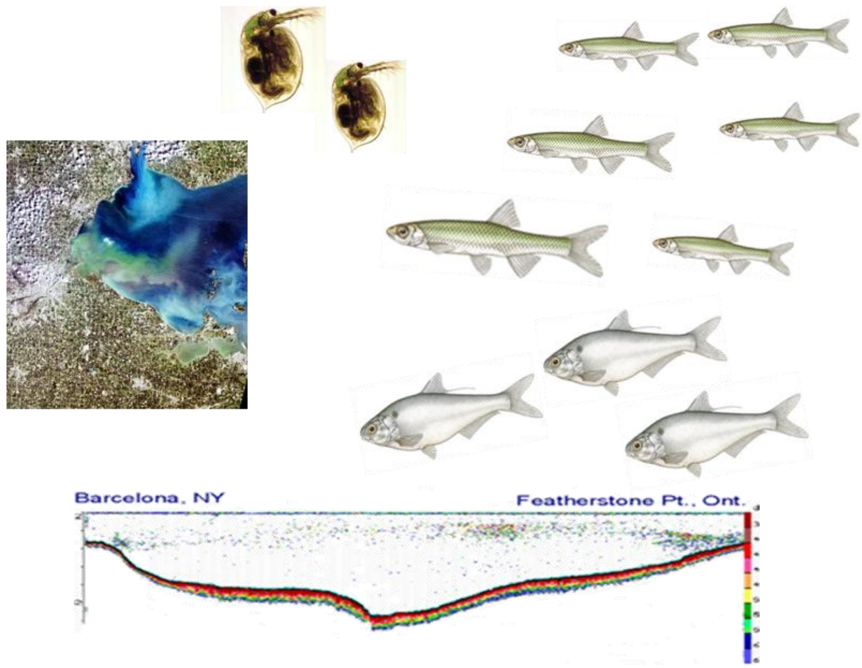
# Report of the Lake Erie Forage Task Group

March 2025




**Members:**

Zak Slagle (co-chair)[1], Heather Luken[1], Peter Jenkins[1], Arthur Bonsall (co-chair)[2], Tom MacDougall[2], Jeremy Holden[2], Jan-Michael Hessenauer[3], Jarrod Ludwig[4], Mike Hosack[5], Mark DuFour[6], Kristen Towne[7]

[1]Ohio Department of Natural Resources; ODNR
[2]Ontario Ministry of Natural Resources; OMNR
[3]Michigan Department of Natural Resources; MDNR
[4]New York State Department of Environmental Conservation; NYSDEC
[5]Pennsylvania Fish and Boat Commission; PFBC
[6]United States Geological Survey; USGS
[7]United States Fish and Wildlife Service; USFWS

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March 2025

# Forage Task Group Executive Summary

Lake Erie Committee

REPRESENTING THE FISHERY MANAGEMENT AGENCIES OF LAKE ERIE AND LAKE ST. CLAIR

**Introduction**

The Lake Erie Committee Forage Task Group (FTG) report addresses progress made on four charges:

1. Report on the results of the interagency lower trophic level monitoring program and status of trophic conditions as they relate to the Lake Erie Environmental Priorities.
2. Describe the status and trends of forage fish in each basin of Lake Erie and evaluate alternate data sources and methods to enhance description of forage fish abundance.
   2.1. Describe forage fish abundance and status using trawl data.
   2.2. Report on the diets of important Lake Erie predator fish where available.
   2.3. Describe growth and condition of Walleye, Lake Trout, and Black Bass.
3. Continue hydro acoustic assessment of the pelagic forage fish community in Lake Erie, while incorporating new methods in survey design and analysis following the GLFC's Great Lakes Hydro Acoustic Standard Operating Procedures where possible/feasible.
4. Act as a point of contact for any new/novel invasive aquatic species and incorporate into the USGS Nonindigenous Aquatic Species database.

The complete report is available from the Great Lakes Fishery Commission's Lake Erie Committee Forage Task Group website (http://www.glfc.org/lake-erie-committee.php) or upon request from a Lake Erie Committee, STC, or FTG representative.

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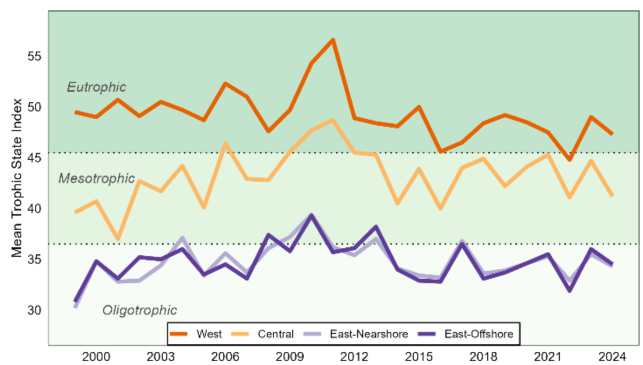
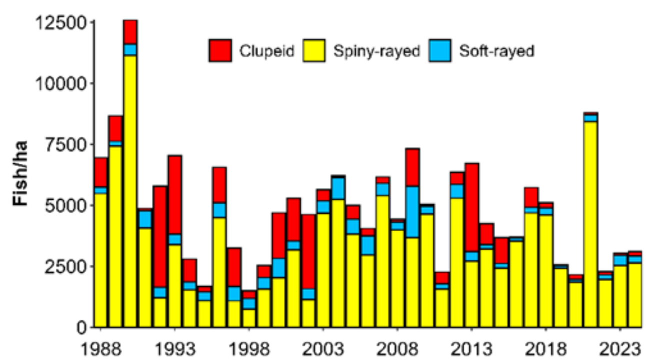
***Interagency Lower Trophic Level Monitoring***

The Lower Trophic Level Assessment monitoring program has measured nine environmental variables at 18 stations around Lake Erie since 1999 to characterize trends in lake productivity. In 2024, lake productivity was down compared to 2023. The Trophic State Index, which is a combination of phosphorus levels, water transparency, and chlorophyll *a*, indicated that the Central Basin was within the targeted mesotrophic status. The West Basin remained in the above-target eutrophic classification. The East Basin offshore and nearshore areas were oligotrophic in 2024. Low hypolimnetic dissolved oxygen continues to be an issue in the Central Basin during the summer months.



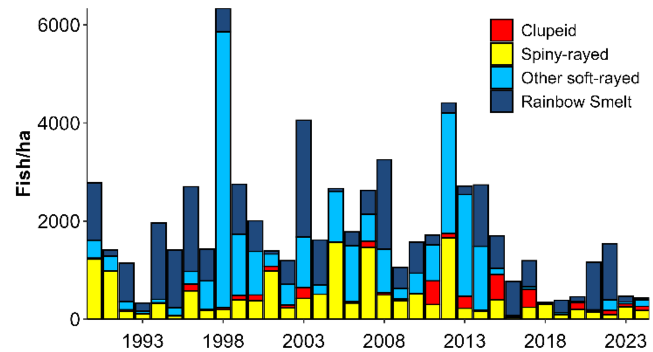

***West Basin Status of Forage***

In 2024, data from 73 trawl tows were used (up from 71 in 2023). Total forage density averaged 3,108 fish per hectare across the West Basin, similar to moderate levels in 2019–2020 and 2022–23. Forage biomass (13.9 kg/ha) decreased 26% from 2023. Age-0 White Perch abundance (1,889/ha) decreased. Age-0 Yellow Perch density (673/ha) was nearly double that of 2023 (381/ha). Age-0 Gizzard Shad abundance (141/ha) remained below the ten-year mean (647/ha). Age-0 Alewife density (47/ha) was the largest since 2002. Densities of Emerald Shiners have remained low for nine years. Round Goby abundance (20/ha) remained below the ten-year mean (27/ha).



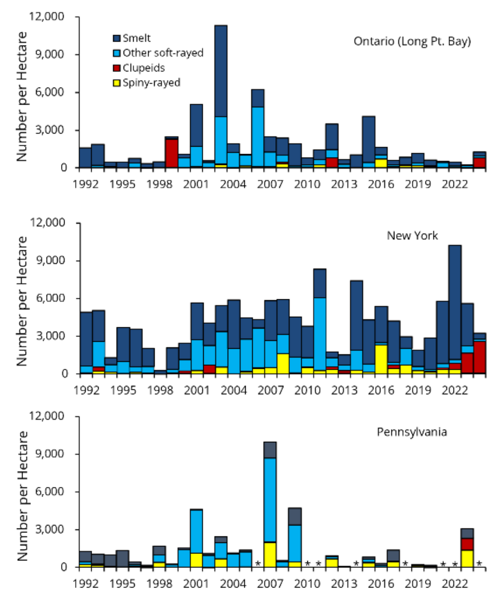
### *Central Basin Status of Forage*

In 2024, 47 trawl tows were completed in the Ohio waters of the Central Basin. Total forage density averaged 515 fish per hectare across the Central Basin, which was similar to 2023. Total forage biomass was 5.524 kg/ha, well below the long-term mean. Age-0 Rainbow Smelt density decreased from 2023 and was well below the long-term average. Age-1+ Rainbow Smelt density decreased from 2023 and was well below the long-term mean. Round Goby indices increased compared to 2023 but were still below the long-term mean. Spiny-rayed forage density (177/ha) decreased slightly from 2023. Age-0 Yellow Perch density increased from 2023; however, these continue to be some of the lowest densities in the time series. Walleye densities were above the long-term mean.




### *East Basin Status of Forage*

In 2024, overall forage fish densities were below time series averages in New York and offshore Ontario waters, although densities in Ontario increased from 2023. Total forage biomass was 26.1 kg/ha in New York waters and was the fourth highest level in the time series. Catches of age-0 and age-1+ Rainbow Smelt were low in both Ontario and New York. Emerald Shiner catches of age-0 and age-1+ decreased far below the time series average in New York waters. Catches of Emerald Shiner in Ontario remain low in 2024. Round Goby densities were below average in New York but above average in Ontario. Abundance of Alewife (mainly age-0) was the highest in the time series in New York and the second highest in the Ontario time series. Average numbers of age-0 Walleye were caught in New York and below-average catches of age-1 Yellow Perch. Catch of Age-0 Lake Whitefish was at the fourth highest level in the time series in New York waters. Catches of most other species were low, although Trout-perch abundance increased in Ontario waters. Pennsylvania intended to trawl in 2024, but boat mechanical issues and scheduling conflicts prevented sampling.




### *Hydroacoustic Assessments*

The primary purpose of Lake Erie hydroacoustic surveys is to estimate densities of important forage fishes in each basin of Lake Erie in July during the new moon. After completing several years of comparison studies, the hydroacoustic surveys in Lake Erie adopted a common stratified, random transect design. The standardization of the survey design allows for results to be generated lake wide and by basin. In 2024, a total of 480 km of transects were sampled, 65 water column profiles were measured, and 43 companion mid-water trawls were towed (the latter in the Central Basin only). Densities of fish (number per hectare) were highest in the West Basin, followed by the East Basin, and lowest in the Central Basin. In the East Basin, age-1+ Rainbow Smelt density declined in 2024 relative to 2023 but was still well above the time series low observed in 2019. In the Central Basin, total density of fish remained low in 2024, with Rainbow Smelt being the most abundant species in both the epilimnion and hypolimnion. In the West Basin, prey fish density decreased in 2024 to just below the time series average.

### *Aquatic Invasive Species*

In 2024, the U.S. Fish and Wildlife Service (USFWS) Early Detection and Monitoring program did not capture any novel aquatic invasive species (AIS). No other Lake Erie agency encountered a novel AIS, either. However, the USFWS captured a total of 8 Western Mosquitofish (*Gambusia affinis*) in 2024: 2 in Maumee River, OH and 6 in Sandusky Bay, OH. According to the USGS Nonindigenous Aquatic Species Database, this species was previously detected in Maumee Bay in 1981 and Sandusky River in 2023. Additionally, commercial fishermen captured a total of 2 hybrid striped bass (*Morone chrysops x M. saxatilis*) in 2024: 1 near Port Burwell, ON and 1 near Magee Marsh, OH. The FTG is continuing work towards incorporating the FTG Aquatic Invasive Species database as well as other agency data into the USGS Nonindigenous Aquatic Species Database so that the data can be archived and help track AIS on a greater geographic scale.

## Charges to the Forage Task Group 2024–2025

1. Report on the results of the interagency lower trophic level monitoring program and status of trophic conditions as they relate to the Lake Erie Environmental Priorities.

2. Describe the status and trends of forage fish in each basin of Lake Erie and evaluate alternate data sources and methods to enhance description of forage fish abundance.
   2.1. Describe forage fish abundance and status using trawl data.
   2.2. Report on the diets of important Lake Erie predator fish where available.
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3. Continue hydro acoustic assessment of the pelagic forage fish community in Lake Erie, while incorporating new methods in survey design and analysis following the GLFC's Great Lakes Hydro Acoustic Standard Operating Procedures where possible/feasible.

4. Act as a point of contact for any new/novel invasive aquatic species and incorporate into the USGS Nonindigenous Aquatic Species database.


### Acknowledgements

The Forage Task Group would like to thank Andy Cook (Ontario Ministry of Natural Resources), Amanda Popovich (Ohio Department of Natural Resources; pending member), Collin Farrell (United States Fish and Wildlife Service; pending member), and Jim Markham (New York State Department of Environmental Conservation).

**Charge 1: Report on the results of the interagency lower trophic level monitoring program and status of trophic conditions as they relate to the Lake Erie Fish Community Objectives.**

(J. Markham, Z. Slagle)

*Background*

In 1999, the Forage Task Group (FTG) initiated a Lower Trophic Level Assessment program (LTLA) within Lake Erie and Lake St. Clair (Figure 1.0.1). Nine key variables, as identified by a panel of lower trophic level experts, were measured to characterize ecosystem change. These variables included temperature and dissolved oxygen profiles, water transparency (Secchi disc depth), nutrients (total phosphorus), chlorophyll *a*, phytoplankton, and zooplankton. The protocol called for each station to be visited every two weeks from May through September, totaling 12 sampling periods. For this report, we will summarize the last 26 years of data for summer surface temperature, summer bottom dissolved oxygen, chlorophyll *a* concentration, water transparency, total phosphorus, and zooplankton. Data from all sampled stations were included in the analysis unless noted. In 2024, stations 3–6 in the West Basin, 7–12 in the Central Basin, and 15-18 in the East Basin were sampled (Figure 1.0.1).

Lake Erie's Environmental Priorities (EP; LEC 2019), in prescribing actions that are critical for achievement of its Fish Community Objectives (Francis et al. 2020), describe desirable trophic conditions in Lake Erie. The EPs designate mesotrophic conditions in the West Basin, Central Basin, and nearshore waters of the East Basin and embayments as desirable. Conversely, an oligotrophic environment would most benefit the cold-water fish community that utilizes the deep, offshore waters of the East Basin (Ryan et al. 2003). Associated with these trophic classes are target ranges for total phosphorus, water transparency, and chlorophyll *a* (Table 1.0.1). For mesotrophic conditions, the total phosphorus range is 9–18 µg/L, summer (June-August) water transparency is 3–6 meters, and chlorophyll *a* concentrations between 2.5–5.0 µg/L (Leach et al. 1977). For the offshore waters of the East Basin, the target for total phosphorus is < 9 µg/L, summer water transparency > 6 m, and chlorophyll *a* concentrations < 2.5 µg/L.

A trophic state index (TSI; Carlson 1977) was used to produce a metric which merges three independent variables to report a single broader measure of trophic conditions. This index uses algal biomass as the basis for trophic state classification, which is independently estimated using measures of chlorophyll *a*, water transparency, and total phosphorus. Each independent measure is scored and the average of the three indices reflects a trophic state value for that site and sampling event. The median value of the combined daily indices is used to determine an annual index for each basin. Because the number generated is only a relative measure of the trophic conditions and does not define trophic status, this index was calibrated to accept Lake Erie ranges for values of total phosphorus, chlorophyll *a*, and transparency (from Leach et al. 1977) that have long been used to assess trophic conditions. In these terms, oligotrophic was determined to have a TSI < 36.5, mesotrophic between 36.5 and 45.5, eutrophic between 45.5 and 59.2, and hyper-eutrophic >59.2.

*Mean Summer Surface Water Temperature*

Summer surface water temperature represents the temperature of the water at 0–1 meters depth for offshore stations only. This index should provide a reliable measure of relative system production and growth rate potential for fishes, assuming prey resources are not limiting. Mean summer surface temperatures across all years are warmest in the West Basin (mean = 22.8 °C), becoming progressively cooler in the Central (mean = 21.9 °C) and East Basins (mean = 20.6 °C; Figure 1.0.2). In 2024, the mean summer surface water temperature was above long-term averages in the West (23.7 °C) and East (21.2 °C) basins. In the Central Basin, mean summer surface water temperature was 22.6 °C, which is above average. An increasing trend in summer surface water temperature is evident in all three basins for this time series (Figure 1.0.2).

*Hypolimnetic Dissolved Oxygen*

Dissolved oxygen (DO) levels less than 2.0 mg/L are deemed stressful to fish and other aquatic biota (Craig 2012; Eby and Crowder 2002). Low DO can occur when the water column becomes stratified, which can begin in early June and continue through September in the Central and East Basins. In the West Basin, shallow depths allow wind mixing to penetrate to the bottom, generally preventing thermal stratification. Consequently, there are only a few summer observations that detect low bottom DO concentrations in the time series (Figure 1.0.3). In 2024, there were no observed measurements from the West Basin stations of DO below the 2.0 mg/L threshold.

Low DO is more of an issue in the Central Basin, where it happens almost annually at the offshore stations (8, 10, 11, and 13) and occasionally at nearshore stations. Dissolved oxygen of less than 2.0 mg/L has been observed as early as mid-June and can persist until late September when fall turnover remixes the water column. In 2024, bottom DO was below the 2.0 mg/L threshold in the Central Basin on three occasions (Station 8: 7/17/2024 – 0.84 mg/L and 7/31/2024 – 0.44 mg/L; Station 10: 7/29/2024 – 1.68 mg/L; Figure 1.0.3).

DO is rarely limiting in the East Basin due to greater water depths, a large hypolimnion and cooler water temperatures. The only occasion when DO was below the 2.0 mg/L threshold was on July 14$^{th}$ and August 13$^{th}$, 2010 (Figure 1.0.3). In 2024, East Basin bottom DO measurements ranged between 5.48–10.47 mg/L and were never below the 2.0 mg/L threshold.

*Chlorophyll a*

Chlorophyll *a* concentrations indicate biomass of the phytoplankton resource, ultimately representing production at the lowest trophic level. In the West Basin, mean chlorophyll *a* concentrations have mostly been above targeted levels in the time series, fitting into eutrophic status rather than targeted mesotrophic status (Figure 1.0.4). Annual variability is also the highest in the West Basin. In 2024, the mean chlorophyll *a* concentration was 5.4 μg/L in the West Basin, which is classified as eutrophic, above the targeted mesotrophic range. In the Central Basin, chlorophyll *a* concentrations have historically been less variable and within the targeted mesotrophic range; however, in 2024, Central Basin chlorophyll *a* mean concentration fell into the eutrophic category for the first time in survey history (5.8 μg/L; Figure 1.0.4). In the East Basin, chlorophyll *a* concentrations in the nearshore waters have been below the targeted mesotrophic level for the entire time series, including in 2024 (2.4 μg/L; Figure 1.0.4). Likewise, chlorophyll *a* levels in the offshore waters of the East Basin remain in, or slightly above, the targeted oligotrophic range (2024: 2.5 μg/L). Chlorophyll *a* concentrations remain the most stable in the East Basin.

*Total Phosphorus*

Total phosphorus levels in the West Basin have exceeded EP targets since the beginning of the LTLA monitoring program; in some years, they have been in the hyper-eutrophic range (Figure 1.0.5). In 2024, mean total phosphorus concentrations in the West Basin increased to 24.8 μg/L, remaining in eutrophic status. In the Central Basin, mean total phosphorus levels had exceeded FCO targets from 2006 through 2013, were borderline mesotrophic/eutrophic in 2014 and 2015, and then began to increase again in 2016 (Figure 1.0.5). Total phosphorus measures in the Central Basin sharply decreased in 2024 to 11.8 mg/L (down from 26.6 μg/L in 2023) and returned to mesotrophic status. In the nearshore waters of the East Basin, total phosphorus levels have remained stable and within or near the targeted mesotrophic range for the entire time series (Figure 1.0.5). Total phosphorus levels in the offshore waters of the East Basin show a similar trend to nearshore waters and had risen above the targeted oligotrophic range from 2008 through 2013 but have declined in more recent years. In 2024, mean total phosphorus measures decreased in both nearshore (6.7 μg/L) and offshore (7.2 μg/L) waters of the East Basin, both in the oligotrophic range (within target for offshore waters but below target for nearshore).

*Water Transparency*

In 2024, Secchi depths increased (i.e., became less eutrophic) across most basins of Lake Erie (Figure 1.0.6). Similar to other fish community ecosystem targets (i.e., chlorophyll *a*, total phosphorus), water transparency in the West Basin has been in the eutrophic range for the entire time series. Mean summer transparency in the West Basin was 2.2 m in 2024, an increase compared to 2023 (1.8 m). In contrast, water transparency in the Central Basin has remained within the targeted mesotrophic range for most of the entire series (Figure 1.0.6). In 2024, water transparency increased to 4.5 m. In the nearshore waters of the East Basin in 2024, water transparency (5.2 m) was in the mesotrophic range and within the FCO target (Figure 1.0.6). In the offshore waters of the East Basin, water transparency was within the oligotrophic target from 1999 through 2007, decreased into the mesotrophic range in five of the next six years, then increased thereafter. In contrast to the nearshore waters, water transparency in the offshore waters decreased in 2024 (5.9 m) and was within the mesotrophic range, outside the FCO target.

*Trophic State Index (TSI) and Ecosystem Targets*

The trophic state index for each Lake Erie basin has fluctuated over time (Figure 1.0.7). Median TSI values indicate that the West Basin remained in a eutrophic status from the beginning of the entire time series until 2016, which was more favorable for a centrarchid (black bass and sunfish) fish community. In some years, overall measures of productivity have declined and are near or within the targeted mesotrophic status (2016 and 2022), which is more favorable for percid (Walleye and Yellow Perch) production. Central Basin waters have generally remained within the targeted mesotrophic range for the entire time series. Nearshore waters of the East Basin were mostly below the targeted mesotrophic range in the early years of the time series, increasing into the targeted mesotrophic zone in the late-2000s, then decreasing back into oligotrophic status since 2014. Offshore waters of the East Basin show a similar trend. TSI values for 2024 indicate eutrophic status in the West Basin (47.3), mesotrophic status in the Central Basin (41.2), and oligotrophic status in both the offshore (34.5) and nearshore (34.3) waters of the East Basin (Table 1.0.2). Trends in trophic status measures indicate that Lake Erie continues to decrease in overall productivity but generally remains in a favorable condition for percid production.

*Zooplankton Biomass*

Average zooplankton biomass varies across basins and among years and has recently only been measured in the West and Central basins. In the West Basin, the 2024 average biomass was 73.0 mg/m$^3$, a decrease from 2023 (104.0 mg/m$^3$) and below the time series average of 140.5 mg/m$^3$ (Figure 1.0.8). This decline was driven by lower biomass of cladocerans (from 71.8 mg/m$^3$ in 2023 to 46.1 mg/m$^3$ in 2024). In the Central Basin, the 2024 average zooplankton biomass was 103.2 mg/m$^3$, which was below the average time series biomass (139.5 mg/m$^3$). This represented a decrease from 2023 (120.9 mg/m$^3$) (Figure 1.0.8). This decline was also driven by lower cladoceran biomass (from 62.5 mg/m$^3$ in 2023 to 45.5 mg/m$^3$ in 2024). In the East Basin, overall zooplankton biomass is traditionally lower compared to the Central and West Basins with cladocerans and calanoid copepods equally important (Figure 1.0.8). Zooplankton samples for the East Basin have been archived but not counted since 2022.

