8	7	0	1
US	325	634	13.7	31	2	5.6	1.5	7	0	1.1

Table 2. The number of distinct sites sampled, number of sampling events, number of sampling events related to IBI scores, total fish species and non-native species found in Great Lakes coastal wetlands and summary statistics by lake for sites sampled from 2011 through 2022. Currently the CWMP has fish IBIs developed for bulrush (*Schoenoplectus* spp.), cattail (*Typha* spp.), lily (*Brasenia* spp., *Nuphar* spp., *Nymphaea* spp.), and submerged aquatic vegetation (SAV; primarily *Myriophyllum* spp., *Ceratophyllum* spp., *Chara* spp., and *Najas* spp.; Cooper et al. 2018). Researchers associated with the CWMP are planning to establish fish IBI scoring systems for wetlands that are dominated by other vegetation types, including *(e.g., Phragmites australis, Peltandra virginica, Pontederia spp., Sparganium spp., Juncus spp., and Zizania spp.)*.

Source: Great Lakes Coastal Wetland Monitoring Program (CWMP), Uzarski et al. 2017.

				Total Fish Taxa			*Non-native Taxa*		
Lake	*# Sites*	*# Samples*	*# Samples w/IBI*	*Mean*	*Max*	*Min*	*Mean*	*Max*	*Min*
Erie	65	130	102	11.8	28	2	1.8	7	0