**Table 1.0.1**: Thresholds for trophic indicators and the trophic state index associated with each trophic state and fish community (Carlson 1977; Leach et al. 1977; Ryder and Kerr 1978).

| Trophic status | Phosphorus (ug/L) | Chlorophyll *a* (ug/L) | Secchi depth (m) | Trophic State Index | Harmonic fish community |
|---|---|---|---|---|---|
| Oligotrophic | <9 | <2.5 | >6 | <36.5 | Salmonids |
| Mesotrophic | 9–18 | 2.5–5.0 | 3–6 | 36.5–45.5 | Percids |
| Eutrophic | 18–50 | 5.0–15.0 | 1–3 | 45.5–59.2 | Centrarchids |
| Hypereutrophic | >50 | >15.0 | <1 | >59.2 | Cyprinids |

**Table 1.0.2:** Current trophic status, by basin, from Lake Erie in 2024.

| Basin | 2024 TSI | 2024 Trophic Status |
|---|---|---|
| West | 47.3 | Eutrophic |
| Central | 41.2 | Mesotrophic |
| East-Nearshore | 34.3 | Oligotrophic |
| East-Offshore | 34.5 | Oligotrophic |

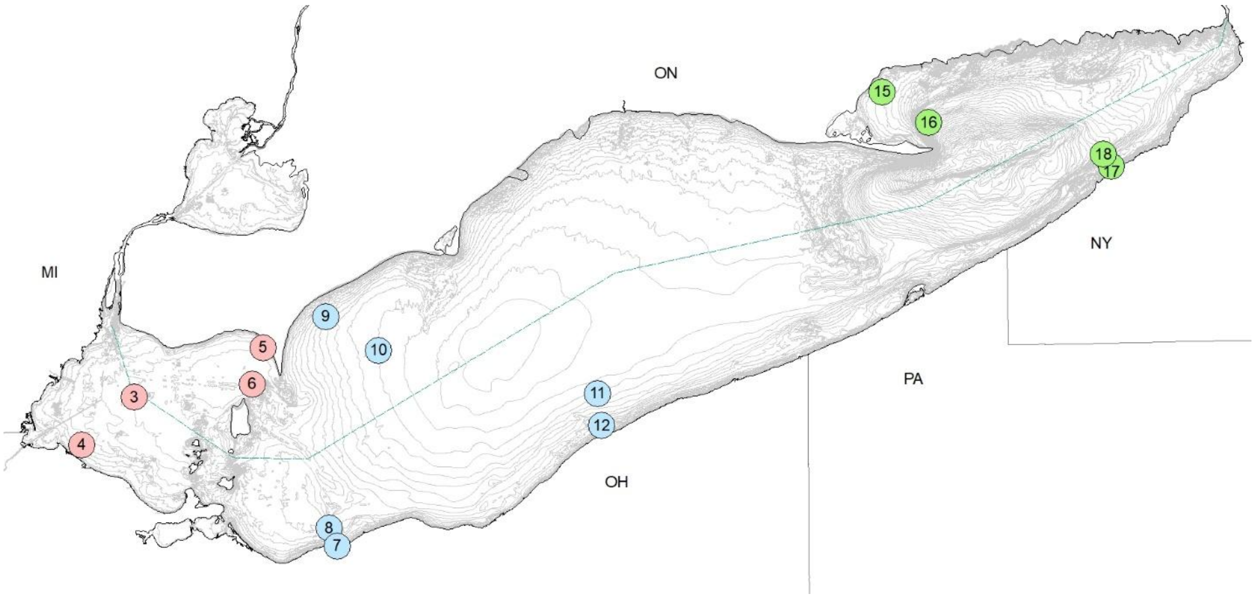



**Figure 1.0.1:** Lower trophic level sampling stations in Lake Erie (red = West Basin, blue = Central Basin, and green = East Basin).

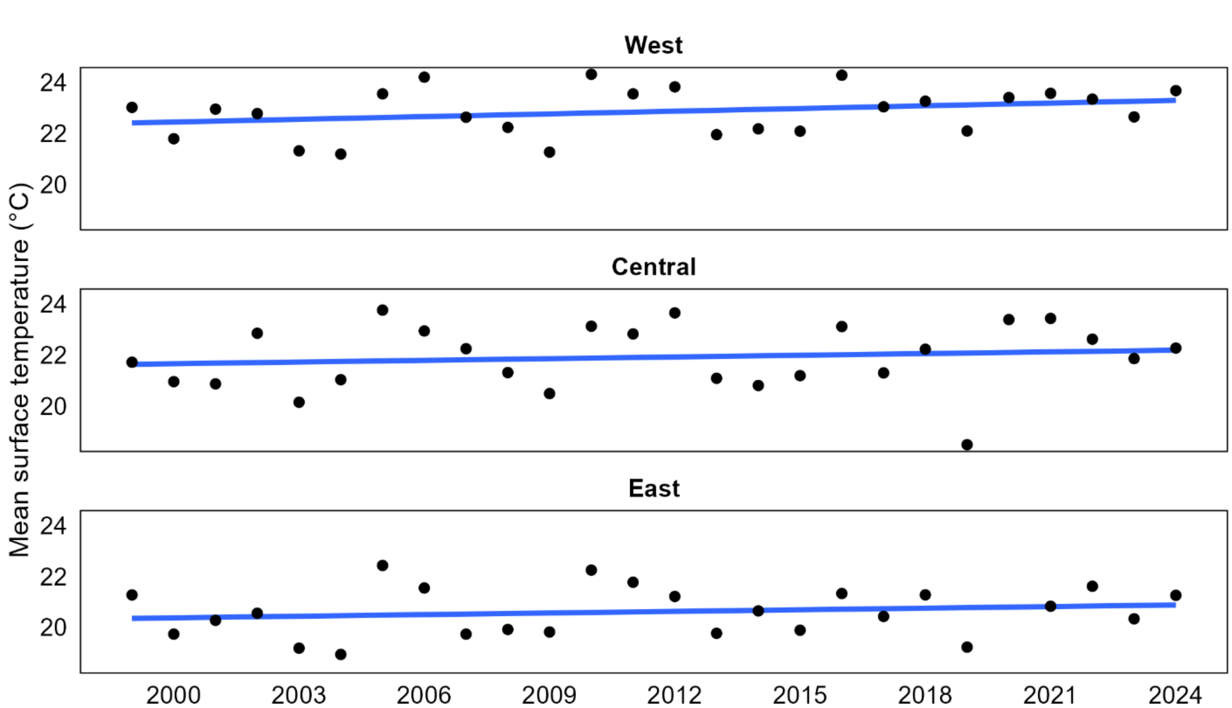



**Figure 1.0.2:** Mean summer (June-August) surface water temperature (°C) at offshore stations weighted by month for each basin in Lake Erie, 1999–2024. Solid blue lines represent time series trends.

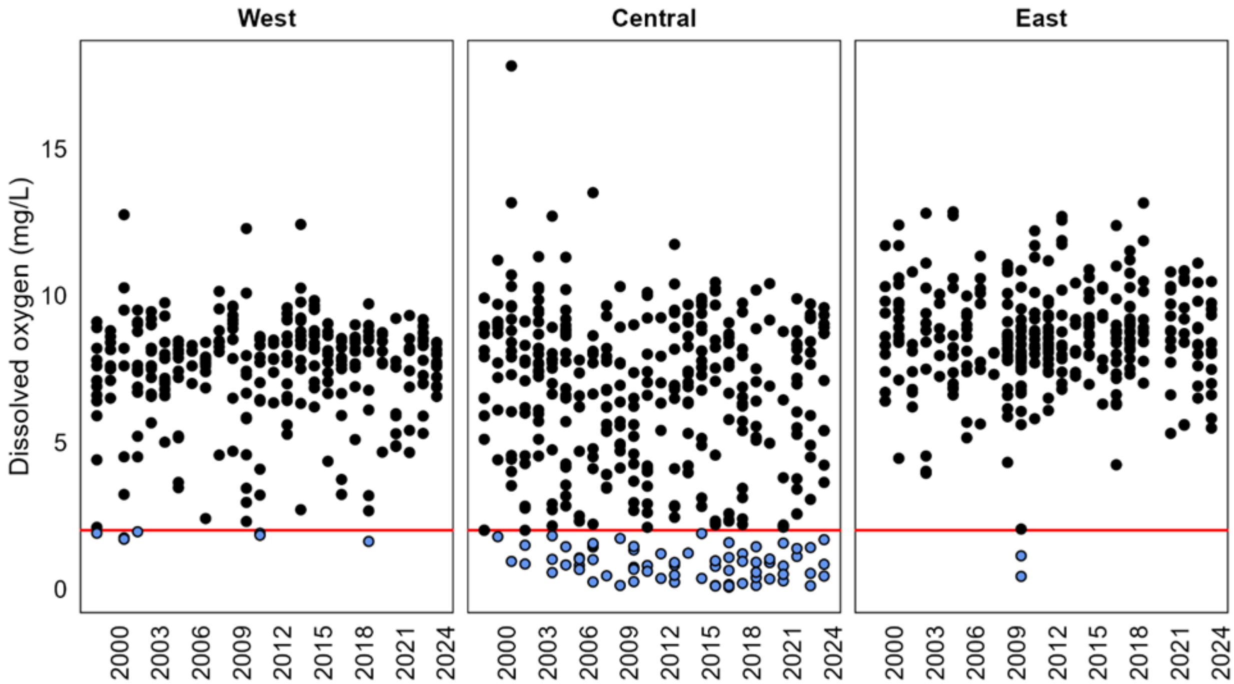



**Figure 1.0.3:** Summer (June-August) bottom dissolved oxygen (mg/L) concentrations for offshore sites by basin in Lake Erie, 1999–2024. The red horizontal line represents 2.0 mg/L, a typical threshold for hypoxia. Values below this are denoted by blue points.

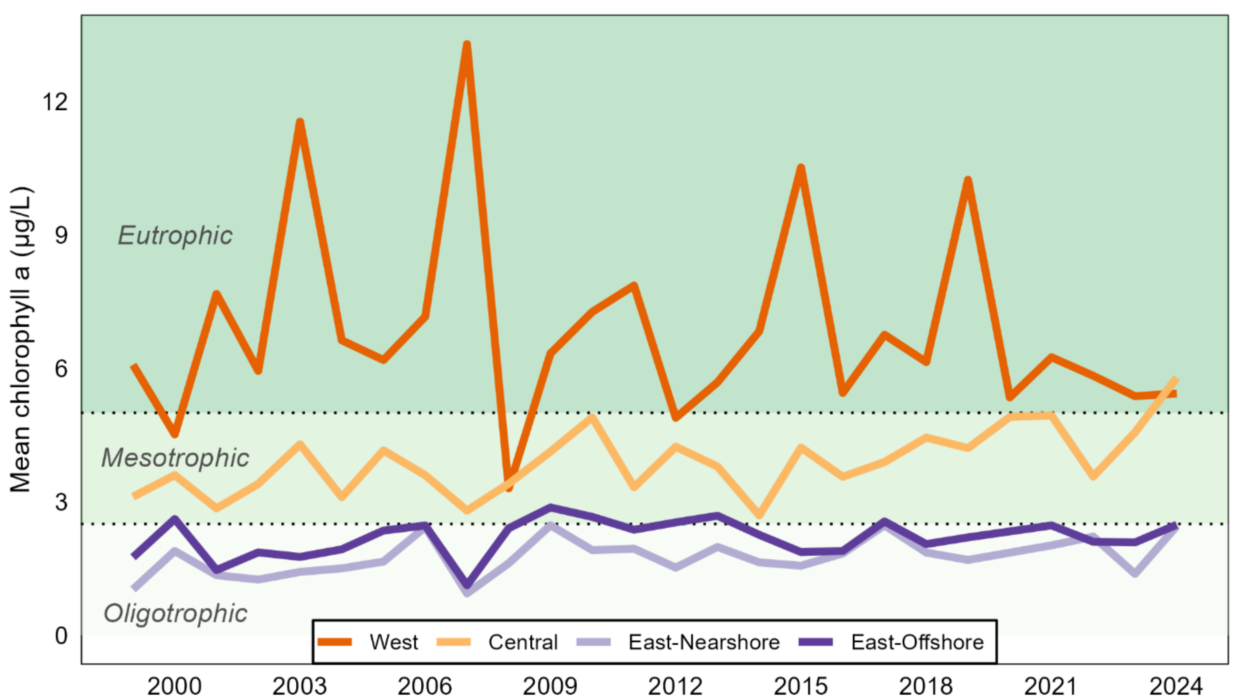



**Figure 1.0.4:** Mean chlorophyll *a* concentration (µg/L), weighted by month, for each basin in Lake Erie, 1999–2024. The East Basin is separated into nearshore and offshore. Shaded areas represent trophic class ranges.

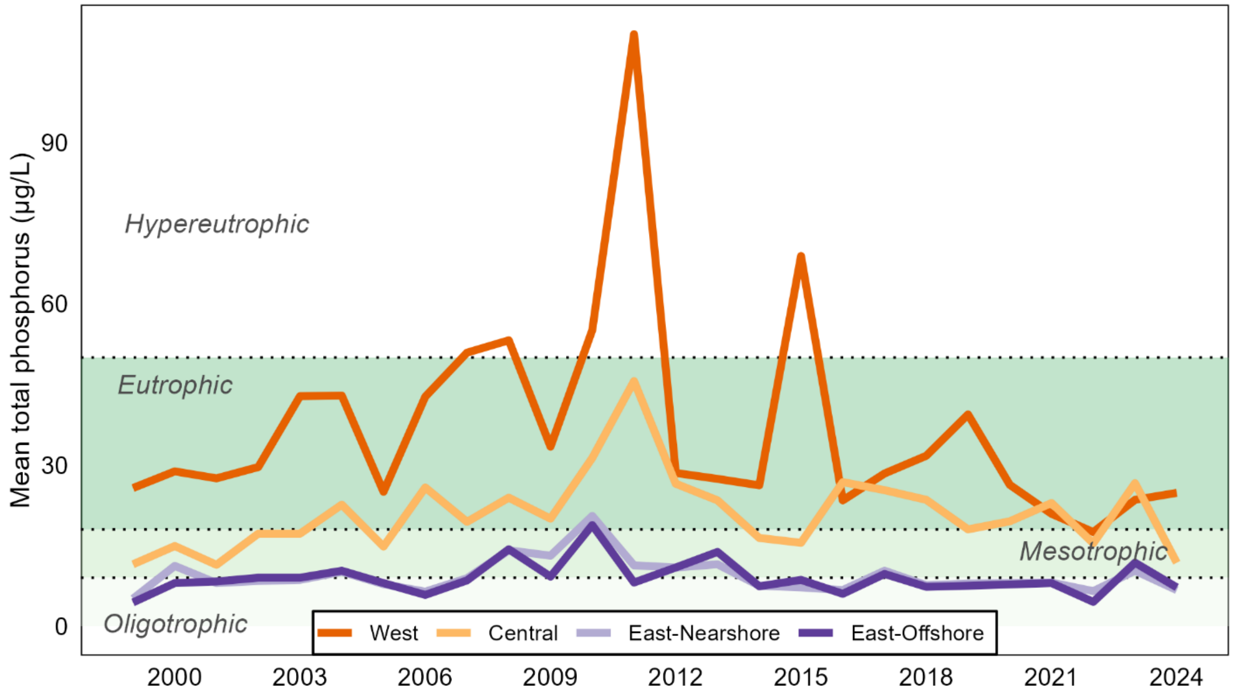



**Figure 1.0.5:** Mean total phosphorus (µg/L), weighted by month, for offshore sites in each basin of Lake Erie, 1999–2024. The East Basin is separated into nearshore and offshore. Shaded areas represent the trophic class ranges.

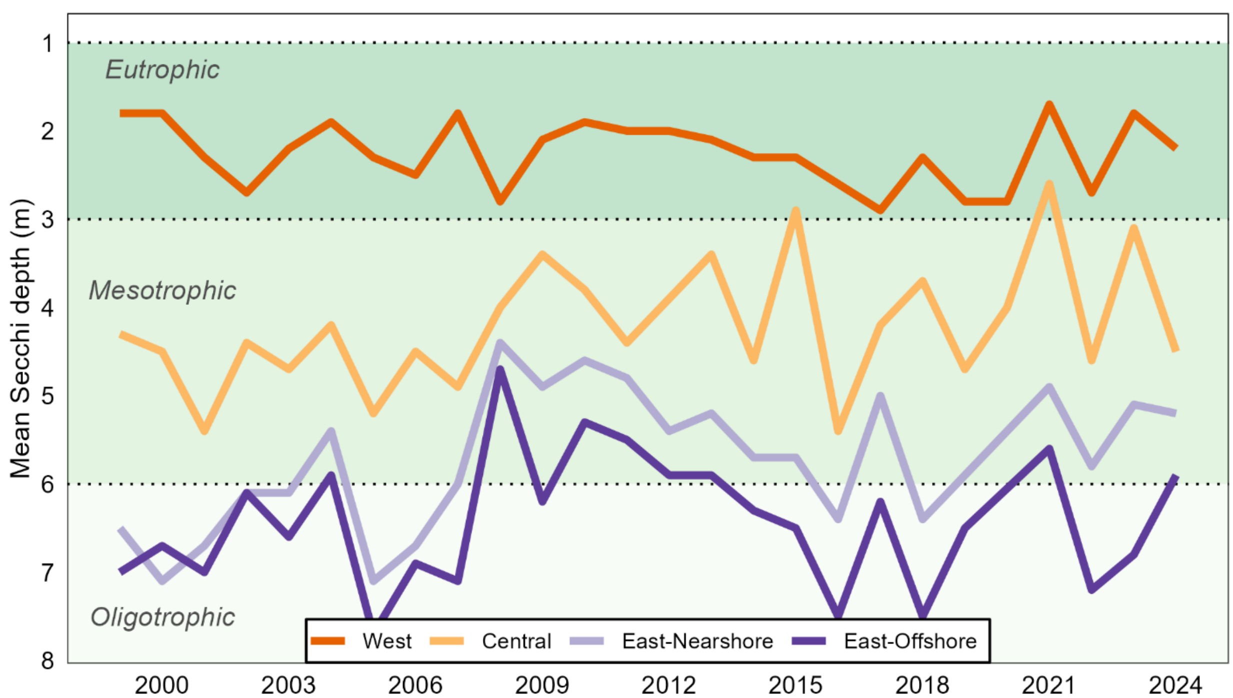



**Figure 1.0.6:** Mean summer (June–August) Secchi depth (m), weighted by month in each basin of Lake Erie, 1999–2024. The East Basin is separated into nearshore and offshore. Shaded areas represent the trophic class ranges.

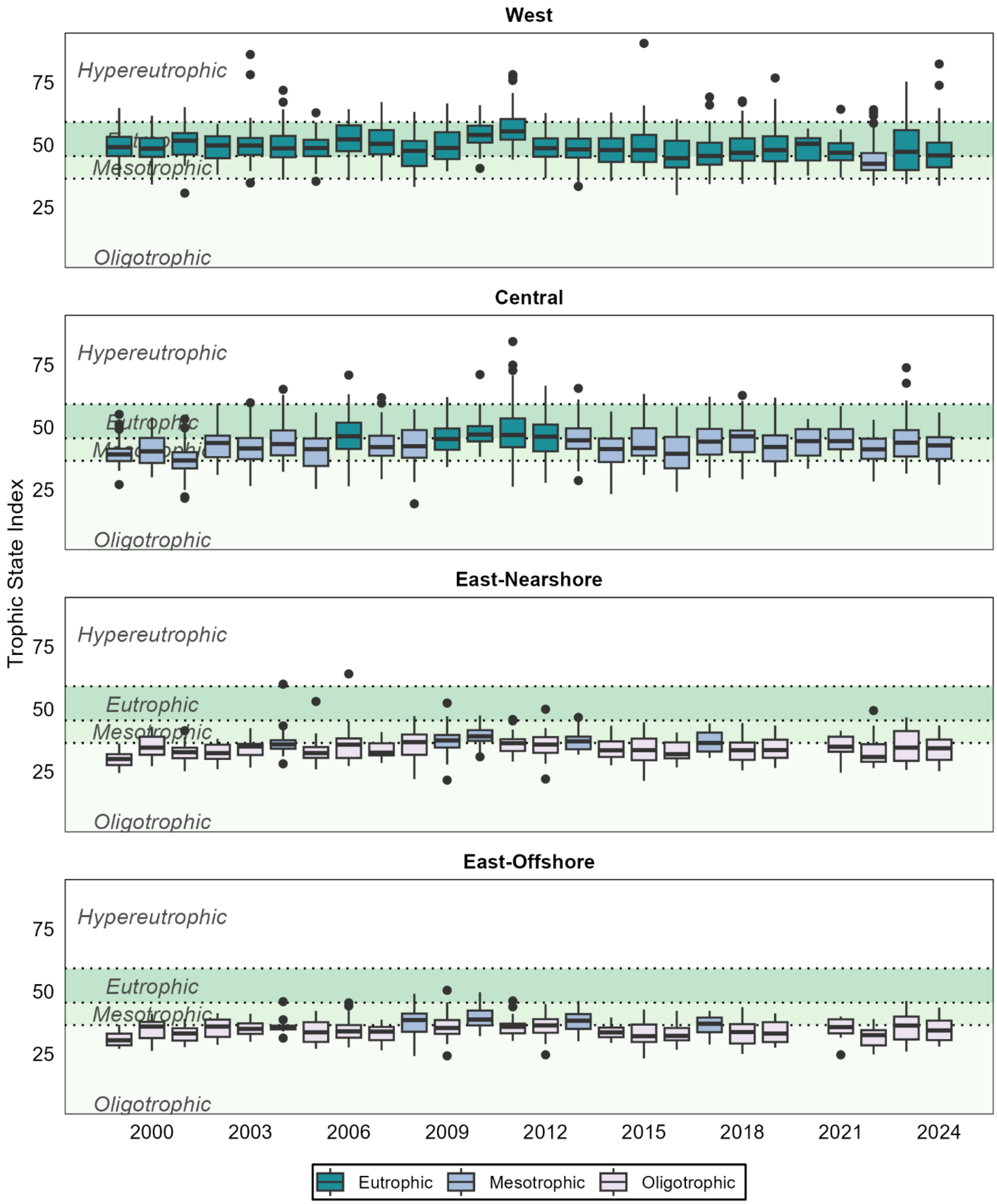



**Figure 1.0.7:** Box and whisker plot of trophic state indices by basin in Lake Erie, 1999–2024. Shaded areas represent trophic class ranges. Boxes indicate 25th and 75th quartiles of the values with the median (thicker line). Vertical lines show the range of values with individual points representing outliers.

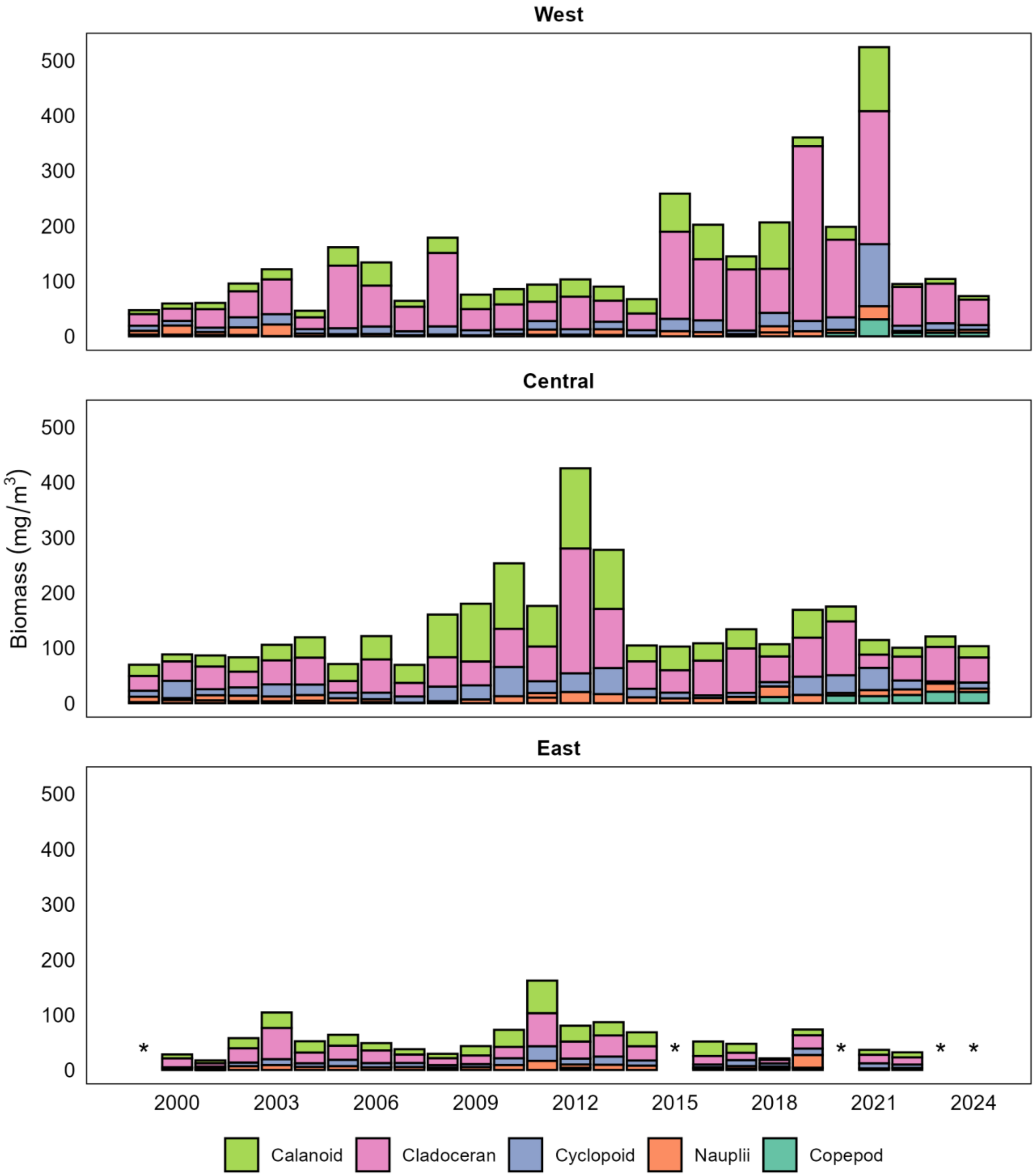



**Figure 1.0.8:** Average zooplankton biomass (mg/m$^3$) by major taxonomic group by basin, 1999-2024. Years of missing data are denoted with asterisks (*). Data excludes rotifers and veligers. Harpacticoid zooplankton comprise a miniscule biomass for most years and are not included in the graph.