Huron	176	351	285	12.1	27	1	0.5	4	0
Michigan	84	159	144	13.7	31	3	1.3	6	0
Ontario	132	257	241	11.1	25	2	0.9	5	0
Superior	56	107	83	13.9	29	3	0.6	6	0



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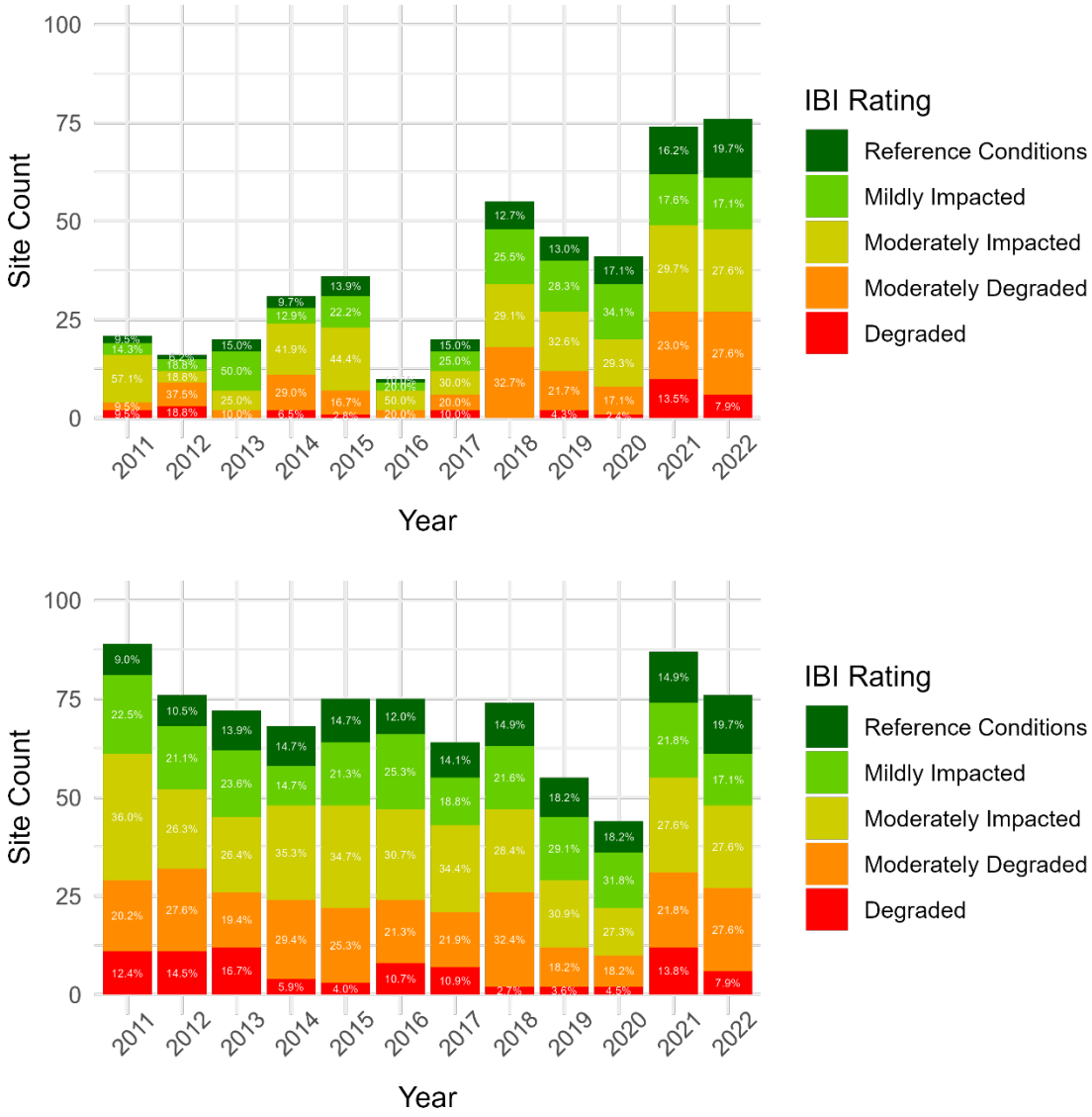

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