**Charge 2: Describe the status and trends of forage fish in each basin of Lake Erie and evaluate alternate data sources and methods to enhance description of forage fish abundance.**

*Note: A full species list and their scientific names can be found in Appendix 1.*

**2.1: Describe forage fish abundance and status using trawl data.**

For reporting purposes, species are pooled into three or four functional groups, following Knight et al. (1984): clupeids (age-0 age classes of Gizzard Shad and Alewife), soft-rayed fish (all age classes of Rainbow Smelt, Emerald Shiner, Spottail Shiner, other leucicids, Silver Chub, Trout-Perch, and Round Goby), and spiny-rayed fish (age-0 age classes of White Perch, White Bass, Yellow Perch, Walleye and Freshwater Drum). In the Central and East basins, Rainbow Smelt are broken out of soft-rayed fish due to their importance in those basins. Total forage is calculated by summing these functional groups.

**2.1.1 East Basin Status of Forage** (J. Ludwig, A. Bonsall, M. Hosack)

Forage fish abundance and distribution is determined primarily from long-term bottom trawl assessments conducted by the basin agencies (also see East Basin Hydroacoustic Survey, Section 3.1). In 2024, a total of 34 trawl tows were sampled across New York waters and 110 trawl tows in the nearshore (n = 70) and offshore (n = 40) waters of Long Point Bay in Ontario (Figure 2.1.1.1). Pennsylvania intended to trawl in 2024 using the USGS R/V *Muskie*, but boat mechanical issues and scheduling conflicts prevented sampling.

In 2024, overall forage fish densities were below time series averages in New York and offshore Ontario waters, although Ontario densities showed a notable increase from 2023 (Figure 2.1.1.2). Despite this lower abundance, total forage biomass (26.1 kg/ha) was fourth highest in the time-series in New York. Rainbow Smelt is typically the most abundant forage species in most years and jurisdictions. In 2024, Rainbow Smelt catches were evenly split between age-0 and age-1+ individuals in New York, but overall abundance was minimal. The age-0 index in New York was the fourth lowest abundance in the time series. In Ontario, catches were primarily composed of age-0 individuals with low densities of age-1+ Rainbow Smelt. Age-1+ Emerald Shiner catches were again low in 2024 in all surveys and age-0 Emerald Shiner abundance in New York was the fifth lowest in the time series. Emerald Shiner catches in the Ontario were considered low overall. Round Goby, an important species in the East Basin forage fish community since it appeared in the late 1990s, peaked in the mid-2000s and have since generally remained at a lower but stable abundance in all jurisdictions. The abundance of Round Goby remained below average in New York in 2024 but was slightly above average in Ontario. Clupeid (Gizzard Shad, Alewife) abundance was the highest in the New York time series and the second highest in the Ontario time series, accounting for most of the increase in overall fish densities in both surveys. Age-0 Alewife accounted for 94% of all Clupeid abundance in New York and 99% in Ontario. New York also recorded its fourth highest abundance of age-0 Lake Whitefish in their time series in 2024 but below average catches of age-1 Yellow Perch. Catches of age-0 and age-1 Yellow Perch in offshore Ontario waters were below average in 2024. Catches of most other species were low in 2024, although Trout-perch increased in Ontario waters.

### 2.1.2 **Central Basin Status of Forage** (P. Jenkins, M. Hosack)

Central basin bottom trawl surveys to assess age-0 percid and forage fish abundance and distributions began in Pennsylvania in 1982 and in Ohio in 1990. Trawl locations in Pennsylvania range from 13 to 24 m in depth and Ohio trawl locations range from 5 to >20 m in depth (Figure 2.1.2.1). Ohio covers the area from Lorain, Ohio to the Pennsylvania state line. Methods for this survey can be found in the Appendix of the ODNR Lake Erie Data Report (Ohio Division of Wildlife 2024). The Pennsylvania survey covers the area from the Pennsylvania state line to Erie. In 2024, 47 trawl tows were completed in Ohio. Pennsylvania intended to trawl in 2024 using the USGS R/V *Muskie*, but boat mechanical issues and scheduling conflicts prevented sampling. Ontario began bottom trawling the Central Basin in 2016 and data from this program will be included in future Forage Task Group reports.

Overall, Central Basin forage abundance was low in Ohio waters. Rainbow Smelt densities decreased in 2024 (Figure 2.1.2.2). The density of spiny-rayed fishes decreased by 9% relative to the 2023 density. Clupeid density stayed very similar to 2023. Other soft-rayed fish density increased 287% relative to their 2023 density. Age-0 and age-1 Yellow Perch densities increased in 2024 relative to 2023 but continue to be some of the lowest in the time series. Walleye densities decreased from 2023 with age-0 being below the long term mean and age-1+ continuing to be high relative to the long-term mean.

### 2.1.3 **West Basin Status of Forage - Interagency** (Z. Slagle)

*Background*

Annual interagency bottom trawling has been conducted in August within the Ontario and Ohio waters of the West Basin, Lake Erie since 1987, though missing effort data from 1987 has resulted in the use of data since 1988. In 2003, an interagency trawl comparison exercise was conducted that allows catches to be standardized across vessels using Fishing Power Correction (FPC) factors and basin-wide estimates to be calculated (Tyson et al. 2006; FTG 2001, 2017). To estimate forage abundance, species are first enumerated by age class in each trawl based on total length. Trawls are then filtered to remove catches where the trawl net was damaged or hung on the bottom. Since 2009, trawls beginning with bottom dissolved oxygen <2.0 mg/L have also been removed as an “interim policy” to deal with hypoxia (FTG 2012). Catches are then divided by area fished (square metres of bottom, calculated by multiplying vessel-specific wing widths from SCANMAR estimates and GPS-measured distance travelled while trawling with the net assumed to be on bottom) to yield catch/m$^2$ (catch per effort, CPE). Arithmetic mean CPE is then converted to hectares and averaged by depth (0–6 m and >6m) and country (US/CAN) strata. CPE by strata are multiplied by strata areas and summed to yield a basin-wide total abundance and are then divided by total basin area to yield basin-wide catch per hectare.

To estimate species biomass, a similar process to abundance calculation is conducted. On deck, a minimum of 30 fish by species and age class are measured for total length. In summary calculations, a length for each unmeasured fish is randomly drawn from a normal distribution with mean and standard deviation calculated from the measured fish within the specific trawl-species-age class combination. Biomass (in grams) is then estimated for each fish (measured and unmeasured) by applying a species-age-class specific length-weight regression generated from historical data.

*2024 Results*

In 2024, hypolimnetic dissolved oxygen levels were not below the 2.0 mg/L threshold (i.e., hypoxic) at any sites during the August trawling survey. Two sites were excluded due to net snags. In total, data from 73 sites were used in 2024, which is up from 71 in 2023 (Figure 2.1.3.1).

Total forage density in 2024 was similar to last year and has been relatively constant for seven years (Figure 2.1.3.2; Table 2.1.3.1; note that the 2021 high abundance was likely influenced by a hypoxia-induced outlier catch of forage fishes). Spiny-rayed density increased 4% from 2023. Soft-rayed species abundance dropped 31%. Clupeid density nearly doubled from 2023. Total forage density averaged 3,108 fish/ha across the West Basin, which is 29% below the ten-year mean (4,365 fish/ha). Clupeid density was 188 fish/ha (ten-year mean 647 fish/ha), soft-rayed fish density was 281 fish/ha (mean 227 fish/ha), and spiny-rayed fish density was 2,638 fish/ha (mean 3,491 fish/ha). Age-0 White Perch (61%), Yellow Perch (22%), Gizzard Shad (5%), and Trout-perch (4%) made up the majority of forage fish abundance.

Total forage biomass (13.9 kg/ha; Figure 2.1.3.3) slightly fell from 2023 (14.9 kg/ha). Spiny-rayed prey biomass (11.3 kg/ha) declined 12% from the previous year. Soft-rayed forage increased somewhat (1.5 kg/ha), while clupeid biomass increased 43% (1.1 kg/ha) but was still below the ten-year mean of 4.0 kg/ha. Biomass of Age-0 White Perch (8.2 kg/ha) was near the ten-year mean (9.6 kg/ha), while Yellow Perch biomass (2.0 kg/ha) was at the ten-year mean. Age-0 Gizzard Shad biomass (1.0 kg/ha) was similar to recent years.

Recruitment of individual species remains highly variable in the West Basin (Table 2.1.3.2). Age-0 Walleye density in 2024 (19/ha) was well below the ten-year mean (118/ha; Figure 2.1.3.4). Age-0 Yellow Perch density (673/ha; Figure 2.1.3.4) was above the ten-year mean (629/ha). Age-0 White Perch density (1,889/ha) was below the ten-year mean (2,578/ha) in 2023 (Figure 2.1.3.5). Age-0 Gizzard Shad density (141/ha) remained below the ten-year mean (647/ha), continuing a trend of low abundance (Figure 2.1.3.5). Densities of age-0 (0.7/ha) and age-1+ Emerald Shiners (0/ha) were again nearly non-existent, with minimal densities for nine straight years (Figure 2.1.3.6). Round Goby (all ages) increased in density (20/ha). Age-0 Alewife density (47/ha) was the greatest since 2002. Age-1+ Silver Chub (27/ha), age-0 Spottail Shiner (27/ha), and age-1+ Mimic Shiner (0.6/ha) were the remaining species with large proportional increases from 2023.

### 2.1.4 West Basin Status of Forage – Michigan (J.-M. Hessenauer)

Michigan initiated a trawling program to assess the forage and age-0 sportfish community in Michigan waters of Lake Erie in August of 2014. This assessment samples eight two-minute index grids for one five- or ten-minute tow, typically sampling an area of approximately 0.2–0.4 ha depending on tow time. Our otter trawl has a 10-meter head rope and 9.5-mm terminal mesh and is deployed with a single warp and 45.7-meter bridle. In 2024, all eight sites (Figure 2.1.3.1) were sampled on August 5$^{th}$ and 8$^{th}$, 2024. Additionally, information on the consumption of forage species is obtained by sampling the diets of adult Walleye captured as part of the trawl survey as well as our annual gill net survey. Our gill net survey occurred from September 30$^{th}$ to October 2$^{nd}$, 2024.

The 2024 trawl survey captured 2,621 foraged sized individual per ha trawled, up just over 7% from 2023 (Figure 2.1.4.1; Table 2.1.4.1). Age-0 White Perch (1,628 per ha trawled) and age-0 Yellow Perch (400 per ha trawled) were the two most abundant species in the catch (Tables 2.1.4.1 & 2.1.4.2); both were up slightly from 2023. White Perch were up about 5% year over year from 2023, and Yellow Perch were up about 3% compared with 2023. Spottail Shiner catch decreased about 16% from 2023, but remained over 141% higher than the survey average, and 2024 represented the second highest catch of Spottail Shiners in our time series. Gizzard Shad catch was up nearly 21% from 2023, though slightly below (about 3%) the 2014–2023 series average. Silver Chub were observed, for the second year in a row, at the highest rate of our survey (39 per ha trawled in 2024). Silver Chub catch per ha was up just under 13% from 2023 and 318% from the 2014–2023 mean. We observed a sharp increase in Round Goby catch rates, up 437% from 2023 and 27.7% from the long-term time series. Age-0 Walleye catch was 11.9 fish per hectare, down 53% from 2023 and 54% below the 2014–2023 mean (Table 2.1.4.2).

**2.2: Report on the use of forage fish in the diets of selected commercially or recreationally important Lake Erie predator fish.**

### 2.2.1 Black Bass

*West and Central Basin – Ohio* (Z. Slagle)

Smallmouth Bass diet percent occurrence (n = 214) in 2024 was dominated by Round Goby (94%), which is typical for the species (Figure 2.2.1.1). Gizzard Shad (4%) made up much of the remainder of gut contents. These data come from the ODNR Smallmouth Bass gill-net survey (September of each year in West and Central basins).

Largemouth Bass diets (n = 28) are more varied than Smallmouth Bass, with eight distinct prey species identified in 2024 (Figure 2.2.1.2). Gizzard Shad (46%) made up the majority of stomach contents by percent occurrence, but Round Goby (29%) and crayfish (infraorder Astacidea; 7%) also made significant contributions. A snake was also identified for the first time in a Largemouth Bass diet. These data come from the ODNR nearshore electrofishing survey (June–August of each year in West and Central basins). However, for this report, only West Basin data were available. Methods for both surveys can be found in the Appendix of the ODNR Lake Erie Data Report (Ohio Division of Wildlife 2024).

*Central and East Basin – Pennsylvania* (M. Hosack)

Round Goby are the primary prey species in Smallmouth Bass stomachs examined from Pennsylvania waters from late May through mid-September from 2000–2024 (n = 490), observed in 10% of samples on average. A total of seven prey species were observed, including six fish species (Round Goby, Sculpin spp., White Perch, White Bass, Rainbow Smelt, and Yellow Perch) and one invertebrate (Crayfish spp.). The percent of empty stomachs has averaged 37% over the time series. For 2024, a total of 16 Smallmouth Bass were examined. Round Goby occurred in 6% of the samples. Fully digested remains were observed in 69% of stomachs, unidentifiable fish were observed in 25%, and 6% of observed stomachs were empty.

### 2.2.2 Lake Trout

*East Basin – New York* (J. Ludwig)

Lake Trout diet information was collected from fish caught during August 2024 (n = 179) in the interagency cold-water gill net assessment surveys in the East Basin of Lake Erie. Rainbow Smelt have traditionally been the main prey item for Lake Trout, typically comprising 80–90% of Lake Trout diet items. Round Goby became a common prey item since they invaded the East Basin of Lake Erie in the early 2000s and in years of lower adult Rainbow Smelt abundance, Lake Trout prey more on Round Goby. In 2024, Rainbow Smelt were again the prominent prey fish for Lake Trout, occurring in 78.4% of the non-empty stomachs. However, Alewife was the next most common diet item (23.9%) followed by Round Goby (21.6%; Figure 2.2.2.1).

*East Basin – Pennsylvania* (M. Hosack)

Rainbow Smelt are the primary prey species in Lake Trout stomachs examined from Pennsylvania waters from late May through mid-September of 2000–2024 (n = 1,154), observed in 42% of samples on average. A total of eight prey species were observed, including Rainbow Smelt, Round Goby, Alewife, Yellow Perch, Rock Bass, White Perch, White Bass, and Walleye. The percent of empty stomachs has averaged 22% over the time series. For 2024, a total of 68 Lake Trout were examined. Rainbow Smelt occurred in 47% of the samples. Twenty-one percent of examined stomachs were empty, 13% contained unidentifiable fish, 9% contained fully digested remains, and 6% of observed stomachs were empty.

### 2.2.3 Walleye

*West Basin – Michigan* (J.-M. Hessenauer)

During August trawls, 46% of Walleye sampled had stomach contents (Table 2.2.3.1). Digested liquid (38%) was the most abundant diet item followed by unidentifiable fish remains (33%) and White Perch (21%). During the October gillnet survey, 57% of sampled Walleye contained food items (Table 2.2.3.2). Digested liquid was the most abundant diet item (41%), followed by Gizzard Shad (40%).

*West and Central Basin – Ohio* (Z. Slagle)

Walleye diets in the fall of 2024 were comprised mostly of Gizzard Shad (59%), typical for the time of year (Figure 2.2.3.1). However, Alewife (11%) appeared in Walleye diets for the first time in this time series. Unidentified clupeids (10%; Gizzard Shad or Alewife), Rainbow Smelt (7%), and Round Goby (7%) made up much of the remainder. A total of 131 Walleye stomachs with contents were examined; empty stomachs were excluded from the analysis. These data come from the ODNR fall gill-net survey (September–October of each year in West and Central basins). Methods can be found in the Appendix of the ODNR Lake Erie Data Report (Ohio Division of Wildlife 2024).

*Central and East Basin – Pennsylvania* (M. Hosack)

Walleye stomachs examined (n = 400) from Pennsylvania waters from late May through mid-September of 2024 contained fully digested remains (68.3% of examined stomachs), invertebrates (16.5%), fish (8.1%), and 14.6% were empty. Round Goby, found in 2% of examined stomachs, were the most commonly observed fish species observed in PA

Walleye diets. Zooplankton were observed in 15% of examined stomachs. These data represent observed percent occurrence in examined stomachs.

*East Basin – New York* (J. Ludwig)

Beginning in 1993, annual summertime (June–August) visits were made to fish cleaning stations by the NYSDEC to gather stomach content information from angler-caught Walleye in the New York waters of Lake Erie. In 2024, 307 Walleye stomachs were examined of which only 80 (26.1%) contained food remains (Wilkins 2025). Angler-caught adult Walleye diets were dominated by volume by Round Goby (45.1%) followed by Rainbow Smelt (40.6%; Figure 2.2.3.2). No Yellow Perch were found in the diet in 2024. Also of note was the presence of zooplankton in Walleye stomachs (2% by volume) which was a rare occurrence but has been present for the past eight years.

### 2.2.4 Yellow Perch

*Central Basin – Ohio* (Z. Slagle)

Yellow Perch stomach content data was unavailable in time for this report.

## 2.3: Describe growth and condition of selected commercially or recreationally important Lake Erie predator fish

### 2.3.1 East Basin Predator Growth and Condition (J. Ludwig)

*Walleye and Yellow Perch*

Walleye length at age-1 and age-2 from netting surveys targeting juveniles in New York has declined for the past eight years. Growth for both age-1 and age-2 Walleye decreased in 2024 and remained 15 and 32 mm below the long-term average length, respectively. Age-1 and age-2 length in 2024 ranked ninth and third lowest, respectively, in the 44-year time series (Ludwig 2025). Age-0 and age-1 Yellow Perch sampled in fall trawl surveys in New York have exhibited stable growth rates since 2006. In 2024, age-0 Yellow Perch mean length equaled the time series average of 81 mm while age-1 Yellow Perch mean length (132 mm) was slightly below the time series average (140 mm; Wilkins and Ludwig 2025).

Adult Walleye condition in the New York waters of Lake Erie had generally been trending down over the last decade. In 2024, the relative weight of the average 18–24 inch Walleye was 81, slightly below the time series average of 84 (Figure 2.3.1.1). Decreasing weight at length may indicate a lack of suitable forage in recent years, especially Rainbow Smelt, and increasing predator demand.

*Lake Trout*

Adult Lake Trout (age-5) condition in the East Basin of Lake Erie has generally remained stable over the past 10 years (Figure 2.3.1.2). In 2024, age-5 Lake Trout mean length was 689 mm and mean weight was 4010 g. Mean length and weight have been slightly increasing over the last five years since low values in 2019, consistent with changes in forage availability.

**2.3.2 West and Central Basin Predator Growth and Condition** (Z. Slagle)

*Age-0 Sportfishes*

Overall, mean lengths of age-0 sport fishes from the West Basin interagency trawl in 2024 were similar to or greater than 2023 (Figure 2.3.2.1). Lengths of select age-0 species in 2024 include Walleye (126 mm), Yellow Perch (69 mm), White Bass (88 mm), and White Perch (66 mm). Walleye average length has increased four straight years from the time series low (101 mm in 2020). Age-0 White Bass average length was the greatest since 1991. Age-0 White Perch and Yellow Perch lengths were near ten-year averages (64 mm and 68 mm, respectively).

*Walleye*

Walleye total length at age-2 through age-4 again declined in 2024, returning to a declining trend since ~2019 (Figure 2.3.2.2). Length at age-2 (377 mm) and age-3 (428 mm) remain below the ten-year means (410 mm and 467 mm, respectively), while length at age-4 (477 mm) was closer to the ten-year mean (494 mm). Length-at-age data come from the ODNR fall gill-net survey (September–October of each year in West and Central basins). Methods can be found in the Appendix of the ODNR Lake Erie Data Report (Ohio Division of Wildlife 2024).

*Black Bass*

Black bass (Micropterus spp.) total lengths at age-3 exhibit different patterns depending on the species (Figure 2.3.2.3). Smallmouth Bass length at age-3 has been relatively stable for over ten years; in 2024, mean total length at age-3 was 378 mm (n = 22). Largemouth Bass length at age-3 has varied widely for the nine years of data collection, with an age-3 mean total length in 2024 of 334 mm (n = 15). Length-at-age data come from two sources: the ODNR Smallmouth Bass gill-net survey (September of each year in West and Central basins) and the ODNR nearshore electrofishing survey (June–August of each year in West and Central basins). Methods can be found in the Appendix of the ODNR Lake Erie Data Report (Ohio Division of Wildlife 2024).

**2.3.3 West Basin Predator Growth - Michigan** (J.-M. Hessenauer)

Average length of age-0 Walleye increased 12.2% from 2023 to 125 mm in 2024. Size of age-0 Walleye has been modestly increasing since 2019 and appears to correlate with catch in our trawls (Figure 2.3.3.1). Average length at ages 2, 3, and 4 for male Walleye captured during the fall gill net survey decreased 3.5%, 5.9%, and 3.6%, respectively, compared with 2023 (Figure 2.3.3.2; A). Likewise average length at age 2, 3, and 4 for female Walleye captured during the fall gill net survey decreased 3.7%, 6.2%, and 7.8%, respectively, compared with 2023 (Figure 2.3.3.2; B). Length at ages 2–4 has slowly, but steadily, declined from 2014 to 2024 for both male and female fish.

The development of this dataset will allow for the evaluation of trends in forage abundance and the recruitment of sportfish in Michigan's Lake Erie waters in future years, while contributing to a greater understanding of forage dynamics in the West Basin.

**Table 2.1.3.1**: Ten-year mean density (arithmetic mean number per hectare), 2024 density, and the percent difference between 2024 and the ten-year average for forage fish functional groups from fall trawl surveys in the West Basin Lake Erie. Data are collected by OMNR and ODNR and combined using FPC factors.

| Functional Group | Mean: 2013–2023 | 2024 | +/- |
|---|---|---|---|
| All forage species | 4365.3 | 3107.6 | -29% |
| Clupeid | 647.4 | 188.1 | -71% |
| Soft-rayed | 226.8 | 281.4 | +24% |
| Spiny-rayed | 3491.1 | 2638.2 | -24% |

**Table 2.1.3.2**: Ten-year mean density (arithmetic mean number per hectare), 2024 density, and the percent difference between 2024 and the ten-year average for selected forage species from fall trawl surveys in West Basin Lake Erie. Data are collected by OMNR and ODNR and combined using FPC factors.

| Species | Age class | Mean: 2013–2023 | 2024 | +/- |
|---|---|---|---|---|
| Emerald shiner | Age-0 | 4.4 | 0.7 | -84% |
| Emerald shiner | Ages-1+ | 23.8 | 0 | -100% |
| Freshwater drum | Age-0 | 90.5 | 45.7 | -50% |
| Gizzard shad | Age-0 | 647 | 141.2 | -78% |
| Rainbow smelt | Age-0 | 42.1 | 0.1 | -100% |
| Rainbow smelt | Ages-1+ | 0.4 | 0 | -100% |
| Round goby | All ages | 27.5 | 20.4 | -26% |
| Walleye | Age-0 | 117.8 | 19 | -84% |
| White bass | Age-0 | 75.9 | 11.2 | -85% |
| White perch | Age-0 | 2577.6 | 1889.2 | -27% |
| Yellow perch | Age-0 | 629.3 | 673.1 | +7% |

**Table 2.1.4.1:** Average density (number of fish per hectare) of select forage sized fish captured during the Michigan trawl survey. Age group for each species presented in first row. Yr/Yr% is the percent change in 2024 compared to 2023. Yr/2014–2023% is the percent change from 2024 to the 2014–2023 average.

| | White Perch | Mimic Shiner | Gizzard Shad | Trout-perch | Round Goby | Spottail Shiner | Silver Chub | Emerald Shiner | Dreissenid mussels* |
|---|---|---|---|---|---|---|---|---|---|
| Age Group/Year | YOY | All | YOY | All | All | All | All | All | All |
| 2014 | 715.5 | 5.3 | 55.4 | 25.6 | 43.4 | 54.2 | 0 | 2.1 | 0.41 |
| 2015 | 783.2 | 617.9 | 2.7 | 16.8 | 135.8 | 18.8 | 11.3 | 0 | 0.55 |
| 2016 | 448.5 | 170.6 | 11.4 | 68.8 | 19.2 | 26.6 | 0.6 | 0 | 0.81 |
| 2017 | 1,896.4 | 120.2 | 730.9 | 62.1 | 41.4 | 2.2 | 3.4 | 0 | 0.45 |
| 2018 | 8,100 | 40.1 | 259.4 | 290.4 | 58.6 | 6.3 | 5.9 | 7.2 | 0.6 |
| 2019 | 389.1 | 141.5 | 0.5 | 19 | 24.7 | 10.6 | 5.2 | 11.4 | 0.66 |
| 2020 | 1,193.8 | 53 | 15.2 | 25.4 | 125.7 | 24.2 | 21.6 | 0 | 0.68 |
| 2021 | 1,633.3 | 6 | 40.9 | 75.3 | 84.1 | 57.7 | 5.8 | 0 | 0.53 |
| 2022 | 846.5 | 6.3 | 58.2 | 60.7 | 9 | 73.8 | 4.9 | 7.9 | 0.47 |
| 2023 | 1,546.9 | 33.2 | 102.9 | 117.9 | 13.2 | 111 | 34.6 | 16.9 | 1.02 |
| 2024 | 1,628.9 | 132.1 | 124.2 | 44.4 | 70.9 | 93.1 | 39.0 | 0.50 | 0.14 |
| Yr/Yr % | 5.3 | 297.9 | 20.7 | -62.3 | 437.1 | -16.1 | 12.7 | -97.0 | -86.3 |
| Yr/ 2014–2023 % | -7.2 | 10.6 | -2.8 | -41.7 | 27.7 | 141.6 | 318.0 | -89.0 | -75.6 |

*Dreissenid mussels reported as kilograms captured per hectare trawled and are not included in the grand total catch per hectare values.

**Table 2.1.4.2**: Average density (number of fish per hectare) of select age-0 sportfish captured during the Michigan trawl survey. Yr/Yr% is the percent change in 2024 compared to 2023. Yr/2014–2023% is the percent change from 2024 to the 2014–2023 average.

| | Yellow Perch | Walleye | White Bass | Smallmouth Bass |
|---|---|---|---|---|
| 2014 | 129.5 | 0.6 | 1.2 | 5.4 |
| 2015 | 335.8 | 4.8 | 7 | 0.3 |
| 2016 | 424.4 | 3 | 8.4 | 1.9 |
| 2017 | 331.6 | 16.6 | 101.8 | 0 |
| 2018 | 1683 | 50.3 | 48.2 | 3.2 |
| 2019 | 1291 | 68.5 | 15.5 | 0 |
| 2020 | 675.2 | 31.9 | 11.4 | 59.9 |
| 2021 | 2723.5 | 25.6 | 9.3 | 14 |
| 2022 | 348.7 | 30.3 | 5.3 | 0.5 |
| 2023 | 365.2 | 25.5 | 40.9 | 2.1 |
| 2024 | 400.0 | 11.9 | 10.2 | 0.5 |
| Yr/Yr % | 3.3 | -53.3 | -75.1 | -79.2 |
| Yr/ 2014–2023 % | -50.7 | -53.7 | -59.0 | -94.3 |

**Table 2.2.3.1:** Diet composition of Walleye sampled by year during the Michigan August trawl survey. Table represents the number of fish sampled, the percent with stomach contents (% With contents), and of fish with stomach contents the percent of prey items that were Gizzard Shad (% G. Shad), White Perch (% White Perch), Mimic Shiner (%Mimic Shiner) Yellow Perch (%Yellow Perch), unidentifiable fish remains (%Unid Fish) and digested liquid (%Digested Liquid).

| Year | Fish Sampled | % With Contents | % G. Shad | % White Perch | %Mimic Shiner | %Yellow Perch | %Unid Fish | %Digested Liquid |
|---|---|---|---|---|---|---|---|---|
| 2014 | 15 | 73 | 62 | 0 | 0 | 0 | 33 | 5 |
| 2015 | 19 | 42 | 7 | 60 | 7 | 13 | 7 | 7 |
| 2016 | 86 | 64 | 17 | 9 | 0 | 7 | 53 | 14 |
| 2017 | 55 | 53 | 34 | 22 | 0 | 14 | 22 | 9 |
| 2018 | 18 | 67 | 23 | 31 | 0 | 8 | 38 | 0 |
| 2019 | 19 | 16 | 0 | 0 | 0 | 67 | 33 | 0 |
| 2020 | 54 | 43 | 8 | 4 | 0 | 0 | 79 | 8 |
| 2021 | 51 | 35 | 14 | 10 | 0 | 19 | 57 | 0 |
| 2022 | 26 | 38 | 5 | 50 | 0 | 9 | 32 | 9 |
| 2023 | 64 | 64 | 12 | 15 | 0 | 0 | 46 | 24 |
| 2024 | 46 | 46 | 0 | 21 | 4 | 0 | 33 | 38 |

**Table 2.2.3.2:** Diet composition of Walleye sampled by year during the Michigan October gill net survey. Table represents the number of fish sampled, the percent with stomach contents (%With contents), and of fish with stomach contents the percent of prey items that were Gizzard Shad (%G. Shad), White Perch (%White Perch), Emerald Shiner (%Emerald Shiner), Yellow Perch (%Yellow Perch), Round Goby (%Round Goby), unidentifiable fish remains (%Unid. Fish) and digested liquid (%Digested Liquid). Survey not completed in 2020 due to COVID-19 restrictions.

| Year | Fish Sampled | %With contents | %G. Shad | %White Perch | %Emerald Shiner | %Yellow Perch | %Round Goby | %Unid. Fish | %Digested Liquid |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 44 | 66 | 49 | 11 | 0 | 0 | 0 | 40 | 0 |
| 2008 | 322 | 83 | 24 | 0 | 17 | 0 | 0 | 25 | 34 |
| 2009 | 136 | 82 | 10 | 11 | 0 | 1 | 0 | 79 | 0 |
| 2010 | 137 | 91 | 28 | 0 | 5 | 0 | 0 | 54 | 13 |
| 2011 | 166 | 88 | 28 | 1 | 0 | 0 | 0 | 24 | 46 |
| 2012 | 223 | 96 | 19 | 1 | 1 | 0 | 0 | 78 | 0 |
| 2013 | 160 | 38 | 33 | 6 | 6 | 0 | 0 | 37 | 17 |
| 2014 | 283 | 74 | 25 | 11 | 14 | 1 | 0 | 43 | 6 |
| 2015 | 198 | 61 | 39 | 1 | 0 | 0 | 0 | 37 | 23 |
| 2016 | 482 | 63 | 38 | 17 | 1 | 1 | 0 | 35 | 9 |
| 2017 | 319 | 55 | 33 | 1 | 0 | 0 | 0 | 40 | 25 |
| 2018 | 652 | 73 | 43 | 1 | 1 | 0 | 0 | 17 | 38 |
| 2019 | 334 | 57 | 32 | 19 | 1 | 0 | 0 | 14 | 33 |
| 2020 | | | | | | | | | |
| 2021 | 295 | 60 | 42 | 9 | 0 | 7 | 0 | 17 | 24 |
| 2022 | 404 | 79 | 66 | 2 | 0 | 0 | 0 | 14 | 17 |
| 2023 | 182 | 48 | 14 | 0 | 3 | 0 | 0 | 42 | 40 |
| 2024 | 787 | 57 | 40 | 3 | 1 | 1 | 0 | 14 | 41 |

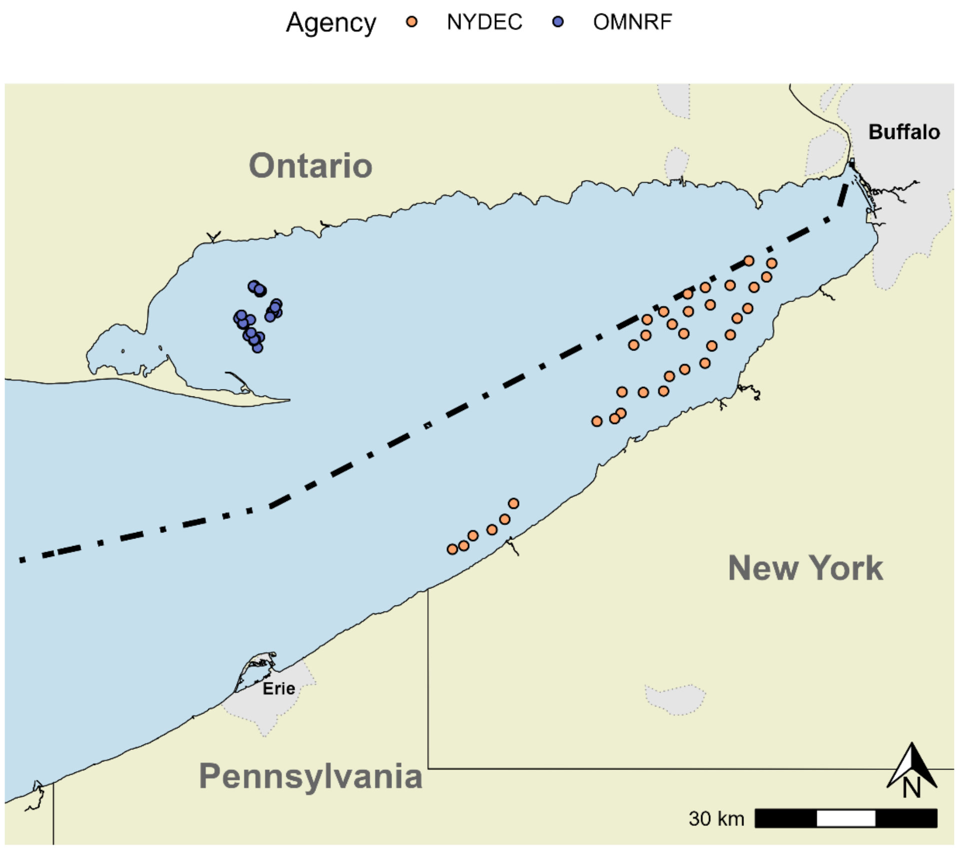



**Figure 2.1.1.1**. Locations of standard index bottom trawls by Ontario (blue) and New York (orange) to assess forage fish abundance in the East Basin of Lake Erie in 2024. Pennsylvania intended to trawl in 2024 using the USGS R/V *Muskie*, but boat mechanical issues and scheduling conflicts prevented sampling.

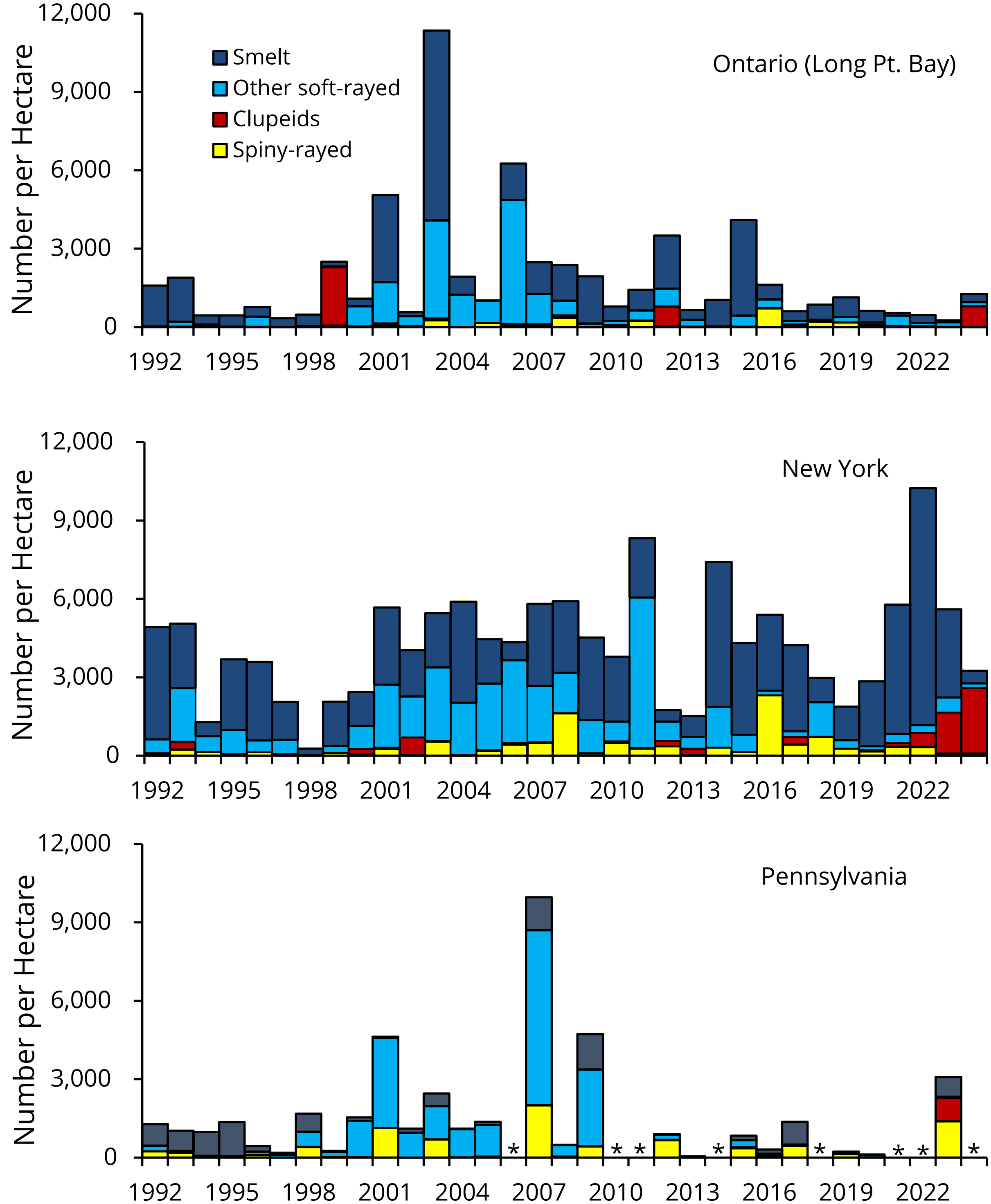



**Figure 2.1.1.2:** Mean density of prey fish (number per hectare) by functional group in the Ontario, New York, and Pennsylvania waters of the East Basin, Lake Erie, 1992-2024. Years without sampling are indicated by an asterisk (*).

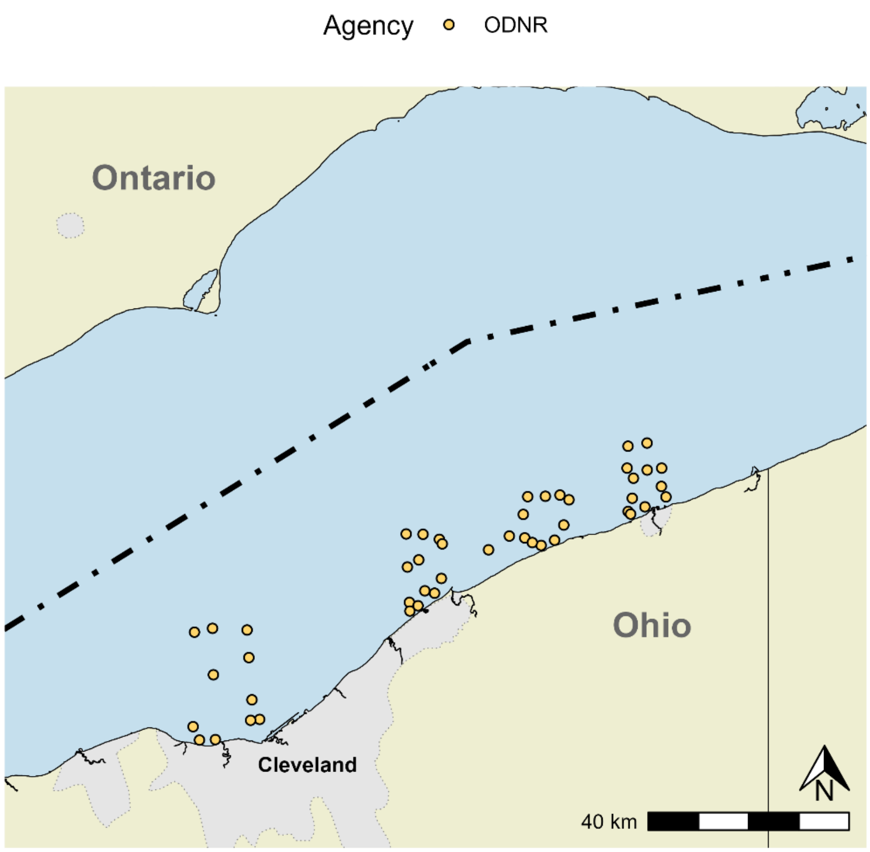



**Figure 2.1.2.1**. Locations sampled by Ohio (yellow) with index bottom trawls to assess forage fish abundance in the Central Basin, Lake Erie during 2024. Pennsylvania intended to trawl in 2024 using the USGS R/V *Muskie*, but boat mechanical issues and scheduling conflicts prevented sampling.

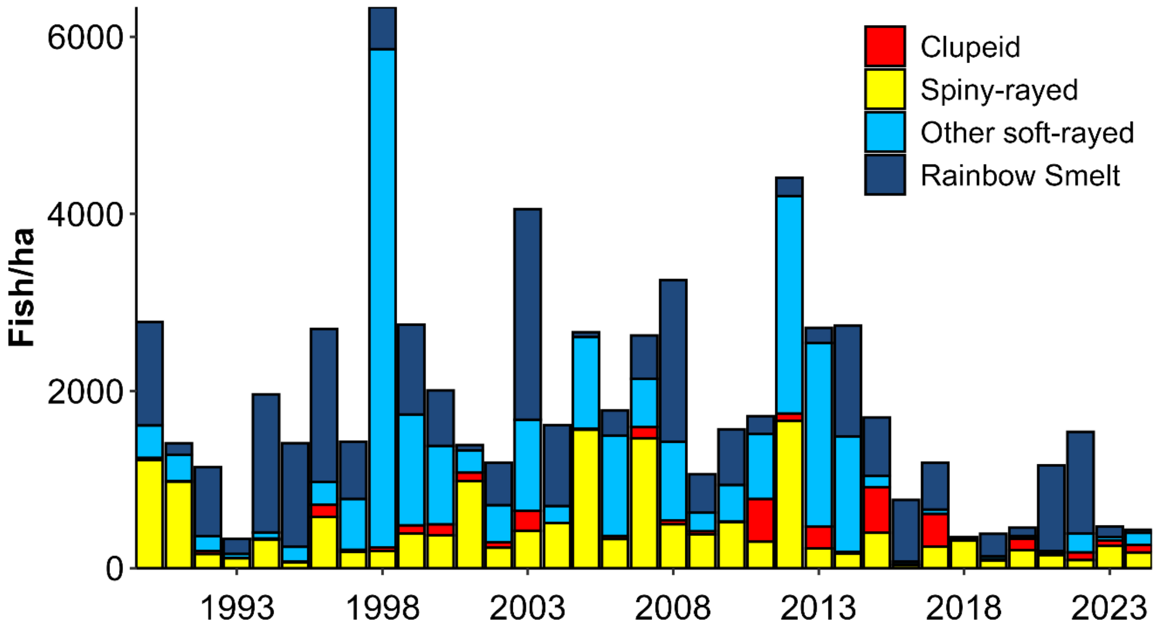



**Figure 2.1.2.2**: Mean density of prey fish (number per hectare) by functional group in Ohio waters of the Central Basin, Lake Erie, 1990–2024.

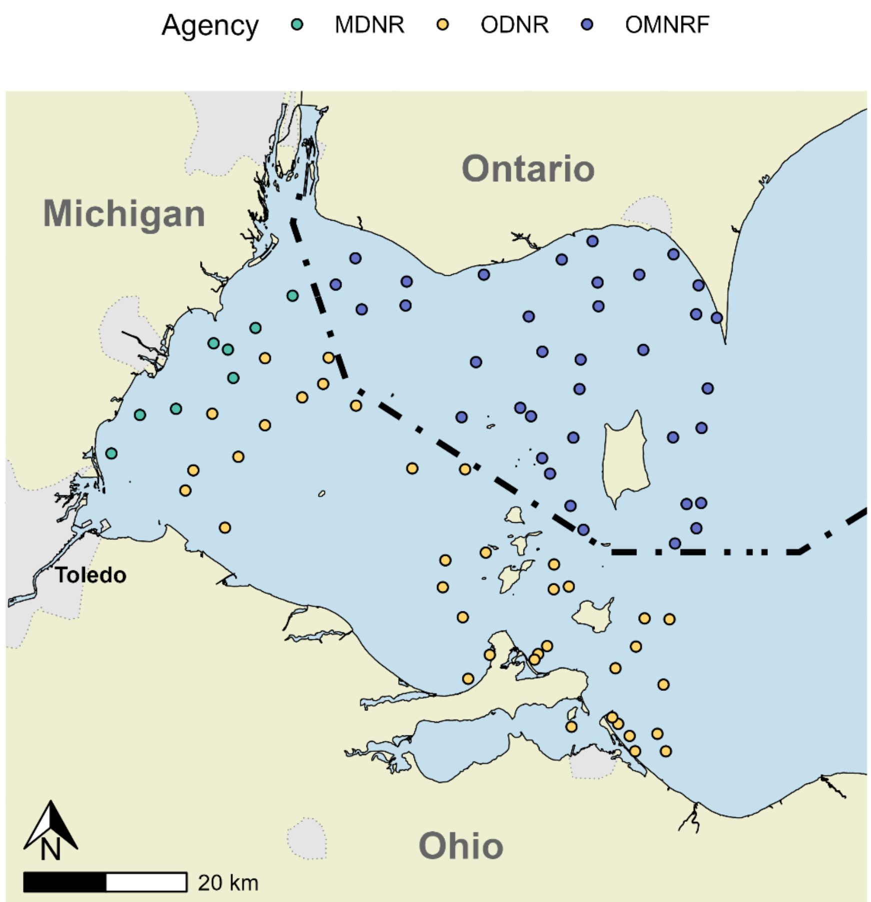



**Figure 2.1.3.1**: Trawl locations for West Basin bottom trawl surveys in 2024. Ohio (yellow) and Ontario (blue) trawls are combined to summarize the interagency indices, while Michigan (green) cannot yet be included due to lacking trawl comparison data.