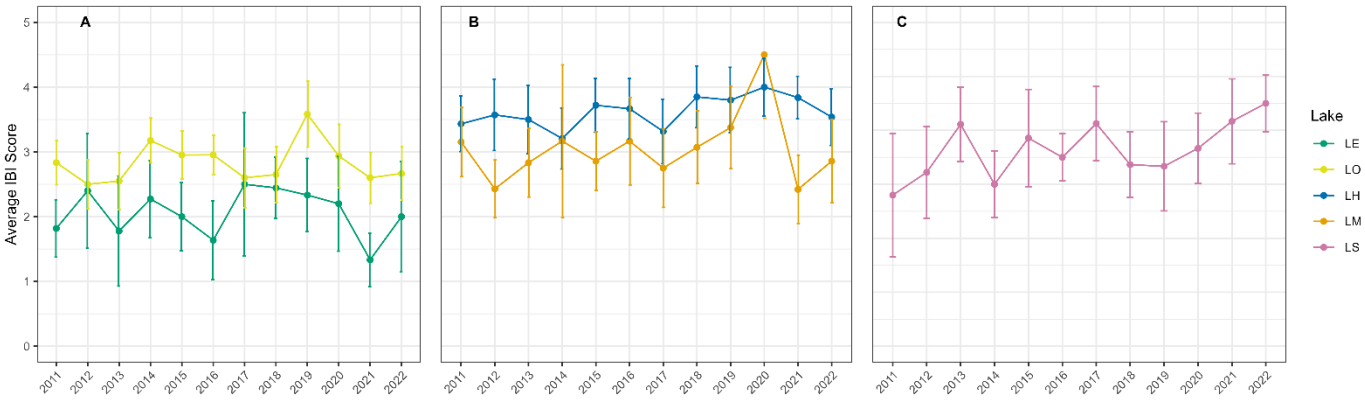

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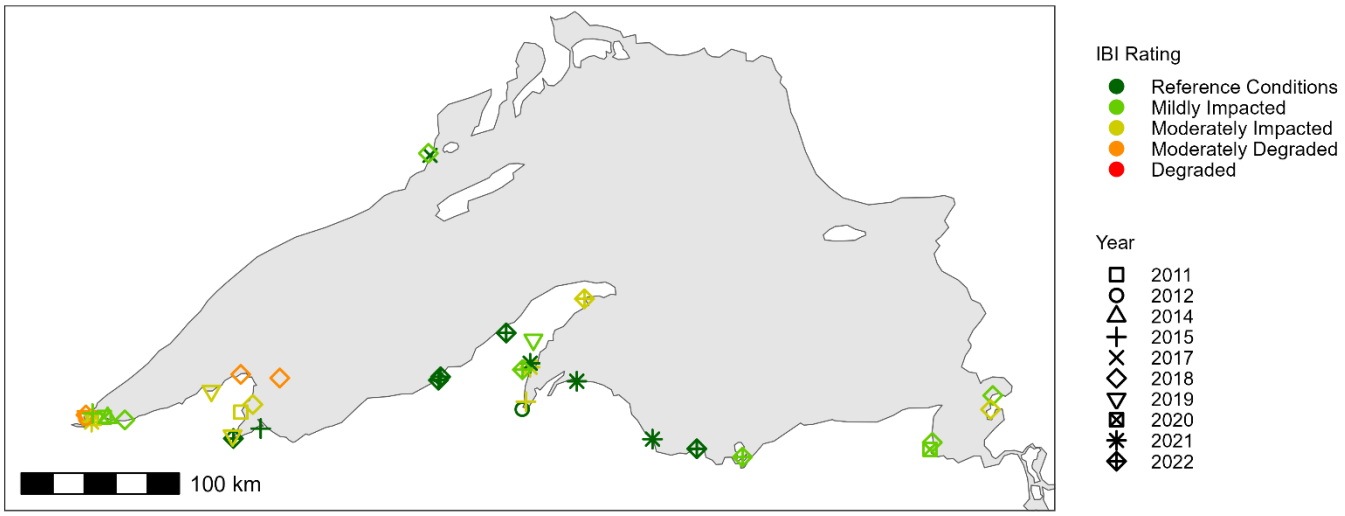

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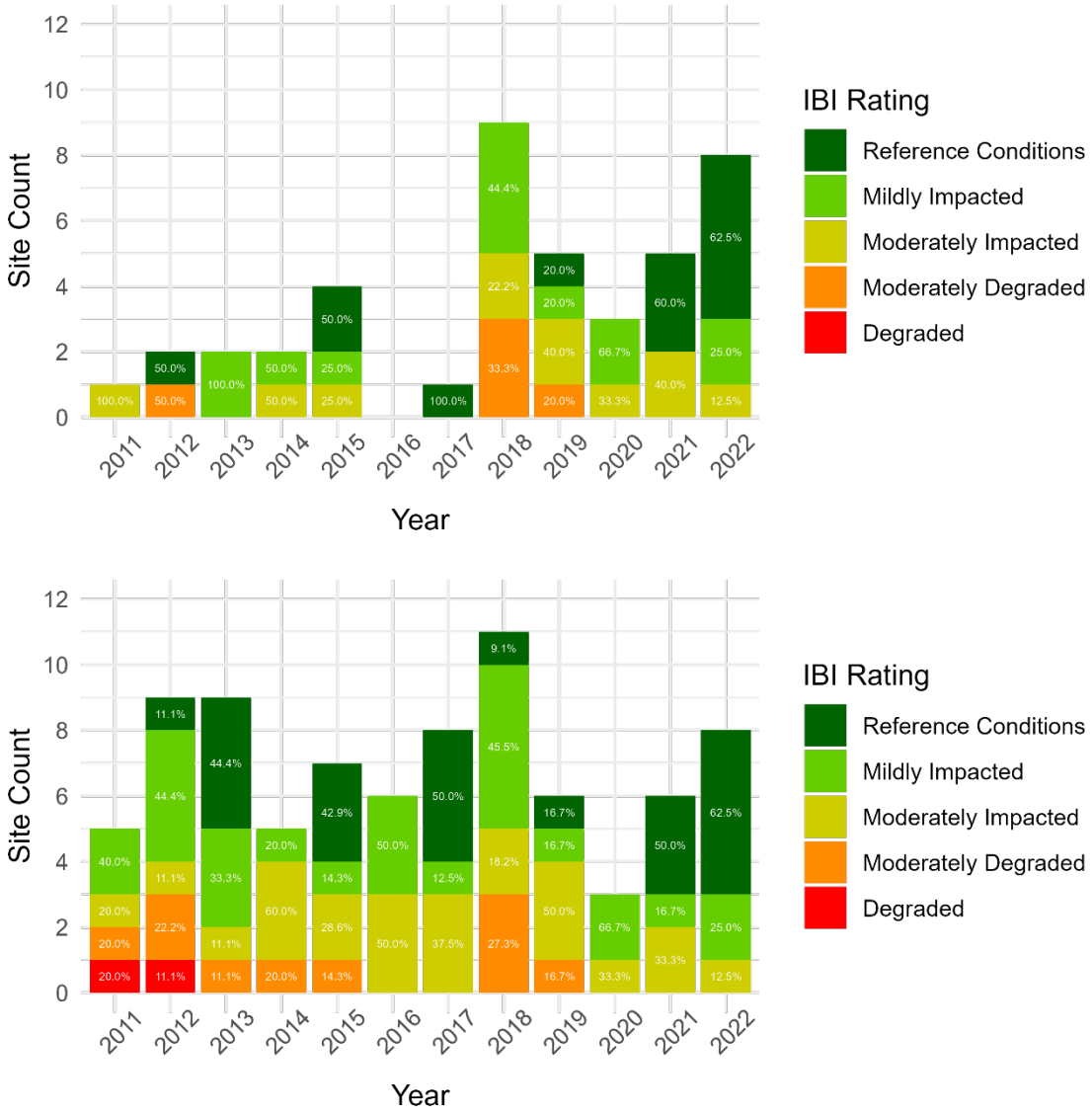

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