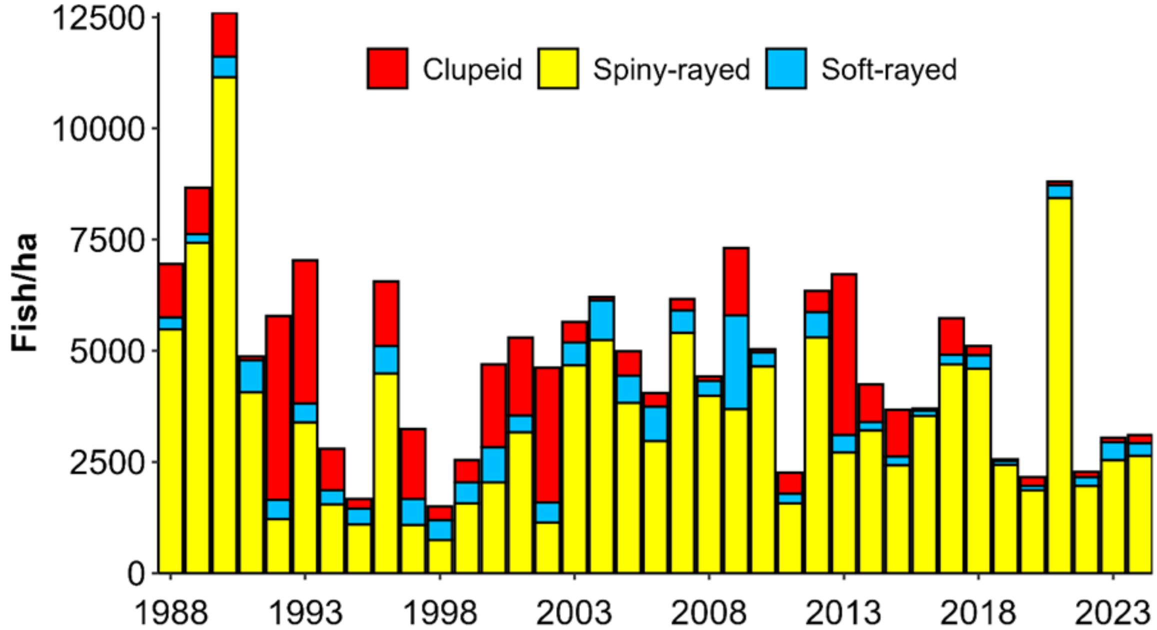



**Figure 2.1.3.2:** Mean density (number per hectare) of prey fish by functional group in the West Basin of Lake Erie, August 1988–2024

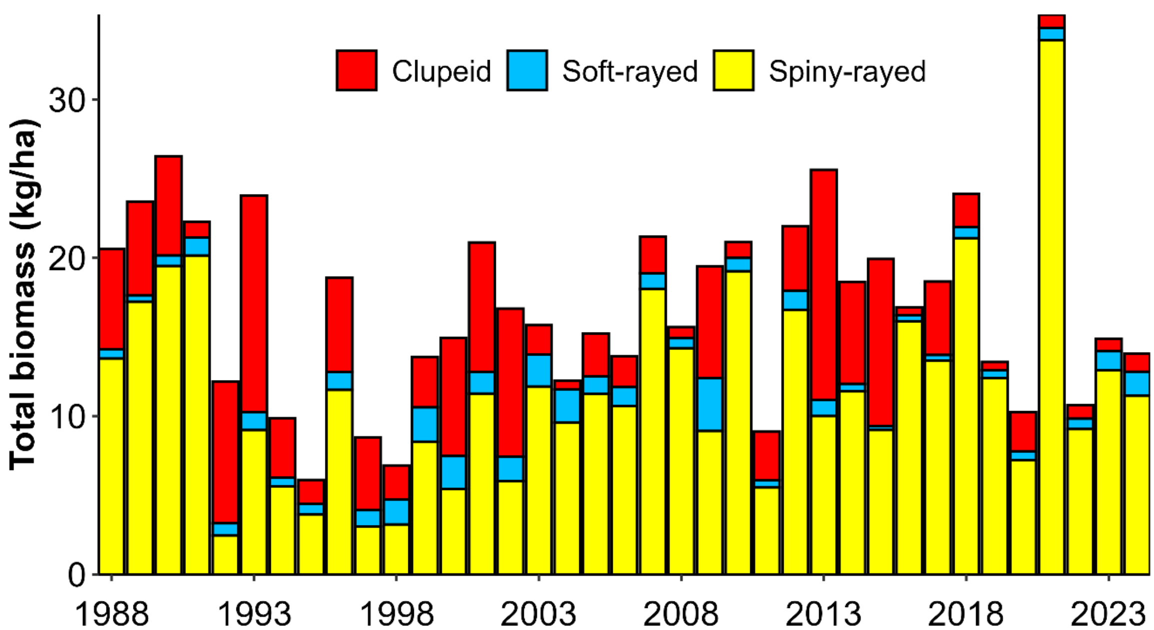



**Figure 2.1.3.3**: Mean biomass (kilograms per hectare) of prey fish by functional group in the West Basin of Lake Erie, August 1988–2024.

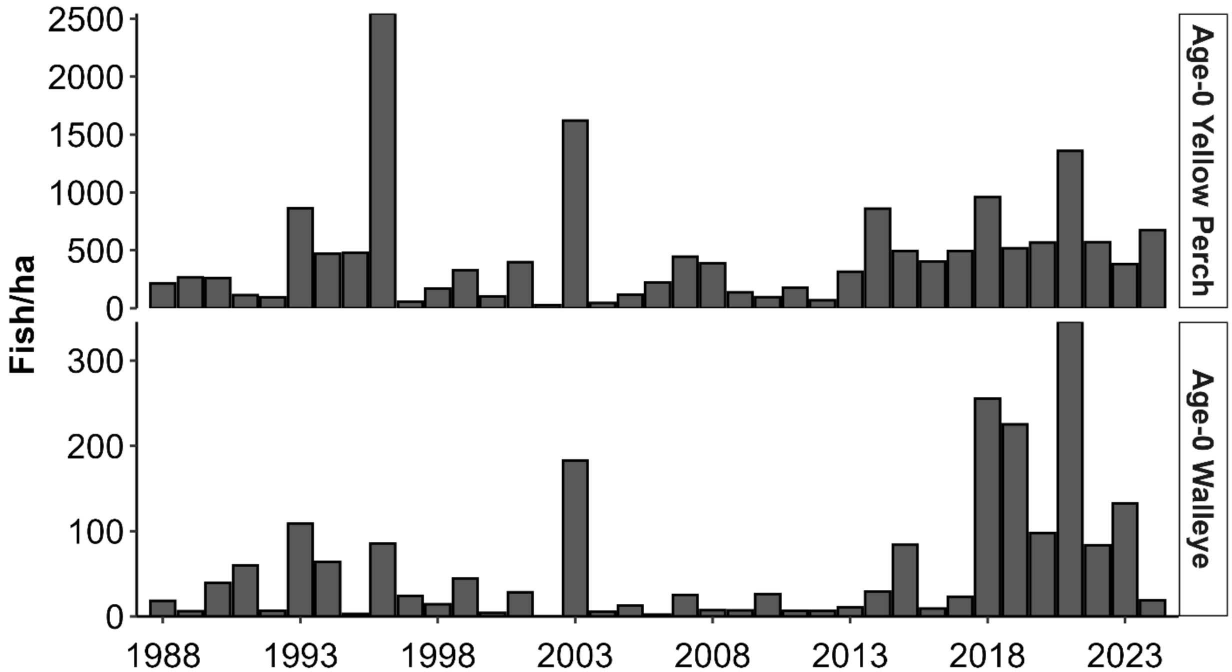



**Figure 2.1.3.4**: Densities of age-0 Yellow Perch (top) and age-0 Walleye (bottom) in the West Basin of Lake Erie, August 1988–2024. Note that the Y-axis scales differ.

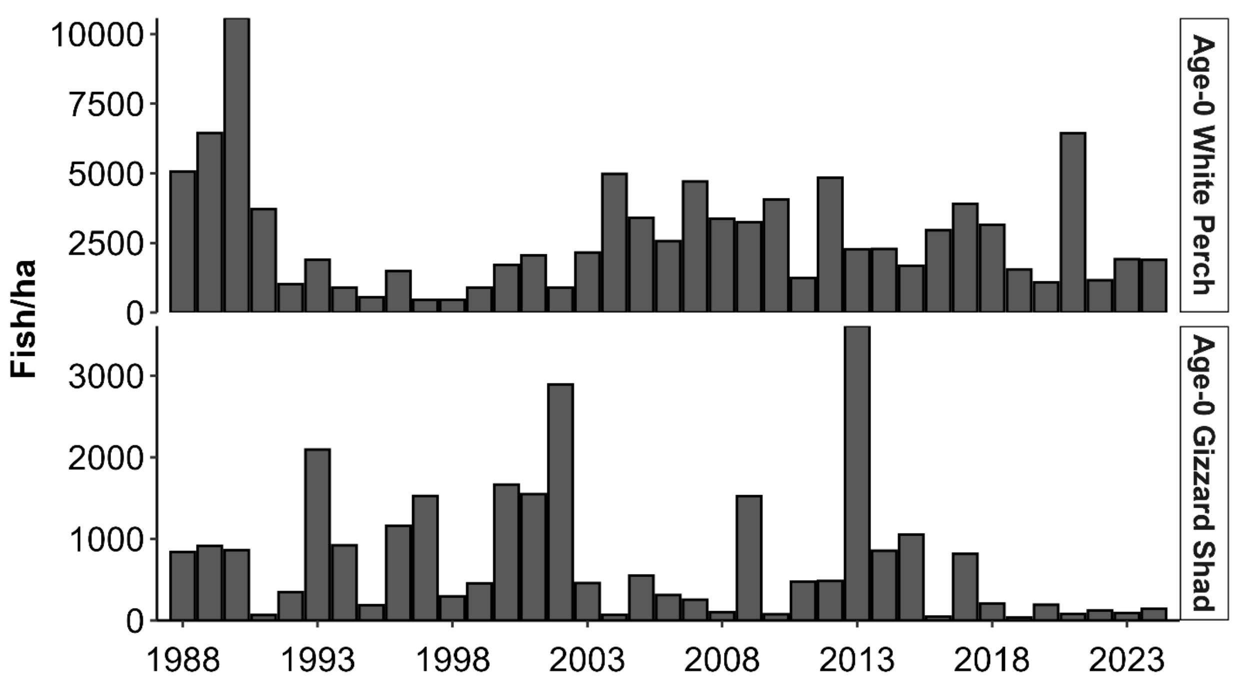



**Figure 2.1.3.5**: Densities of age-0 White Perch (top) and age-0 Gizzard Shad (bottom) in the West Basin of Lake Erie, August 1988–2024. Note that the Y-axis scales differ.

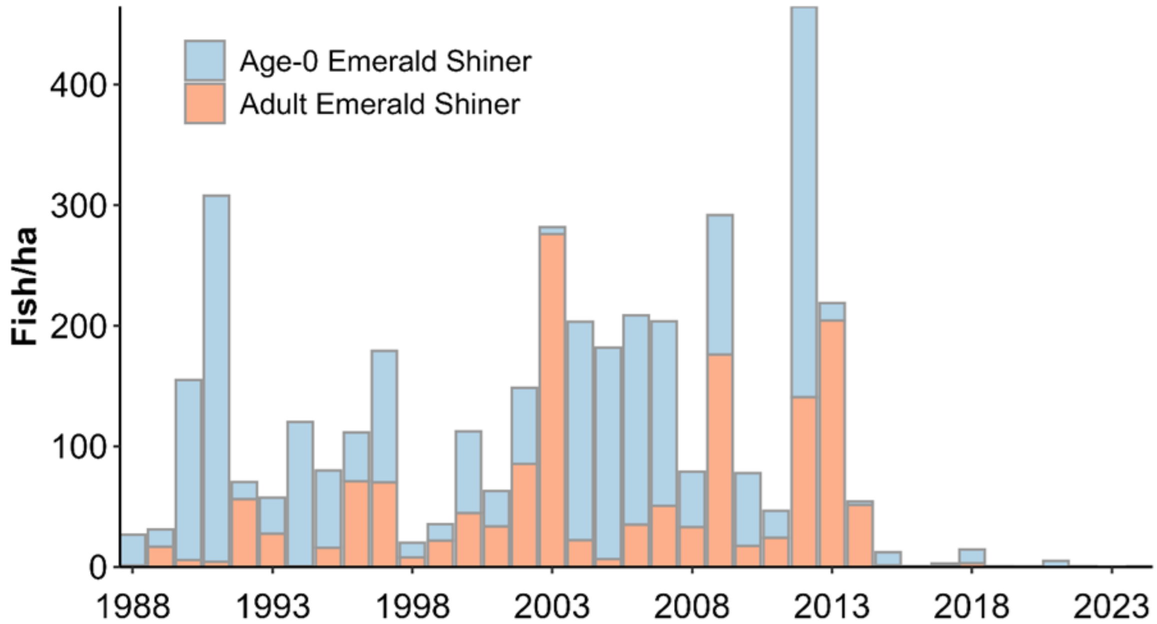



**Figure 2.1.3.6:** Densities of age-0 (blue) and age-1+ (red) Emerald Shiner in the West Basin of Lake Erie, August 1988–2024. Densities for both groups have remained minimal for eight years.

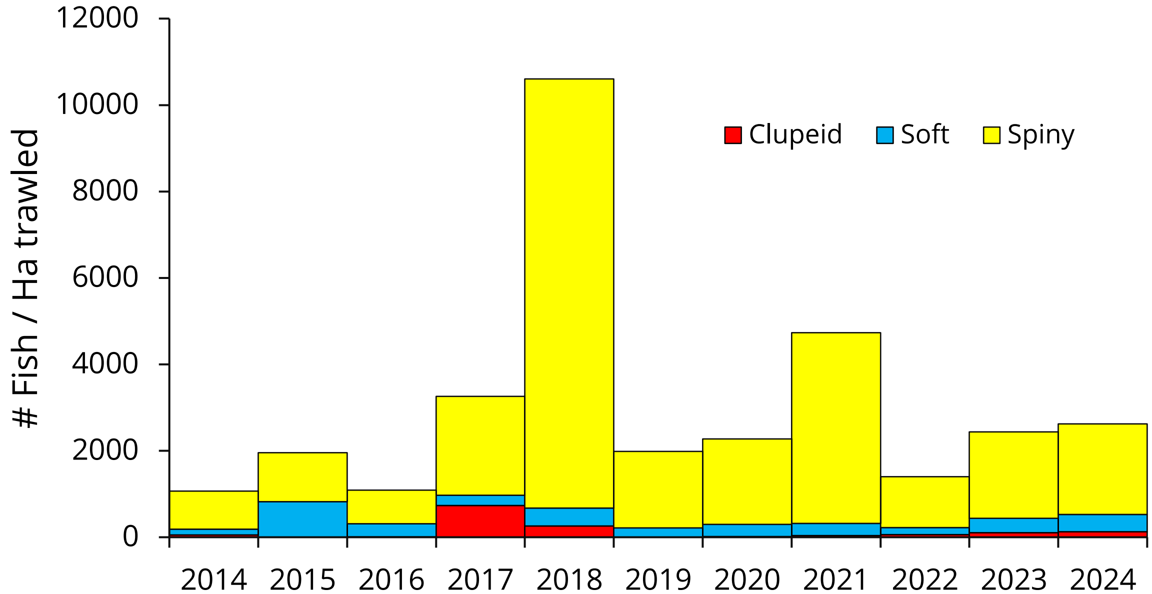



**Figure 2.1.4.1:** Mean density (number per hectare) of prey fish by functional group in Michigan waters of Lake Erie, August 2014–2024.

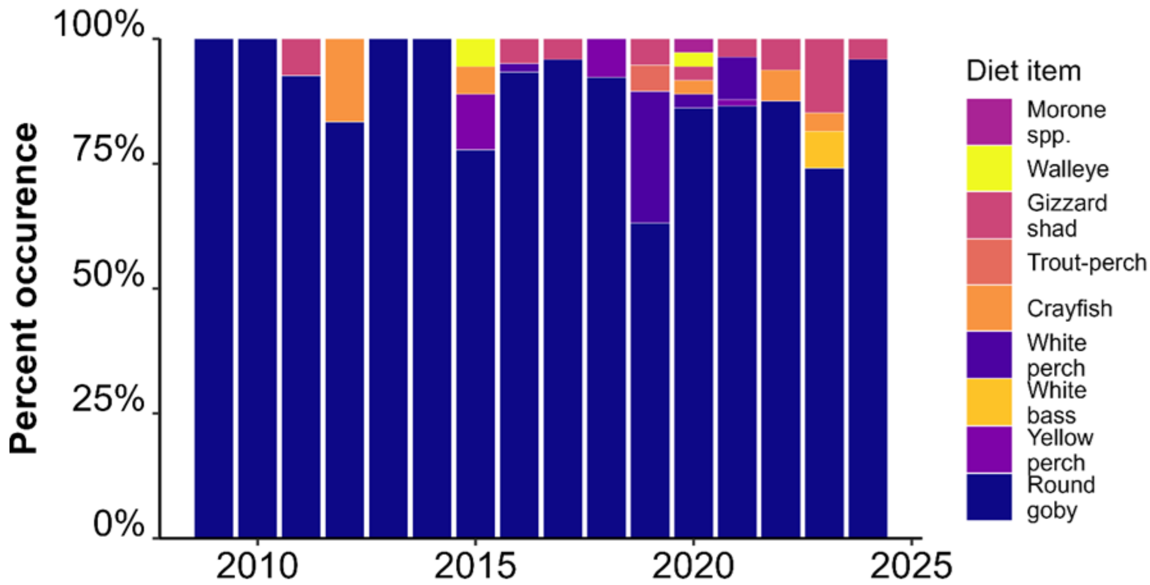



**Figure 2.2.1.1:** Percent occurrence of diet items from non-empty stomachs of Smallmouth Bass collected in West and Central Basin gill-net assessments in September 1998–2024.

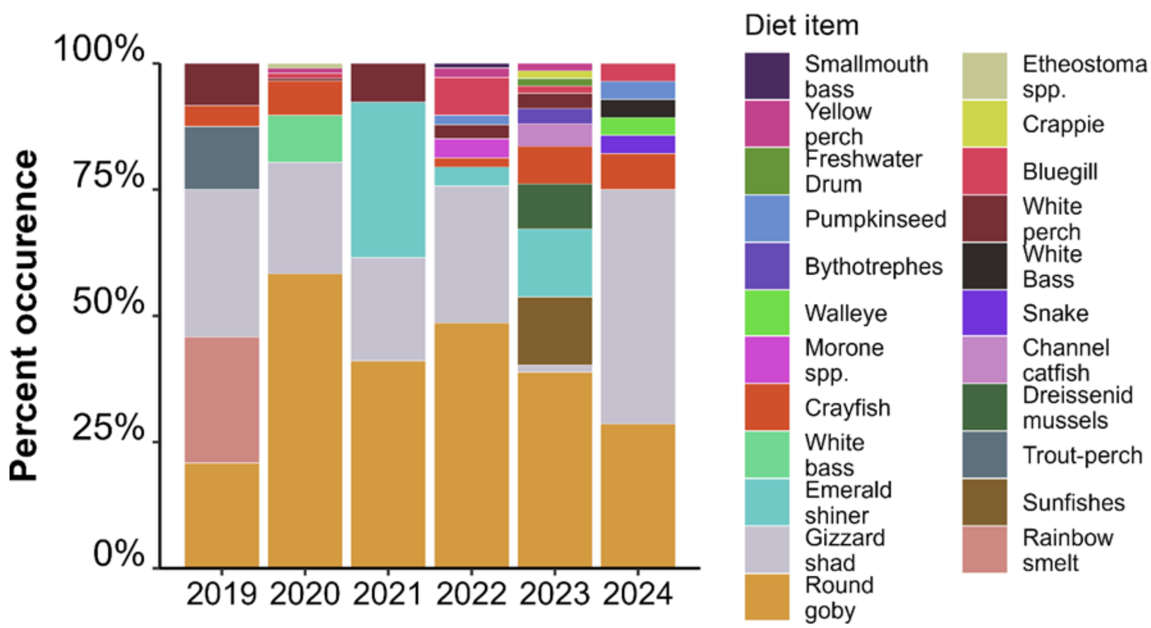



**Figure 2.2.1.2:** Percent occurrence of diet items from non-empty stomachs of Largemouth Bass collected in West and Central Basin electrofishing assessments, June–August 2019–2024.

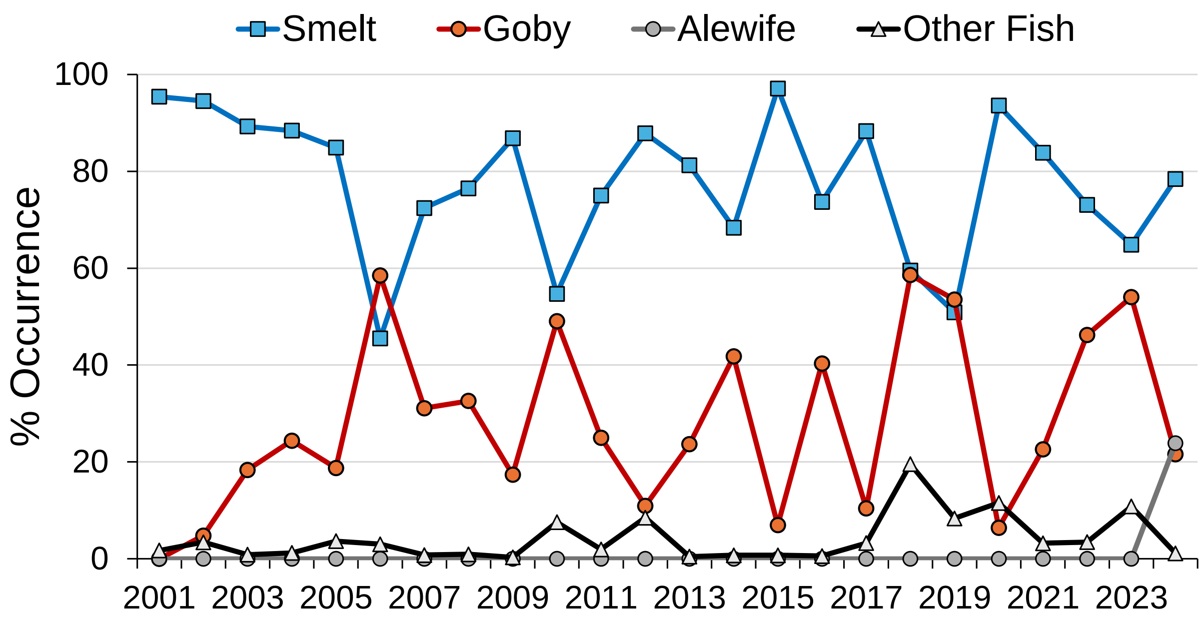



**Figure 2.2.2.1**: Percent occurrence of diet items from non-empty stomachs of lean strain Lake Trout collected from gill net assessment surveys in the East Basin of Lake Erie, August 2001-2024.

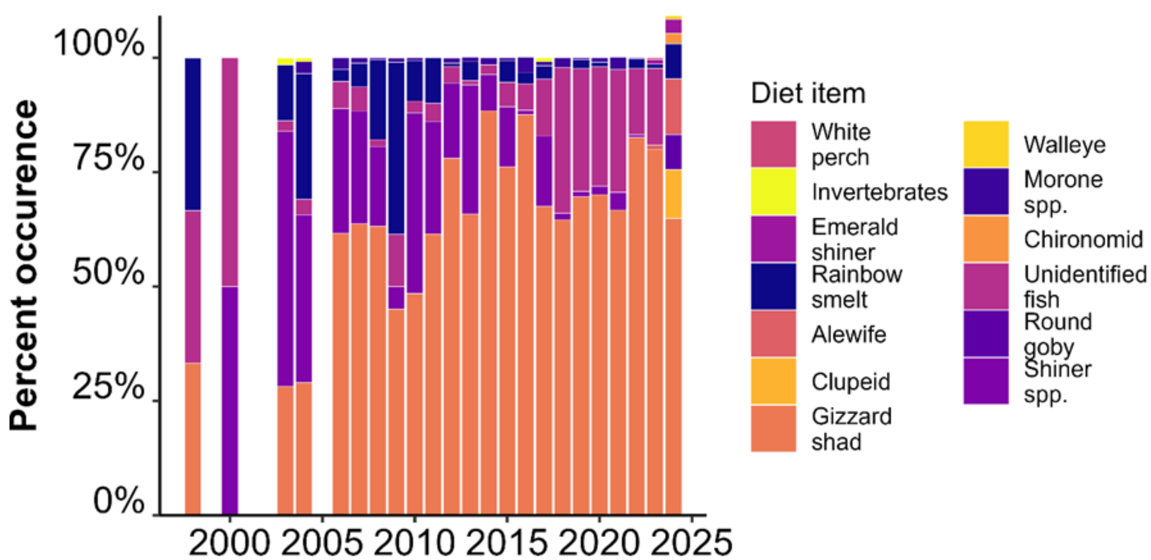



**Figure 2.2.3.1:** Percent occurrence of diet items from non-empty stomachs of Walleye collected in West and Central Basin gill-net assessments, September–November, 1998–2024.

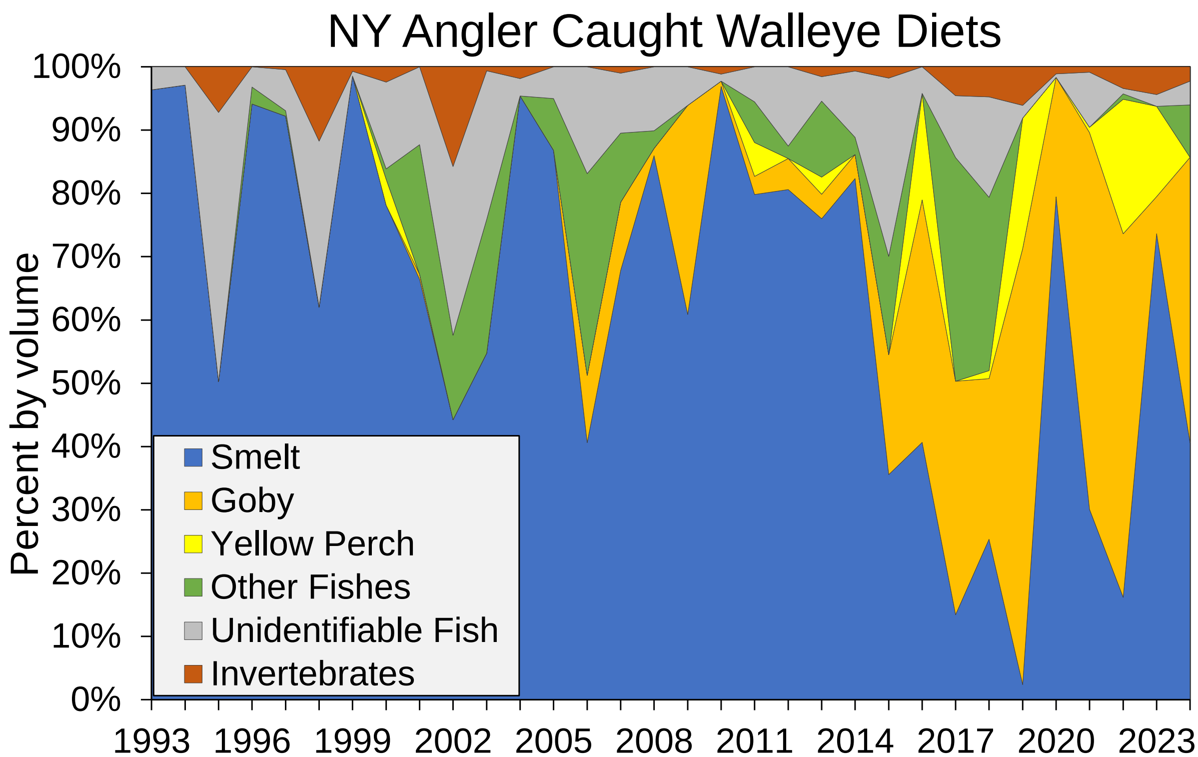



**Figure 2.2.3.2:** The percent contribution (by volume) of identifiable prey in non-empty stomachs of adult Walleye caught by anglers in New York's portion of Lake Erie, June–August 1993–2024.

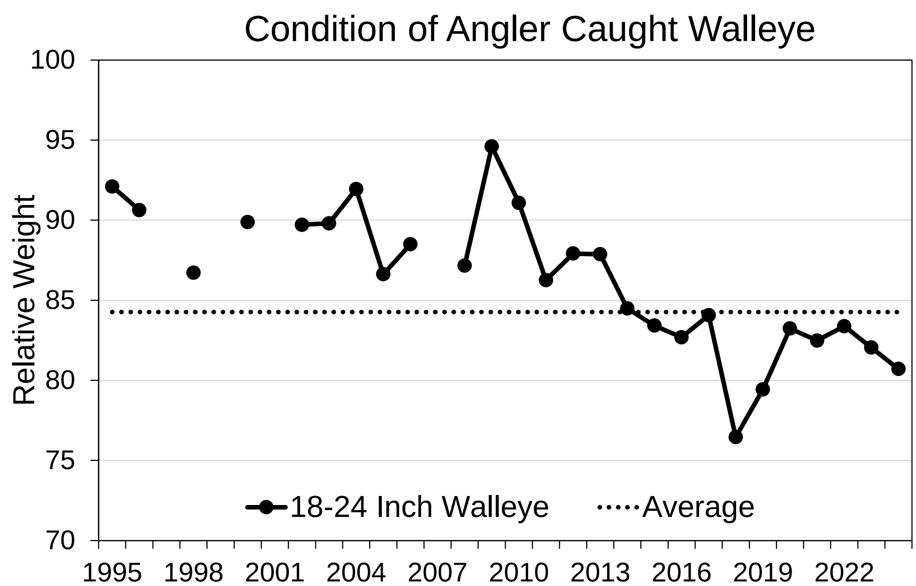



**Figure 2.3.1.1:** Relative weight of angler-caught walleye in the New York waters of Lake Erie at 18–24 inches from 1995-2024.

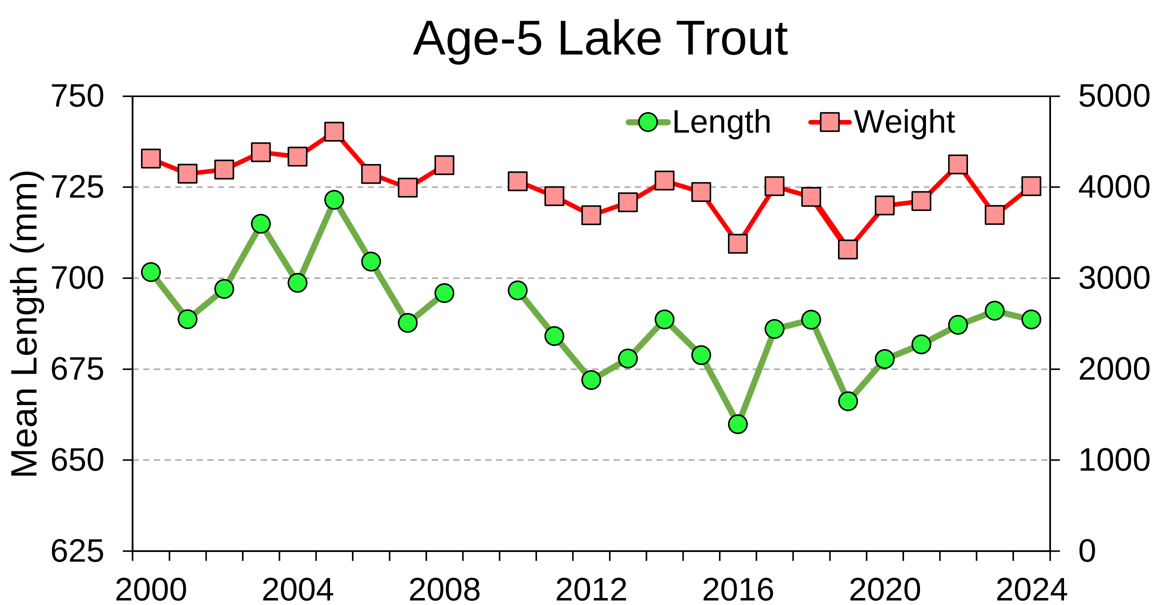



**Figure 2.3.1.2:** Mean length (mm) and weight (g) of age-5 lean strain Lake Trout caught in gill net assessment surveys from the East Basin of Lake Erie, August 2000–2024.

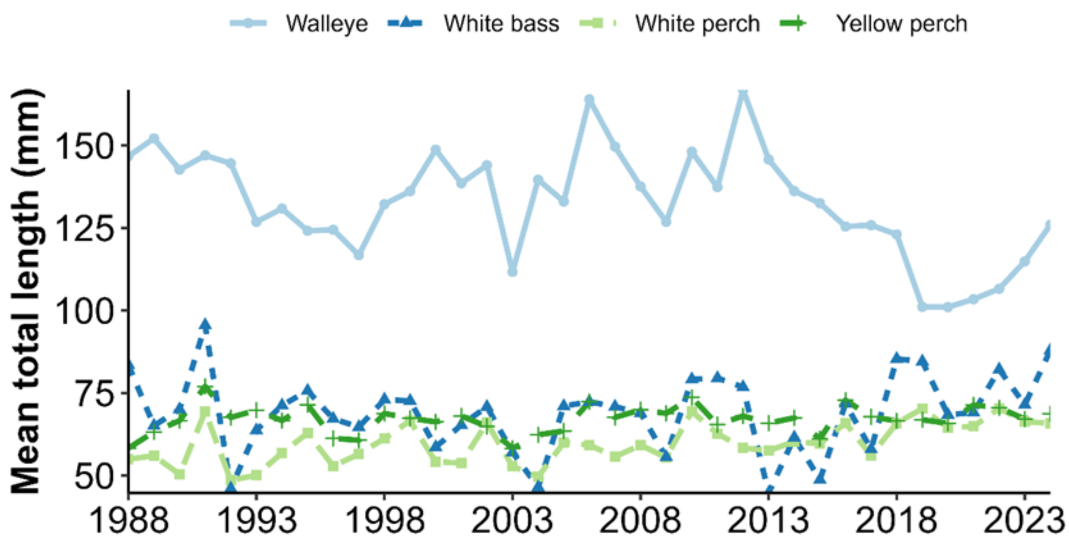



**Figure 2.3.2.1:** Mean total length of select age-0 fishes in West Basin Lake Erie, August 1988–2024. Data are from the Interagency Trawl Survey.

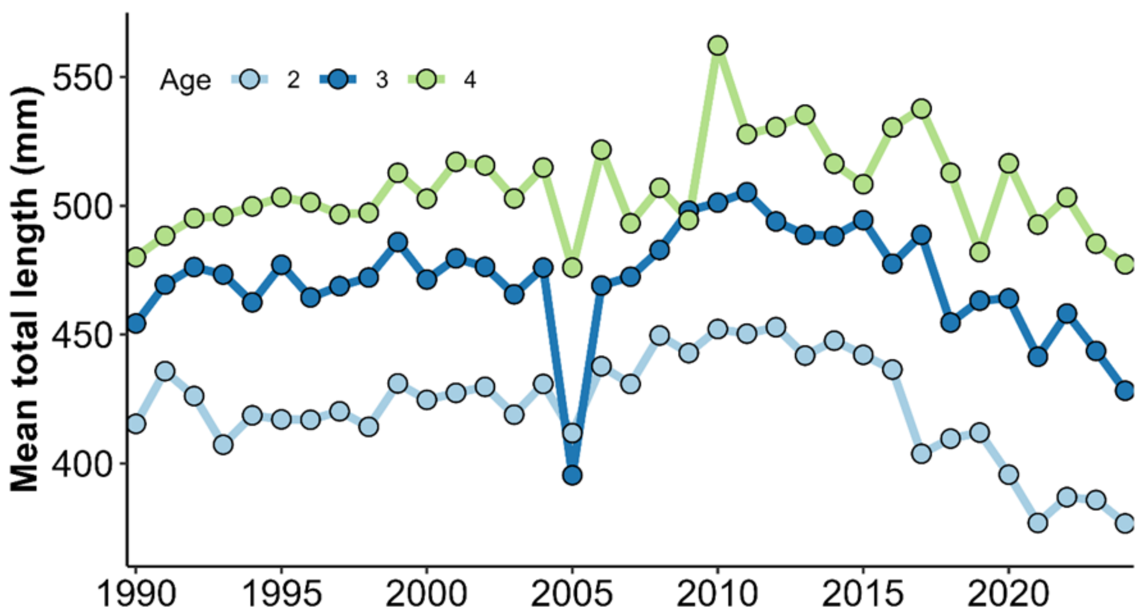



**Figure 2.3.2.2:** Mean total length of Walleye (ages 2–4) in West and Central basins of Lake Erie, 1988–2024. Data are from the ODNR fall gill net survey (September–November).

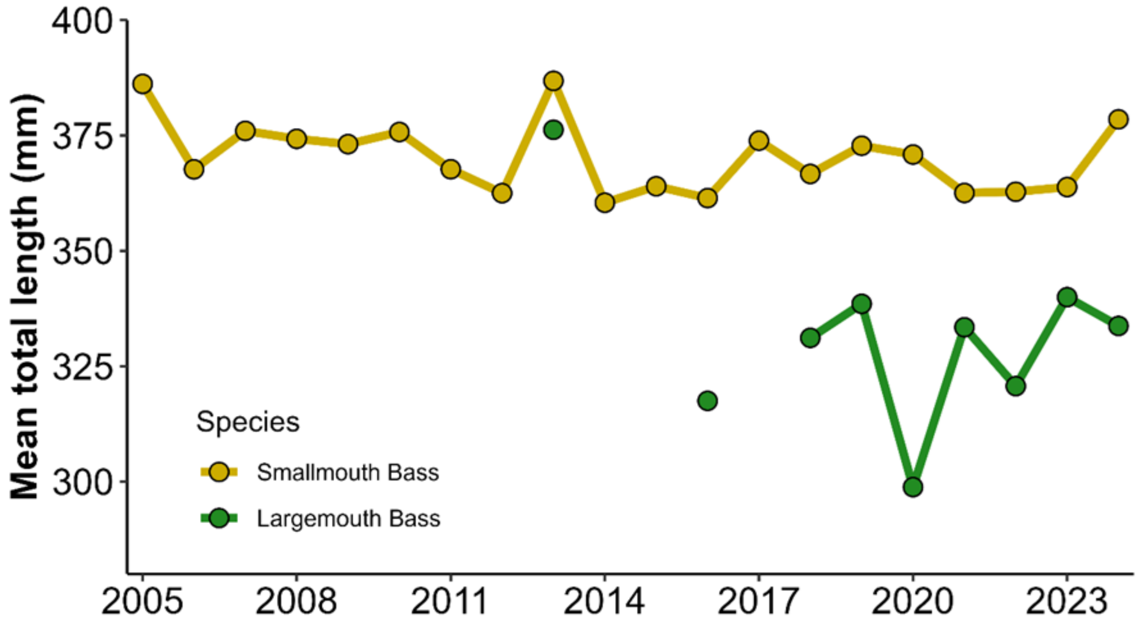



**Figure 2.3.2.3:** Mean total length of age-3 black basses in West and Central basins of Lake Erie, 2005–2024. Data are from ODNR surveys: gill net (Smallmouth Bass, September) and electrofishing (Largemouth Bass, June–August).

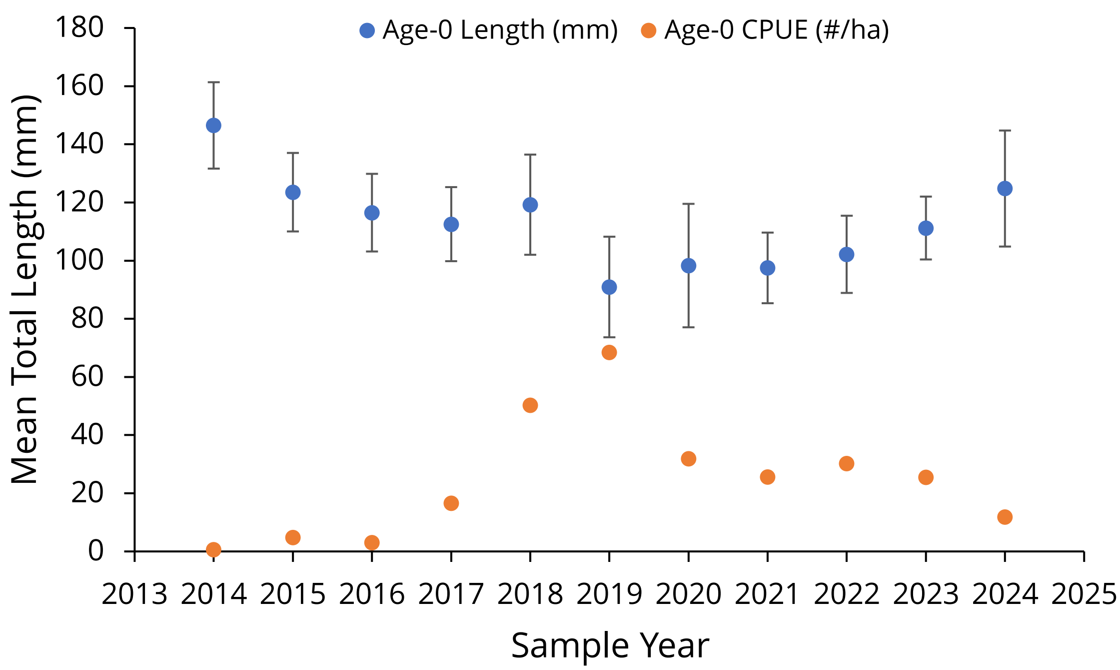



**Figure 2.3.3.1**: Average length (mm) of age-0 Walleye (blue dots) ± SD compared with number of age-0 Walleye captured per ha of trawling (orange dots) in Michigan waters of Lake Erie, August 2014-2024.

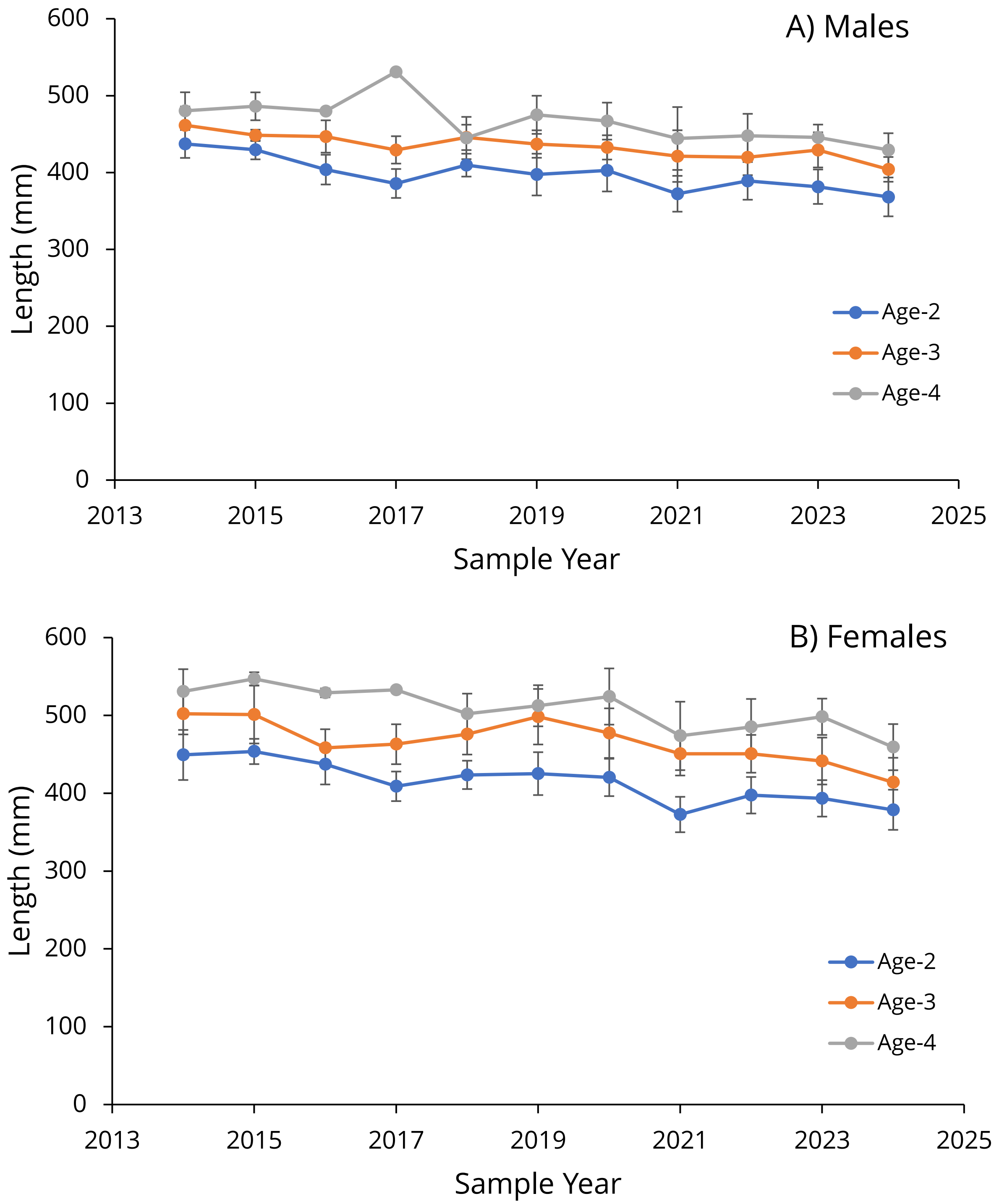



**Figure 2.3.3.2**: Average length (mm) ± SD at age for Walleye by sex captured in Michigan waters of Lake Erie, October 2014-2024.

**Charge 3: Continue hydroacoustic assessment of the pelagic forage fish community in Lake Erie, while incorporating new methods in survey design and analysis following the GLFC's Great Lakes Hydro Acoustic Standard Operating Procedures where possible/feasible.**

**3.0 Hydroacoustic Surveys in Lake Erie** (M. DuFour, J. Holden, H. Luken)

*Introduction*

Lake Erie hydroacoustic surveys estimate important forage fish densities including Gizzard Shad and Emerald Shiner in the West Basin (WB), Rainbow Smelt and Emerald Shiner in the Central Basin (CB), and Rainbow Smelt in the East Basin (EB). Historical survey designs were based on cross-lake transects that routinely experienced challenges that inhibited survey completion. In 2022, hydroacoustic surveys across the three basins implemented a new standardized whole-lake approach following a multi-year survey evaluation and redesign process. The new stratified-random grid approach reduces the overall survey effort, emphasizes data collection in strata with the greatest variability, and provides greater operational flexibility. A thorough description of historical surveys and the redesign process can be found in FTG (2022). Implementation and evaluation of the standardized whole-lake survey design continued during 2024.

*Methods*

The whole-lake survey design uses a stratified approach within each of the three basins (Figure 3.0.1). Each basin is subdivided into smaller strata based in part on depth, water quality characteristics, forage species compositions, and historical strata. Total sampling effort (i.e., kilometer of transect) in each basin was established through an analysis of historical data to achieve a target precision (Relative Standard Error < 15%). Within basins, sampling effort across strata was apportioned based on strata size and historical data variance. Random sites are selected from within each strata using a 5-minute grid. Transects (5 km) must pass through the centroid of the grid but can be surveyed in any direction based on weather or logistical considerations. Hydroacoustic transect data are collected with the ODNR R/V *Almar* in the WB, USGS R/V *Muskie* in the CB, and OMNRF R/V *Erie Explorer* in the EB.

Data collection begins 0.5 h after sunset and is completed by 0.5 h before sunrise. Collection settings during the survey in the Central and East basins include 4 pings per second (pps). The Central Basin uses 0.4 milli-second (msec) pulse length and the East Basin uses 0.256 msec. Both basins use a -130 dB minimum collection threshold (Table 3.0.1) following recommendations in Parker-Stetter et al. (2009). Collection settings in the West Basin use 10 pps and a 0.2 msec pulse duration to accommodate shallow waters and high fish densities. The sampling environment (water temperature) is set to the temperature at 2 m depth on the evening of sampling. Temperature and dissolved oxygen profiles are collected at each grid. Sampling occurred between July 01 and July 13, 2024.

Currently, midwater trawling only occurs in the CB with the OMNRF R/V *Keenosay* operating in Ontario waters and the ODNR R/V *Grandon* operating in U.S. waters. Midwater trawl samples are collected at grid locations in concordance with the hydroacoustic data collection. Up to four midwater trawls are conducted in each grid, with trawl depths distributed among the epilimnion, metalimnion, and hypolimnion to capture the fish community distribution across depths. Trawl catch is sorted by species and age group, and a subsample of fish are measured (total length). Temperature and dissolved oxygen profiles are collected at each sample grid.

*Data Analysis*

Hydroacoustic data were analyzed using the 'erieacoustics' R package (Holden and DuFour 2023) which interacts with standardized processing templates developed in Myriax software Echoview 14.0 (Echoview 2023). Each 500-m sample interval (EDSU; elementary distance sampling unit) was partitioned vertically into epilimnetic and hypolimnetic layers based on fish distribution and water temperature profiles. Analyses produced areal fish density (fish per hectare) estimates and size frequency distributions for each EDSU and layer along each 5-km transect.

Trawl catches were associated with the sampled stratum, grid, and layer. Similar to hydroacoustic data, trawl samples were partitioned into epilimnetic and hypolimnetic layers based on trawl depth and thermocline depths identified by hydroacoustic data and temperature profiles. Trawl catches were clustered into five species groups, including all ages of Emerald Shiner, age-0 Rainbow Smelt, age-1+ Rainbow Smelt, age-0 Yellow Perch, and others.