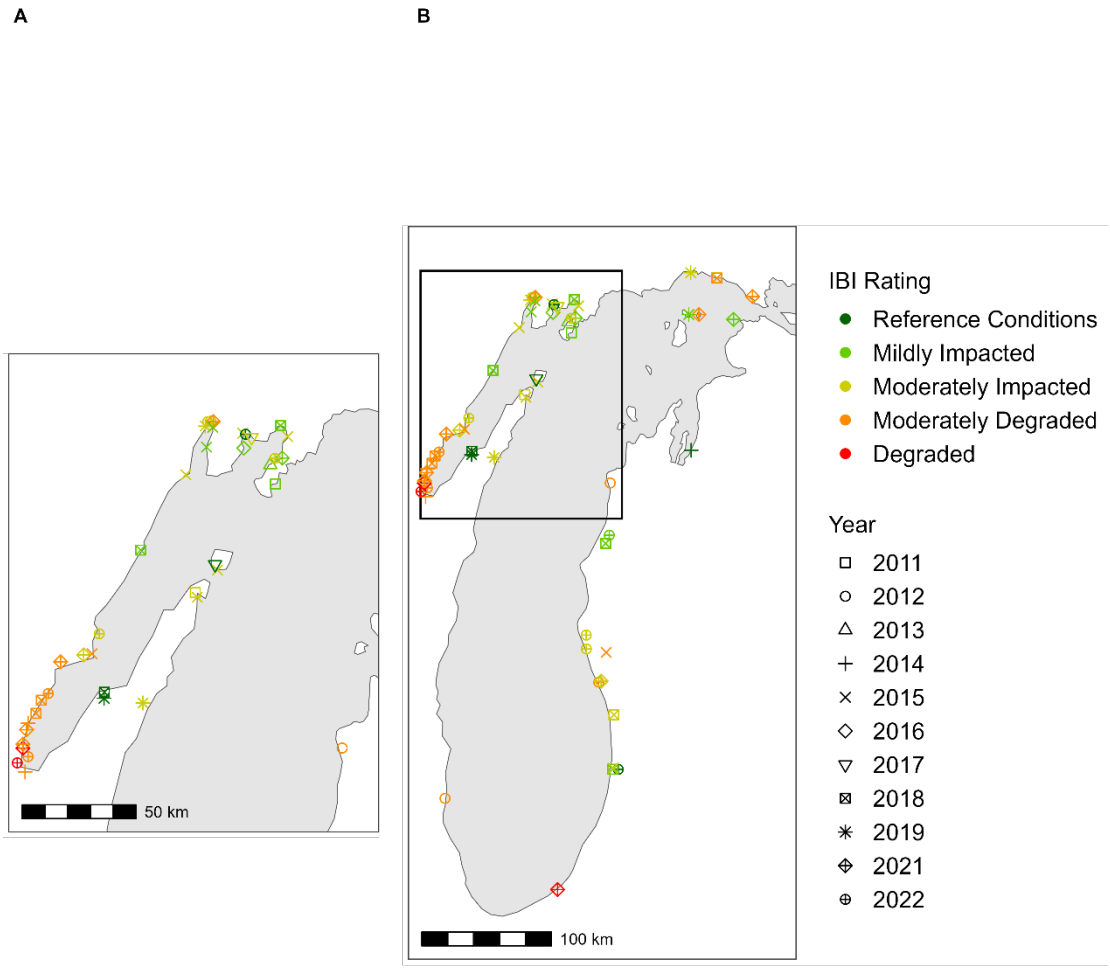

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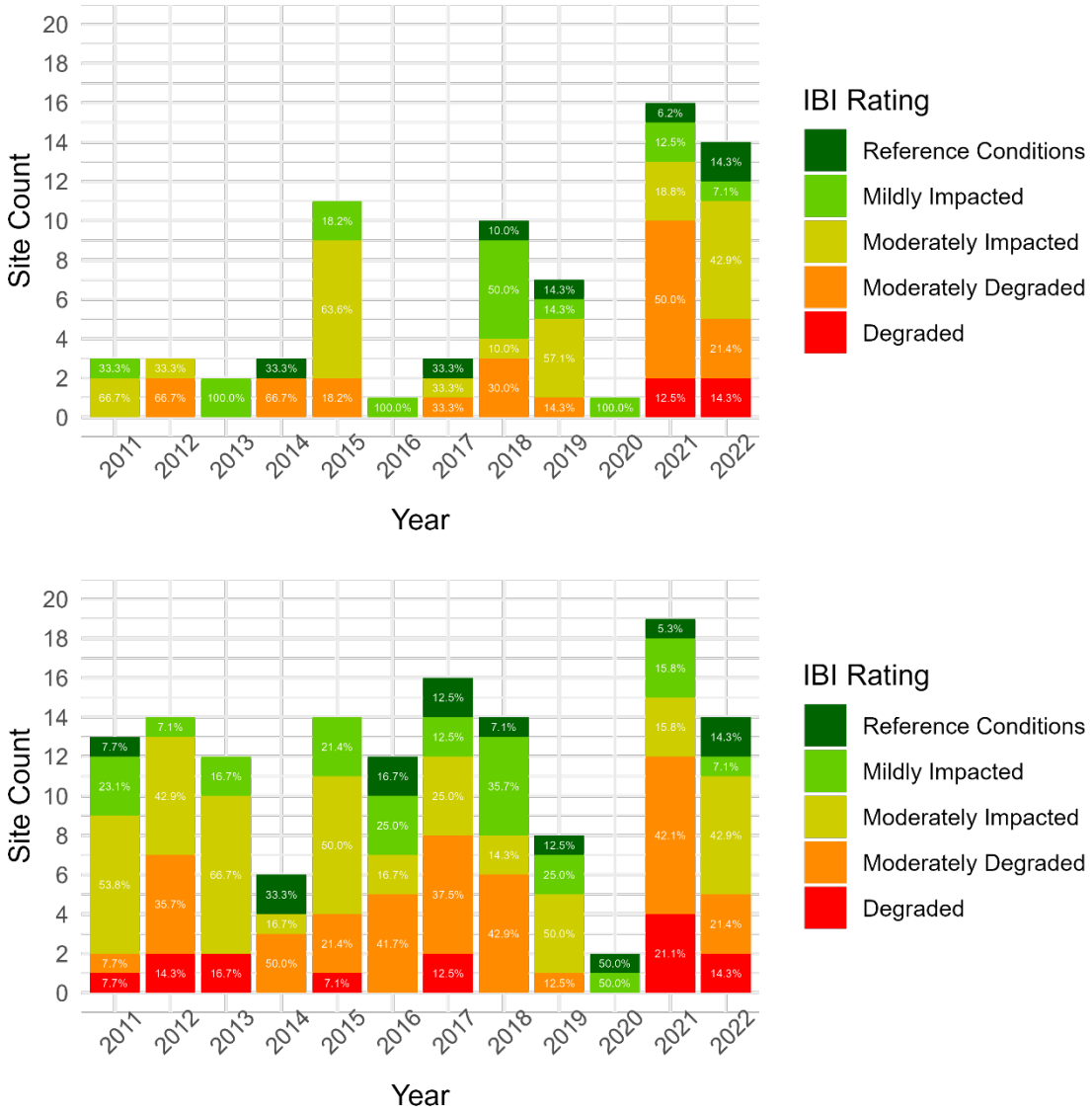

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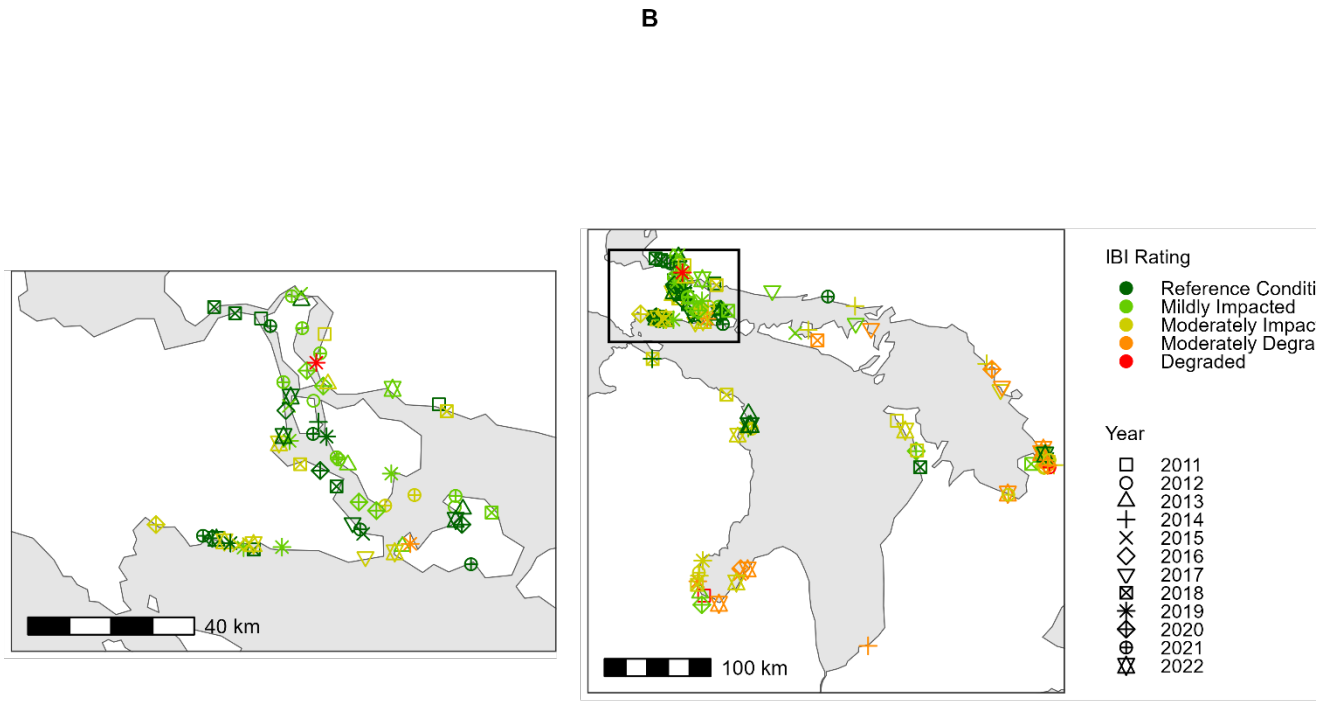

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