*Survey Effort*

Lake-wide hydroacoustic effort included 96 sampled grids (WB - 21, CB - 26, and EB - 49), totaling 480 km of sampled transect (Figure 3.0.2). Water column profiles (n = 65) associated with sampled grids were strategically collected to inform portioning of hydroacoustic and trawl data into epilimnetic and hypolimnetic layers. A total of 43 midwater trawls were collected across 16 sample grids in 6 strata of the Central Basin.

*Water Column Profiles*

Water column profiles demonstrate increasing depth from west to east, with decreasing temperatures and increasing levels of dissolved oxygen (Figure 3.0.3). Much of the WB was isothermal, with no thermocline observed at any site. The thermocline was variable in the CB, and consistently deeper in the EB. Low dissolved oxygen (< 2 mg/L) was observed at four sites in CB. No low oxygen conditions were observed in EB sites.

*Lake Wide Size Distribution and Fish Density*

Hydroacoustic surveys observed two abundant size groups including age-0 fishes between -64 and -55 dB, and age-1+ fishes greater than -55 dB (Figure 3.0.4). Higher frequencies of age-0 fish were observed in epilimnetic waters across the survey, while age-1+ fish dominated the hypolimnion, especially in the EB (Figure 3.0.5 and 3.0.6). The size of age-0 fishes appeared to decline from west to east as cooler waters likely contribute to later hatching dates and slower growth. No historical hydroacoustic-associated midwater trawling data exist in the WB. The CB epilimnetic catches are a mix of age-0 Rainbow Smelt, Emerald Shiner, and other species. Epilimnetic catches from 2019 midwater trawl data in the EB consisted primarily of age-0 Rainbow Smelt and age-0 Yellow Perch. Hypolimnetic waters in both the CB and EB are dominated by age-1+ Rainbow Smelt.

Lake-wide areal densities (fish/ha), in general, where highest in the WB followed by the EB and CB, respectively (Figure 3.0.6). Epilimnetic densities were consistently higher when compared to hypolimnetic densities, with extremely high observations in the WB. High EB densities in the epilimnion are generated by a high abundance of small age-0 Rainbow Smelt (< -55 dB) and do not contribute proportionally to total biomass. Hypolimnetic habitat was not observed in the WB, but consistently observed in the CB and EB. Some of the highest areal densities observed were in the EB hypolimnion and likely consisted of age-1+ Rainbow Smelt.

*West Basin Results*

The WB survey consisted of 21 5-km transects with 21 associated water column profiles sampled between July 08-13 (Table 3.0.2; Figure 3.0.2). Alternative grids (G254 and G134) were sampled in stratum S05 because shallow waters prohibited safe passage through two of the planned grids (G435 and G134). Midwater trawl samples were not collected. Results represent prey fish densities in the epilimnion because no stratification was observed (Figure 3.0.3). Most single targets were measured at a target strength around -61 dB or -56 dB, likely representing age-0 Percidae and Moronidae species as well as Gizzard Shad (Figure 3.0.4). A greater proportion of larger targets (~56 dB) were observed in strata further east (S04 and S05). Fish densities were highest in G306 and G429 within the Detroit River plume (stratum S01), although these grids were >20 km apart. Fish densities tended to be lowest east of Pelee Island (stratum S05). Annual mean prey fish density in the West Basin decreased in 2024 to 11,849 fish/ha, just below the time series average of 16,449 fish/ha (Figure 3.0.7).

*Central Basin Results*

The CB survey consisted of 26 5-km transects with associated water column profiles sampled between July 01-05. All targeted 5-minute grids were sampled including additional grids in stratum S07, S09, S10, S12, and S13 (Table 3.0.3; Figure 3.0.2). Twenty-seven midwater trawl samples were collected in Canadian waters across four strata (S7, S8, S11, and S12) while 16 midwater trawl samples were collected in U.S. waters between two strata (S09 and S10; Table 3.0.3). Annual mean areal fish density decreased to the lowest in the time series 2,176 fish/ha in 2024 (Figure 3.0.8). In general, the highest midwater trawl catches occurred in the epilimnion and were comprised of age-0 and age-1+ Rainbow Smelt as well as other species, while age-1+ Rainbow Smelt dominated the hypolimnion (Figure 3.0.9). Relative to water column depth (Figure 3.0.10), Emerald Shiner catches were non-existent in nearshore (< 20 m) and extremely low (n=1) in offshore habits (>20 m). Age-0 Yellow Perch catches were greater than age-0 Emerald Shiner but low across the survey (n=33). Age-0 Rainbow Smelt catches were moderate in both nearshore and offshore waters, while the highest catches of age-1+ Rainbow Smelt occurred offshore in the hypolimnion. The highest catches of other species occurred predominately in offshore waters.

*East Basin Results*

The EB survey consisted of 49 5-km transects with 18 associated water column profiles sampled between July 03-10. Representative water column profiles were taken in each stratum although not for each sampled 5-minute grid. Midwater trawl samples were not collected. The time series of age-1+ Rainbow Smelt is an index of fish abundance in the hypolimnion that have target strengths consistent with age-1+ sized Rainbow Smelt (-60 dB to -40 dB). Companion midwater trawls completed by NYSDEC in early years of the survey (up to 2007) found that age-1+ Rainbow Smelt made up greater than 95% of catches of fish of their acoustic target strength in meta-hypolimnion trawls. Midwater trawl catches by OMNR in 2019 again confirmed the assumption. Grids that did not have hypolimnetic conditions were assumed to not have any yearling and older Rainbow Smelt (0 fish/ha). Strata density is the mean density of all the 500 m EDSU within the strata. The basin estimate is an area weighted mean of the combined strata. The highest densities of age-1+ Rainbow Smelt were observed in S22, S21, and S17 (mean N/ha = 39,006, 11,686 and, 4,919 respectively). The density of age-1+ Rainbow Smelt decreased slightly to 3,311 fish/ha in 2024 from 3,416 fish/ha in 2023 (Figure 3.0.11).

*Evaluating Potential Hydroacoustic Biases using Autonomous Vehicles*

During 2024, the U.S. Geological Survey and Cornell University in cooperation with partner agencies (ODNR and OMNR) began analyzing data collected from an uncrewed sailing vessel and two long-range autonomous underwater vehicles deployed in Lake Erie between August 1 and September 26, 2023 (see FTG 2024). Analyses for these science objectives are ongoing.

**Table 3.0.1**: Lake-wide hydroacoustic data collection summary.

| Basin | Sounder | Frequency | Ping Rate | Pulse Length | Collection Threshold | WC Profiles | Companion MTR |
|---|---|---|---|---|---|---|---|
| WB | Biosonics | 201 kHz | 10 pps | 0.2 msec | -130 dB | yes | no |
| CB | Biosonics | 120 kHz | 4 pps | 0.4 msec | -130 dB | yes | yes |
| EB | Simrad EK80 | 120 kHz | 4 pps | 0.256 msec | -130 dB | yes | no |

**Table 3.0.2**: Number of targeted and completed 5-minute samples grids for each stratum in the West Basin survey area.

| Stratum | Target | N Complete |
|---|---|---|
| S01 | 5 | 5 |
| S02 | 4 | 4 |
| S03 | 2 | 2 |
| S04 | 3 | 3 |
| S05 | 6 | 6 |
| S06 | 1 | 1 |

**Table 3.0.3**: Number of targeted and completed 5-minute samples grids, and midwater trawl samples collected for each stratum in the Central Basin survey area.

| Stratum | Target | N Complete | N Trawls |
|---|---|---|---|
| S07 | 1 | 2 | 2 |
| S08 | 2 | 2 | 6 |
| S09 | 3 | 4 | NA |
| S10 | 2 | 3 | NA |
| S11 | 2 | 2 | 4 |
| S12 | 4 | 5 | 15 |
| S13 | 5 | 6 | 14 |
| S14 | 1 | 2 | 2 |

**Table 3.0.4**: Number of targeted and completed 5-minute samples grids for each stratum in the East Basin survey area.

| Stratum | Target | N Complete |
|---|---|---|
| S15 | 2 | 2 |
| S16 | 4 | 4 |
| S17 | 5 | 8 |
| S18 | 6 | 8 |
| S19 | 5 | 6 |
| S20 | 5 | 7 |
| S21 | 4 | 5 |
| S22 | 3 | 4 |
| S23 | 2 | 2 |
| S24 | 3 | 3 |

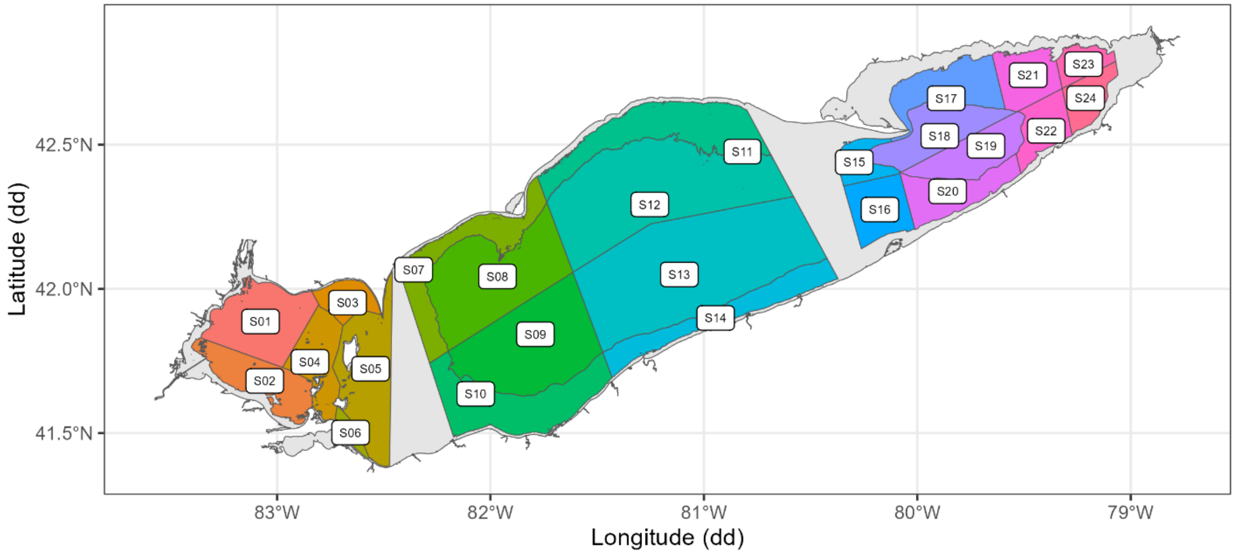



**Figure 3.0.1**. Lake Erie forage fish acoustic survey strata used since the survey redesign. The West Basin strata are 1-6; Central Basin are 7-14, and the East Basin are 15-24.

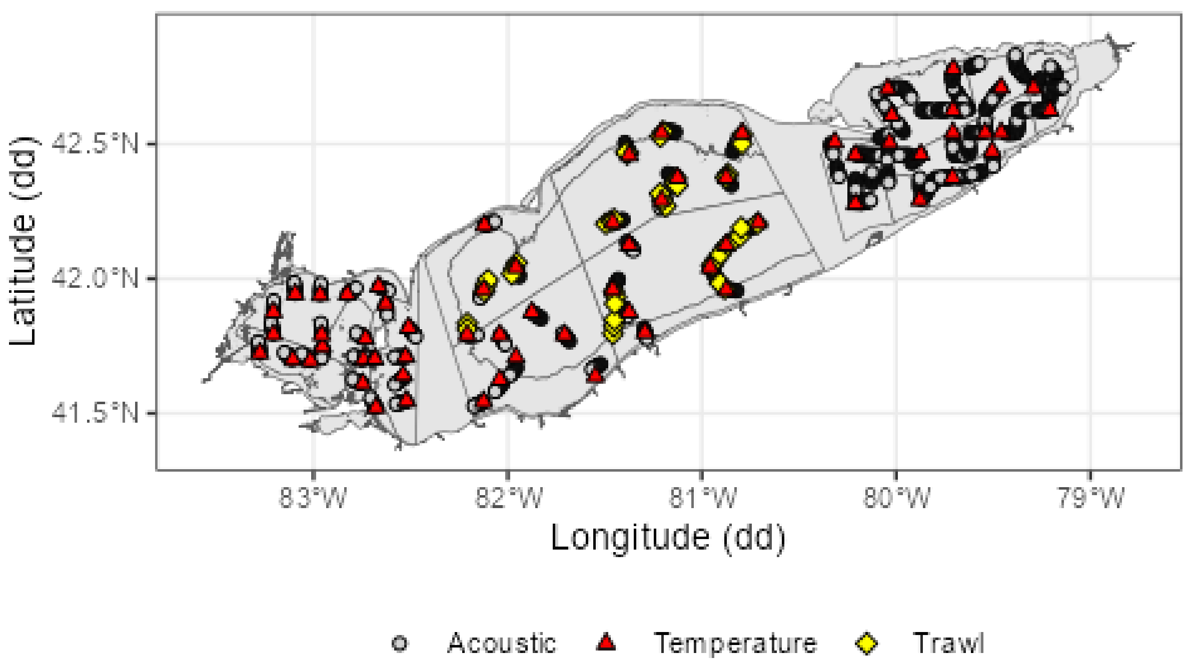



**Figure 3.0.2**: Lake-wide forage fish survey effort distributed across sample stratum including hydroacoustic transects (open black circles), midwater trawling (yellow diamonds), and water column profiles (red triangles).

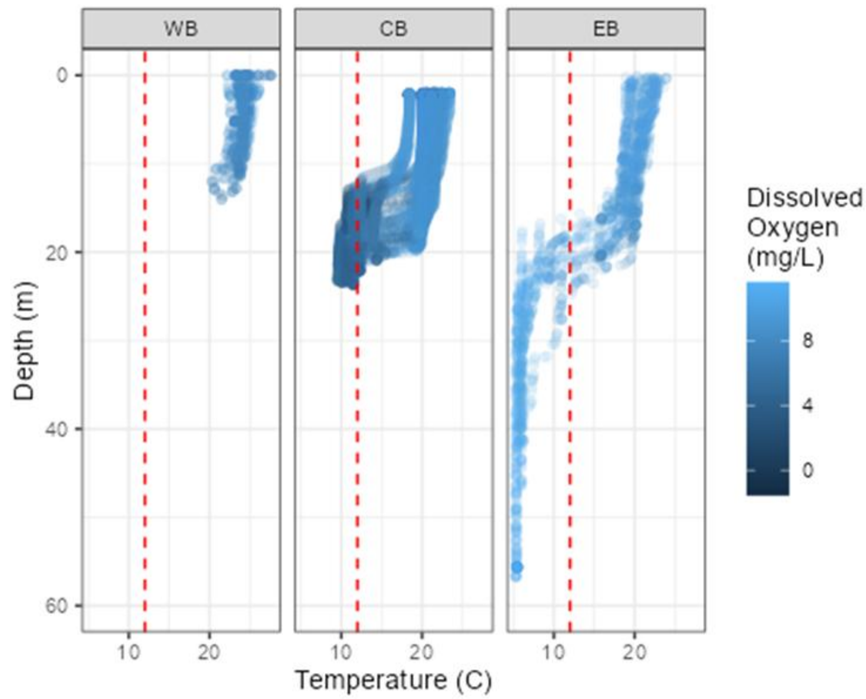



**Figure 3.0.3**: Water column profiles displayed by basin (West Basin = WB, Central Basin = CB, and East Basin = EB) with depth on the x-axis, temperature (˚C) on the y-axis, and color associated with the level of dissolved oxygen (mg/L). The dashed vertical line indicates 12˚C.

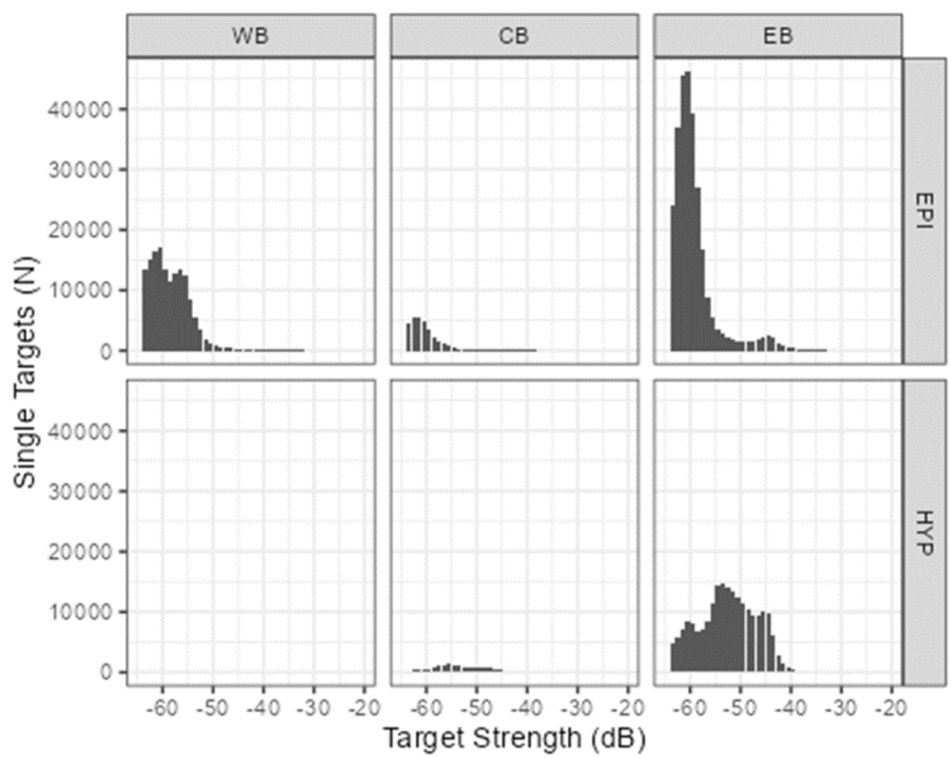



**Figure 3.0.4**: Target strength distributions of single targets by layer and across basins. Target strength is a measure of echo intensity that is relative to fish size. Single targets are individual echoes produced by fish encountered in the acoustic beam. In general, age-0 fishes are < -55 dB while age-1+ fishes are > -55 dB.

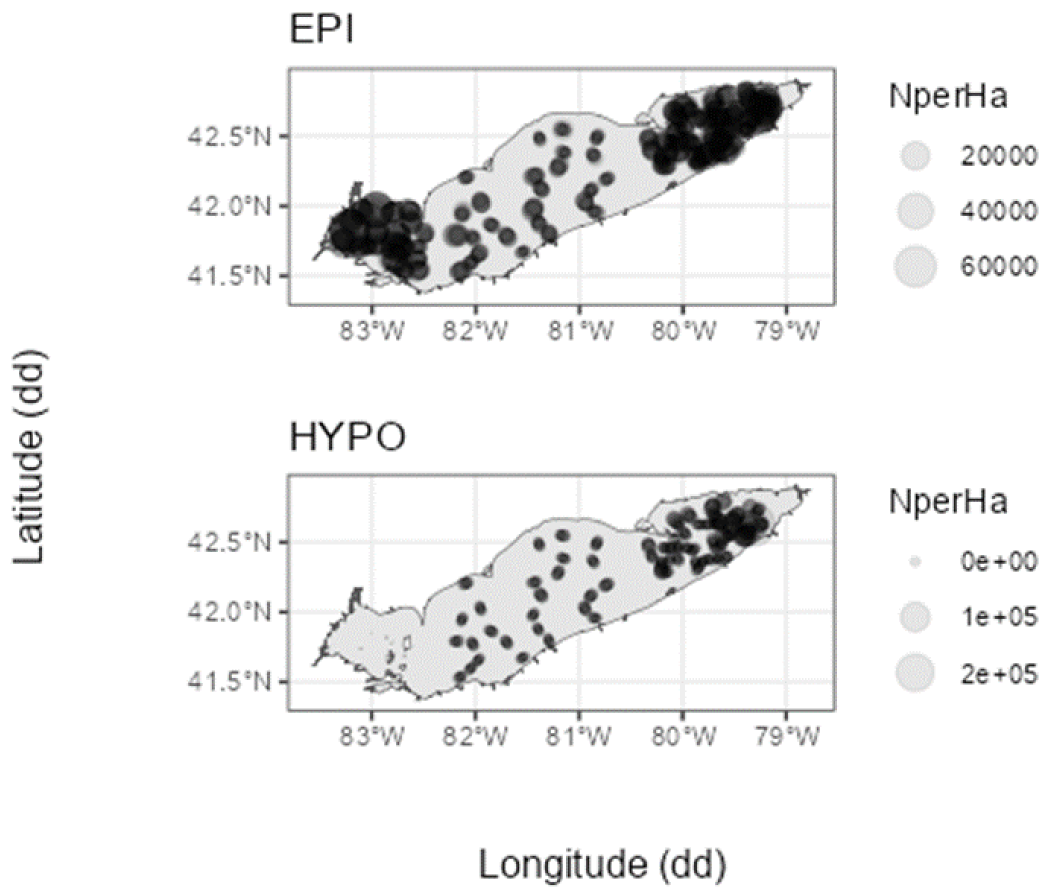



**Figure 3.0.5**: Lake-wide fish densities (number per hectare; NperHa) by lake layer (epilimnetic [EPI], upper panel, and hypolimnetic [HYPO], lower panel). Larger open circles display increased density in epilimnetic waters of the West and East basins, and increased density in the northern hypolimnetic waters of the East Basin.

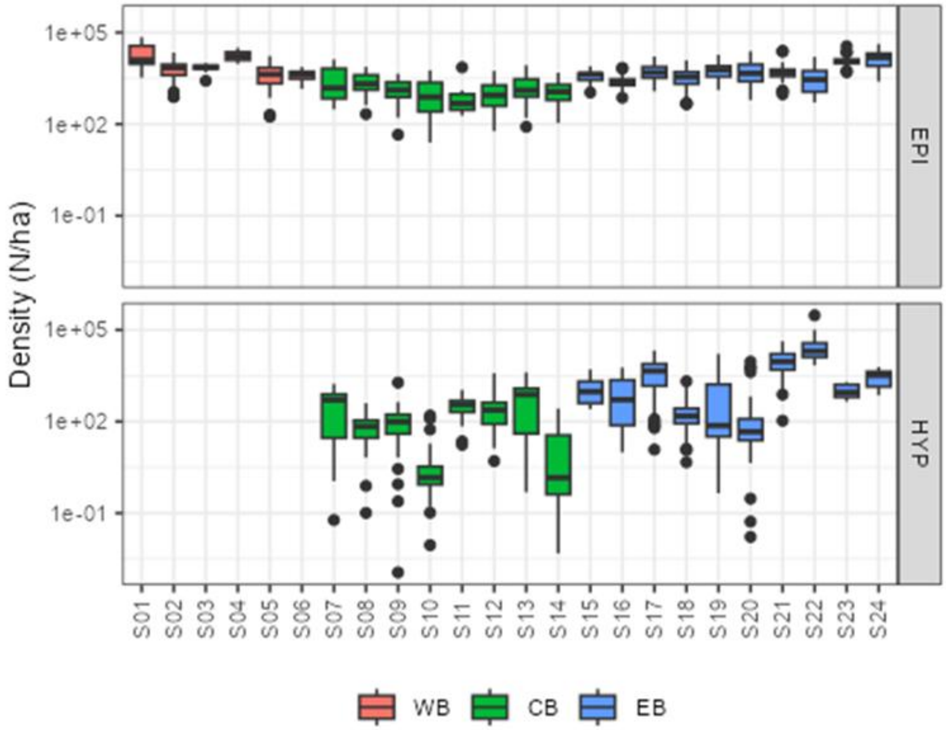



**Figure 3.0.6**: Density estimates (N/ha) within each stratum in the epilimnetic (upper panel) and hypolimnetic (lower panel) layers. Box captures the 50% quantiles while whiskers capture 95% quantiles of the data and the thick line represents the median value. Points that exceed the 95% quantiles are indicated with individual points Note: y-axis uses a log scale.

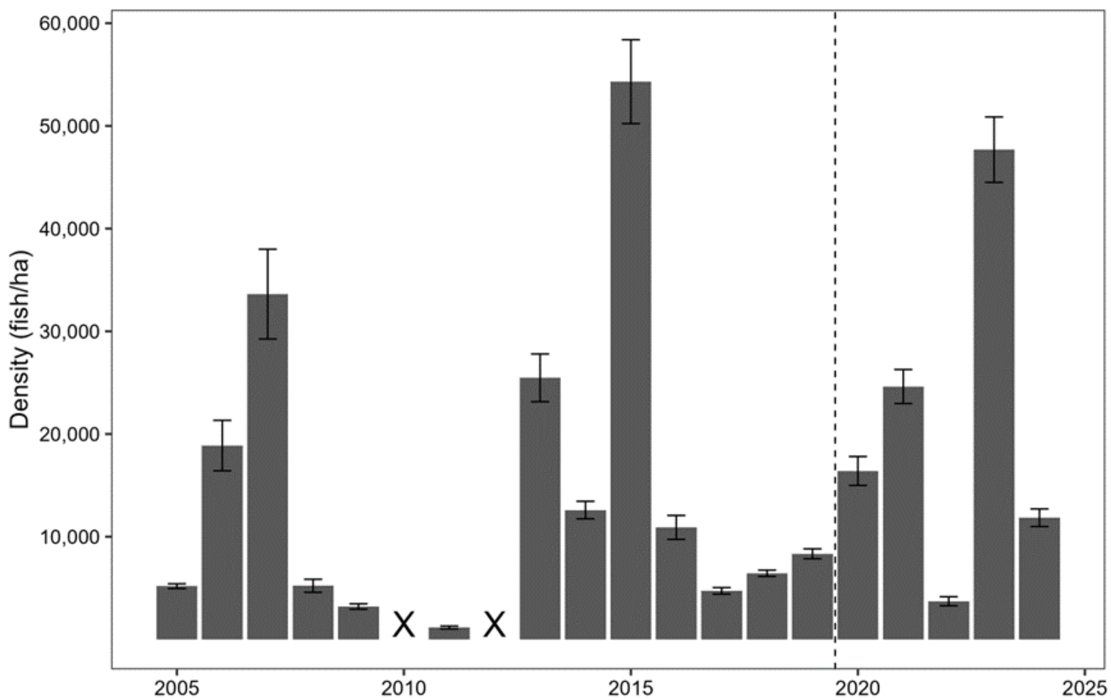



**Figure 3.0.7**: West Basin mean areal density (fish/ha) estimates over time. Error bars represent ±1 standard error. Survey years with no data (2010 and 2012) are denoted with an “X” and the vertical dashed line signifies the change in sampling design.

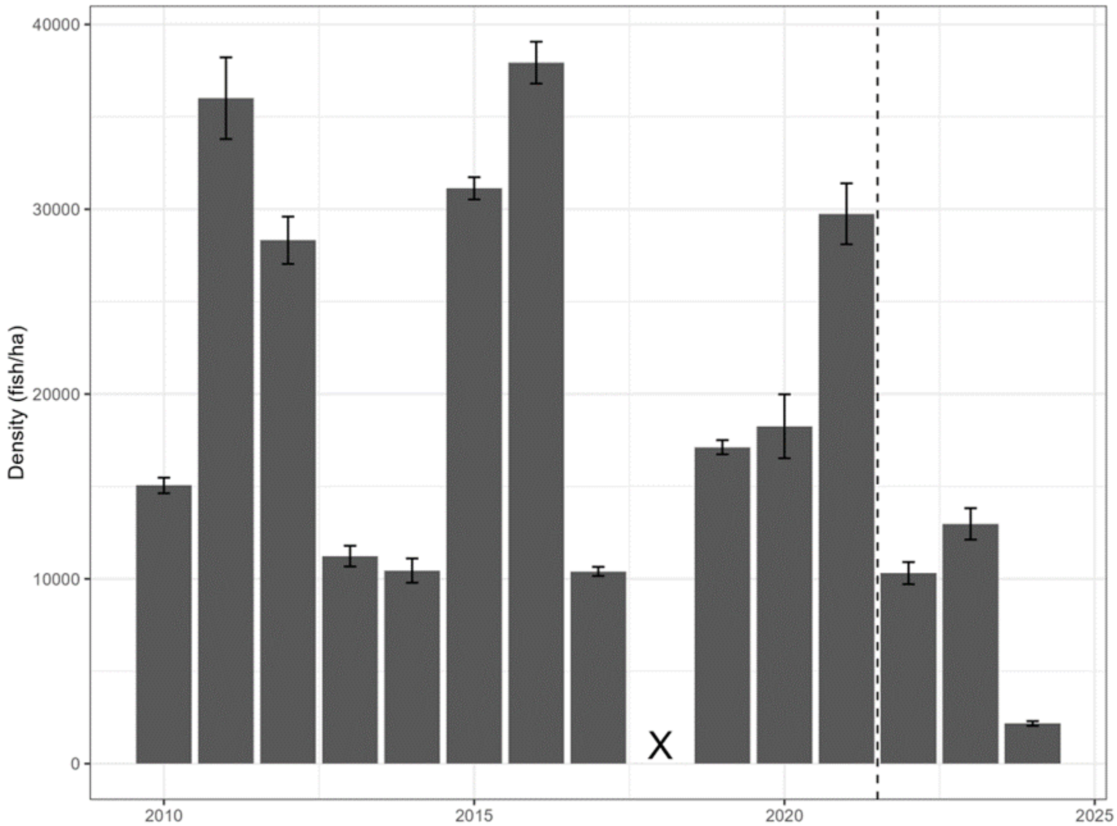



**Figure 3.0.8**: Central Basin mean areal density (fish/ha) estimates over time. Error bars represent ±1 standard error. Survey years with no data (2018) are denoted with an “X” and the vertical dashed line signifies the change in sampling design.

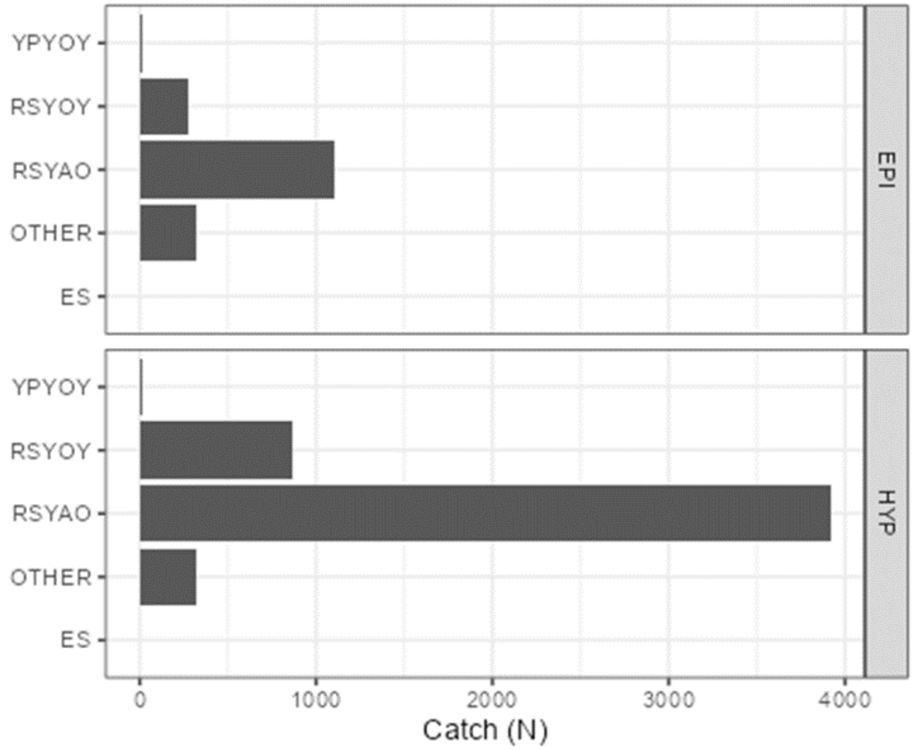



**Figure 3.0.9**: Total midwater trawl catch from epilimnetic (EPI, upper panel) and hypolimnetic (HYP, lower panel) tows across the Canadian waters and a portion of U.S. waters of the Central Basin, including species groups age-0 Rainbow Smelt (RSYOY), age-1+ Rainbow Smelt (RSYAO), Emerald Shiner (ES), age-0 Yellow Perch (YPYOY), and other species (OTHER).

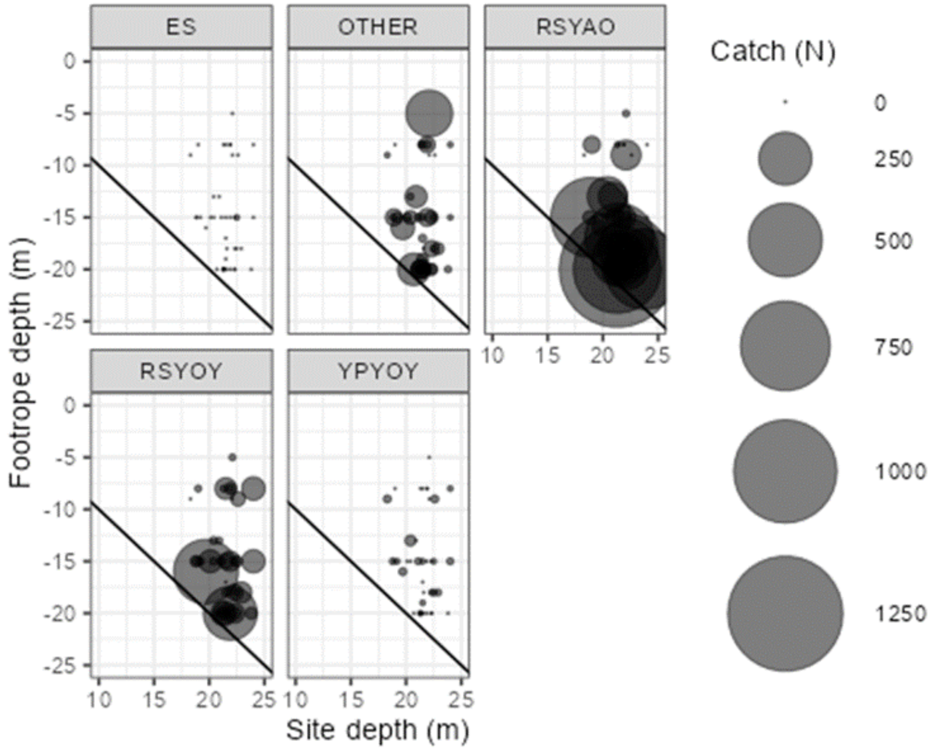
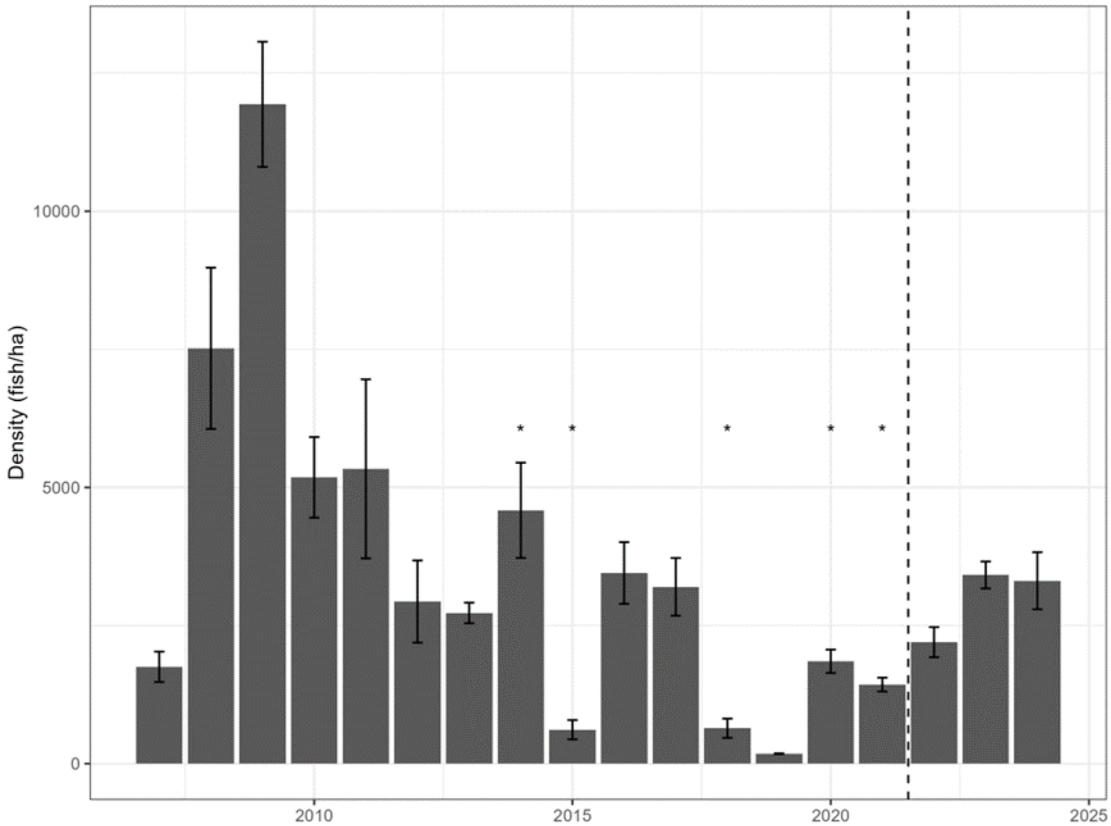



**Figure 3.0.10**: Species group catches (N) relative to water column depth (diagonal black line) in Canadian and U.S. waters of the Central Basin including Emerald Shiner (ES), other species (OTHER), age-1+ Rainbow Smelt (RSYAO), age-0 Rainbow Smelt (RSYOY), and age-0 Yellow Perch (YPYOY). Water column depths < 20 correspond to near shore strata (S07, S10, S11, and S14) and depths > 20 m correspond to offshore strata (S08, S09, S12, and S13).




**Figures 3.0.11**: East Basin index of age-1+ Rainbow Smelt. Error bars represent ±1 standard error. A single asterisk (*) indicates years where not all transects were completed and vertical dashed line signifies when the change in sampling design occurred.

**Charge 4: Act as a point of contact for any new/novel invasive aquatic species.**

(K. Towne)

Since 2016, the Forage Task Group has maintained a database to track Aquatic Invasive Species (AIS) in Lake Erie. Recently, the FTG has been working with the USGS Nonindigenous Aquatic Species database team to incorporate the FTG database and other agency data into the USGS Nonindigenous Aquatic Species Database so that the Lake Erie data can be better archived and help track AIS on a greater geographic scale.

The FTG is actively monitoring for any new aquatic invasive species that enters the Lake Erie watershed. A few AIS that are not yet in Lake Erie but are of particular concern to the FTG are Black Carp, Silver Carp, Bighead Carp, and Tench. Black, Silver, and Bighead carps are present throughout the Mississippi Basin and have been found in tributaries close to Lake Michigan. Tench was first detected in a tributary of the St. Lawrence River in 1994 and has since spread into the St. Lawrence River and eastern Lake Ontario (Bay of Quinte; Avlijas et al. 2018). The rapid expansion of Tench suggests there is an elevated risk of Tench entering Lake Erie should their expansion into Lake Ontario continue. No Black Carp, Silver Carp, Bighead Carp, Tench, or any other novel non-native fish species were captured in Lake Erie waters in 2024.

Two notable non-native species were captured in Lake Erie in 2024. The first was one hybrid striped bass (*Morone chrysops x M. saxatilis*) captured in a commercial gill net near Port Burwell, ON (42.62500, -80.79167) on April 4, 2024. One additional hybrid striped bass was captured in a commercial trap net near Magee Marsh, OH (41.63492, -83.19278) on April 29, 2024. Unlike most hybrids, the hybrid striped bass is fertile and may backcross with native White Bass (*M. chrysops*; Hodson 1989). The second notable species captured was a total of eight Western Mosquitofish (*Gambusia affinis*); two captured while boat electrofishing during USFWS Early Detection Program efforts in the Maumee River (41.55537, -83.65105) on September 12, 2024, and six additional Western Mosquitofish captured while boat electrofishing during USFWS Early Detection Program efforts in Sandusky Bay (41.41884, -82.95314) on September 26, 2024. The USGS Nonindigenous Aquatic Species Database reports that this species was previously detected in Maumee Bay in 1981 and in the Sandusky River in 2023. Western Mosquitofish has an overall risk assessment of 'High' due to their history of invasiveness and likelihood of establishing (USFWS 2024).

**Protocol for Use of Forage Task Group Data and Reports**

- The Forage Task Group has standardized methods, equipment, and protocols as much as possible; however, data are not identical across agencies, management units, or basins. The data are based on surveys that have limitations due to gear, depth, time, and weather constraints that vary from year to year. Any results, conclusions, or abundance information must be treated with respect to these limitations. Caution should be exercised by outside researchers not familiar with each agency's collection and analysis methods to avoid misinterpretation.

- The FTG strongly encourages outside researchers to contact and involve the FTG in the use of any specific data contained in this report. Coordination with the FTG can only enhance the final output or publication and benefit all parties involved. Raw data and summaries are available upon request; please contact the co-chairs (Arthur Bonsall [arthur.bonsall@ontario.ca] and Zak Slagle [zachary.slagle@dnr.ohio.gov]) to initiate a request.

## Literature Cited


Avlijas, S., A. Ricciardi, and N.E. Mandrak. 2018. Eurasian Tench (*Tinca tinca*): The next Great Lakes invader. Canadian Journal of Fisheries and Aquatic Sciences 75: 169-179.

Carlson, R.E. 1977. A trophic state index for lakes. Limnology and Oceanography 22(2): 361-369.

Craig, J.K. 2012. Aggregation on the edge: Effects of hypoxia avoidance on the spatial distribution of brown shrimp and demersal fishes in the Northern Gulf of Mexico. Marine Ecology Progress Series 445: 75-95.

Eby, L.A. and L.B. Crowder. 2002. Hypoxia-based habitat compression in the Neuse River Estuary: Context-dependent shifts in behavioral avoidance thresholds. Canadian Journal of Fisheries and Aquatic Sciences 59: 952-965.

Echoview Software Pty Ltd. 2023. Echoview Software, Version 12.1. Echoview Software Pty Ltd, Hobart, Australia.

Forage Task Group (FTG). 2001. Report of the Lake Erie Forage Task Group, March 2001. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Forage Task Group (FTG). 2012. Report of the Lake Erie Forage Task Group, March 2012. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Forage Task Group (FTG). 2017. Report of the Lake Erie Forage Task Group, March 2017. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Forage Task Group (FTG). 2022. Report of the Lake Erie Forage Task Group, March 2022. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Forage Task Group (FTG). 2024. Report of the Lake Erie Forage Task Group, March 2024. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Francis, J., T. Hartman, K. Kuhn, B. Locke, and J. Robinson. 2020. Fish community objectives for the Lake Erie basin [online]. Great Lakes Fishery Commission. Fishery Management Document 2022-01. 14 p. Available from: https://www.glfc.org/pubs/FisheryMgmtDocs/Fmd20-01.pdf

Hodson, R.G. 1989. Hybrid Striped Bass: Biology and Life History. Texas Agricultural Extension Service. Southern Regional Aquaculture Centre Publication No. 300.

Holden, J., and M. DuFour. 2023. erieacoustics: Analysis Tools for Erie Acoustic Surveys. R package version 0.3.0. Available from: https://github.com/LakeErie-PreyFish-Acoustics/erieacoustics

Knight, R.L., F.J. Margraf, and R.F. Carline. 1984. Piscivory by Walleyes and Yellow Perch in Western Lake Erie. Transactions of the American Fisheries Society 113: 677–693.

Leach, J. H., M.G. Johnson, J.R.M. Kelso, J. Hartman, W. Numan, and B. Ents. 1977. Responses of percid fishes and their habitats to eutrophication. Journal of the Fisheries Research Board of Canada 34: 1964-1971.

Lake Erie Committee (LEC). 2019. Lake Erie Committee Environmental Priorities [online]. 2 p. Accessed from: http://www.glfc.org/pubs/lake_committees/erie/2019%20Lake%20Erie%20Committee%20Environmental%20Priorities.pdf

Ludwig, J.M. 2025. Warmwater gill net assessment. Section D in NYSDEC 2025, Lake Erie 2024 Annual Report. New York State Department of Environmental Conservation, Albany.

Ohio Division of Wildlife. 2024. Ohio's Lake Erie fisheries, 2023 annual data report. Federal Aid in Sport Fish Restoration Project F-69-P. Page 113. Ohio Department of Natural Resources, Division of Wildlife, Lake Erie Fisheries Units, Fairport and Sandusky. Available from: https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/wildlife/fish-management/LakeErieStatus.pdf

Parker-Stetter, S.L., L.G. Rudstam, P. J. Sullivan, and D.M. Warner. 2009. Standard operating procedures for fisheries acoustic surveys in the Great Lakes. Great Lakes Fishery Commission Special Publication 09-01. 167 p. Available from: https://www.glfc.org/pubs/SpecialPubs/Sp09_1.pdf

Ryan, P.A., R. Knight, R. MacGregor, G. Towns, R. Hoopes, and W. Culligan. 2003. Fish-community goals and objectives for Lake Erie. Great Lakes Fisheries Commission Special Publication 03-02. 56 p. Available from: https://www.glfc.org/pubs/SpecialPubs/Sp03_2.pdf

Ryder, R.A., and S.R. Kerr. 1978. Adult Walleye in the percid community - a niche definition based on feeding behavior and food specificity. American Fisheries Society Special Publication 11.

Tyson, J.T., T.B. Johnson, C.T. Knight, and M.T. Bur. 2006. Intercalibration of Research Survey Vessels on Lake Erie. North American Journal of Fisheries Management 26: 559-570.

U.S. Fish & Wildlife Service (USFWS). 2024. Western Mosquitofish (*Gambusia affinis*): Ecological Risk Screening Summary. 35 p. Available from: https://www.fws.gov/sites/default/files/documents/2024-06/ecological-risk-screening-summary-western-mosquitofish.pdf

Wilkins, P.D.  2025. Open lake sport fishing survey. Section F in NYSDEC 2025, Lake Erie 2024 Annual Report. New York State Department of Environmental Conservation, Albany.

Wilkins, P.D. and J.M. Ludwig. 2025. Forage and juvenile yellow perch survey. Section C in NYSDEC 2025, Lake Erie 2024 Annual Report. New York State Department of Environmental Conservation, Albany, USA.

**Appendix 1: List of Species Common and Scientific Names**

| Common name | Scientific name | Comments |
|---|---|---|
| Alewife | *Alosa pseudoharengus* | Invasive species |
| Bighead Carp | *Hypophthalmichthys nobilis* | Invasive species, not present in Lake Erie |
| Black Carp | *Mylopharyngodon piceus* | Invasive species, not present in Lake Erie |
| Bluegill | *Lepomis macrochirus* | |
| Brook Silverside | *Labidesthes sicculus* | |
| Channel Catfish | *Ictalurus punctatus* | |
| Channel Darter | *Percina copelandi* | |
| Common Carp | *Cyprinus carpio* | Invasive species |
| Crayfish | *Astacoidea* spp. | |
| Emerald Shiner | *Notropis atherinoides* | |
| Freshwater Drum | *Aplodinotus grunniens* | |
| Gizzard Shad | *Dorosoma cepedianum* | |
| Grass Carp | *Ctenopharangydon idella* | Invasive species |
| Johnny Darter | *Etheostoma nigrum* | |
| Lake Sturgeon | *Acipenser fulvescens* | |
| Largemouth Bass | *Micropterus nigricans* | Formerly *Micropterus salmoides.* |
| Logperch | *Percina caprodes* | |
| Mimic Shiner | *Paranotropis volucellus* | Formerly *Notropis volucellus.* |
| Mudpuppy | *Necturus maculosus* | Native salamander |
| Rainbow Smelt | *Osmerus mordax* | Invasive species |
| Rock Bass | *Ambloplites rupestris* | |
| Round Goby | *Neogobius melanstomus* | Invasive species |
| Rudd | *Scardinius erythrophthalmus* | Invasive species |
| Ruffe | *Gymnocephalus cernuus* | Invasive species |
| Silver Carp | *Hypophthalmichthys molitrix* | Invasive species, not present in Lake Erie |
| Silver Chub | *Macrhybopsis storeriana* | |
| Smallmouth Bass | *Micropterus dolomieu* | |
| Spottail Shiner | *Hudsonius hudsonius* | Formerly *Notropis hudsonius.* |
| Tench | *Tinca tinca* | Invasive species, not present in Lake Erie |
| Trout-perch | *Percopsis omiscomaycus* | |
| Tubenose Goby | *Proterorhinus semilunaris* | Invasive species |
| Walleye | *Sander vitreus* | |
| White Bass | *Morone chrysops* | |
| White Perch | *Morone americana* | Invasive species |
| White Sucker | *Catostomus commersoni* | |
| Yellow Perch | *Perca flavescens* | |