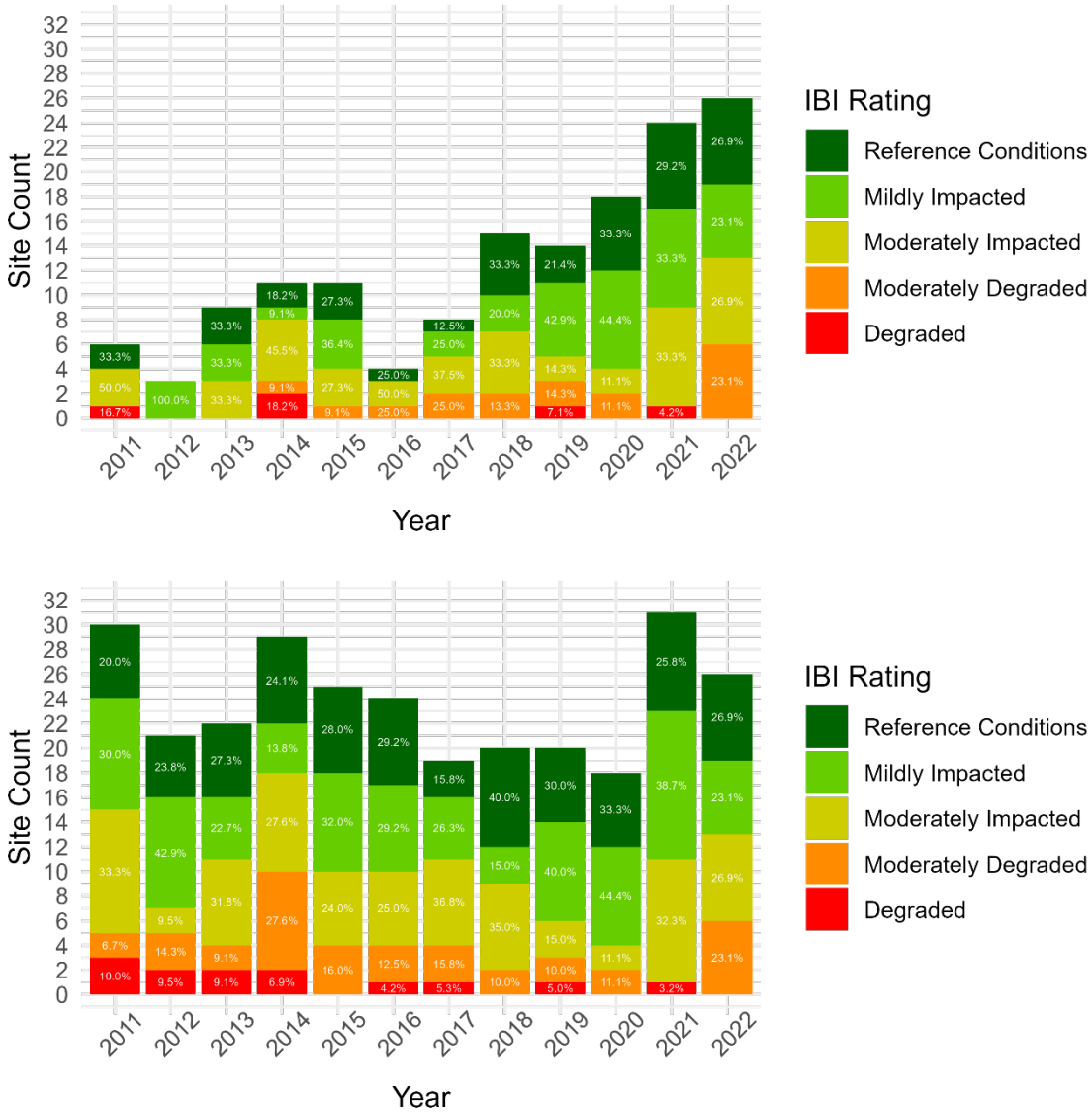

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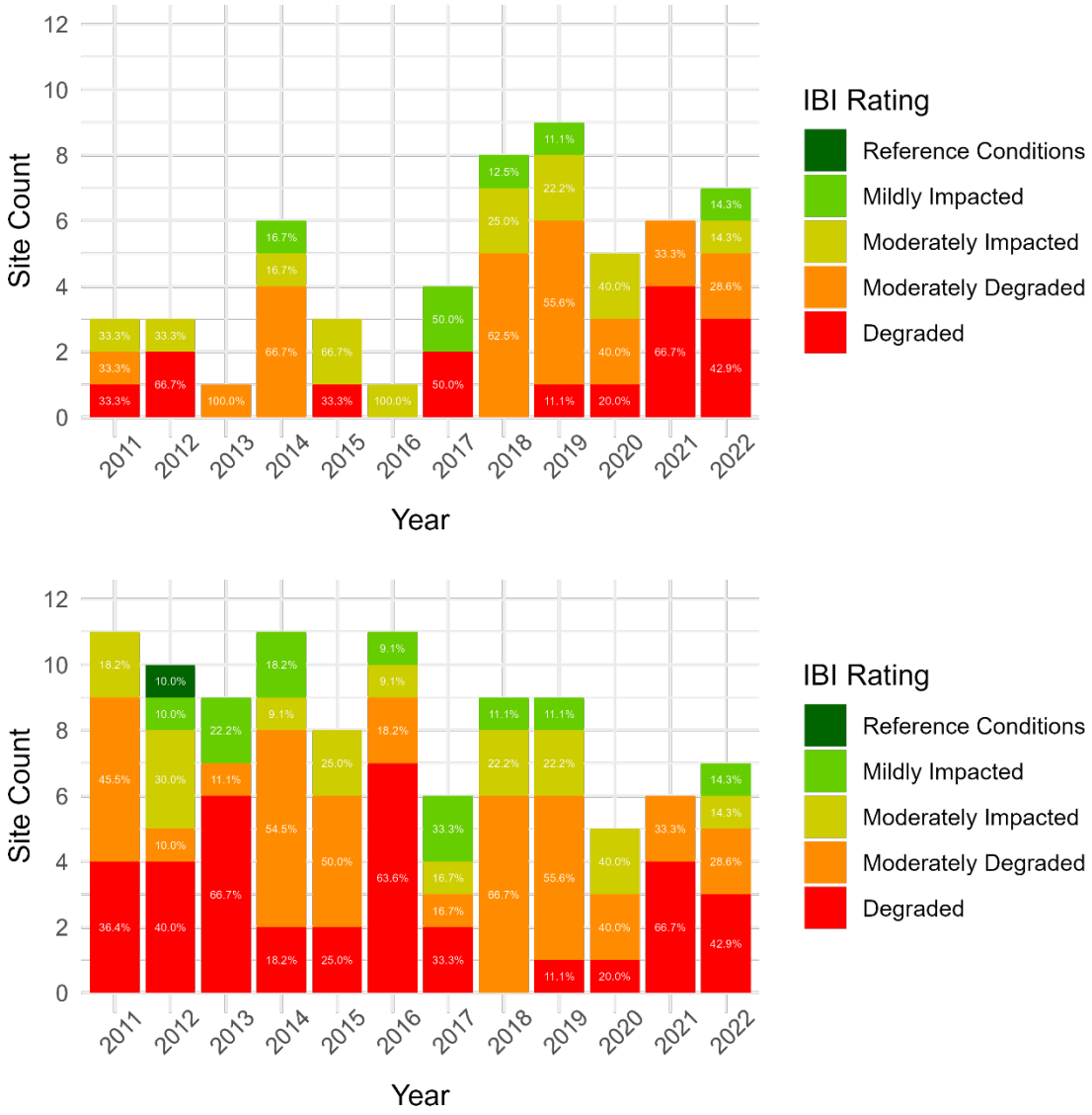

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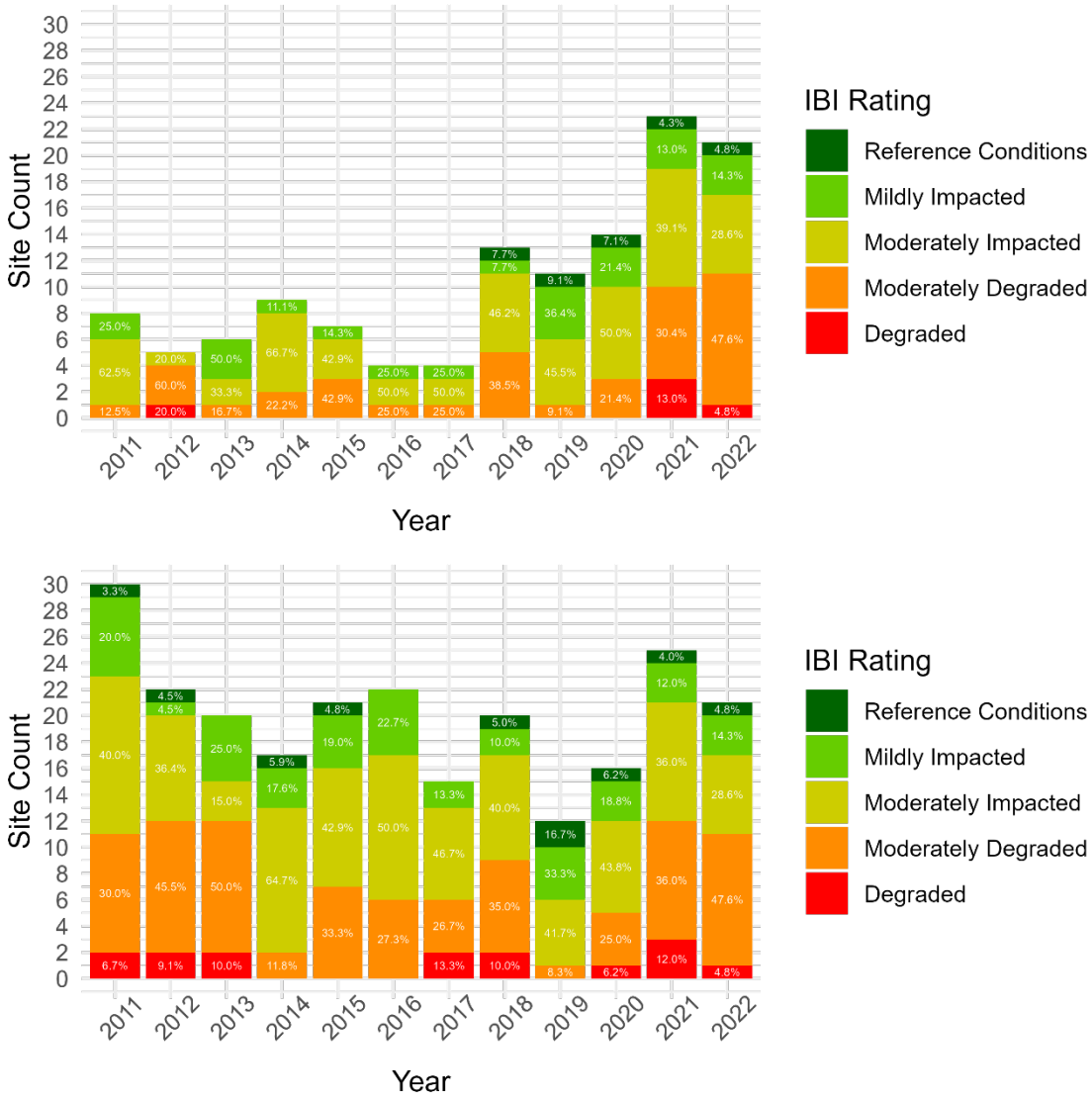

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