Inland Seas Angler

GREAT LAKES BASIN REPORT©

Special Report – Lake Michigan Part 1

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Highlights of the Annual Lake Committee Meetings

Great Lakes Fishery Commission proceedings, Ypsilanti, MI

This third of a series of annual special reports is a two-part summary of Lake Michigan. This lake committee report is from the annual Lake Committee meetings hosted by the Great Lakes Fishery Commission in March 2019. We encourage reproduction with the appropriate credit to the GLSFC and the agencies involved. Our thanks to IL DNR, IN DNR, MI DNR; USFWS; USGS and the many other DNR biologists who make this all happen, and also thanks to the staffs of the GLFC and USGS for their contributions to these science documents. Thanks also to the Great Lakes Fishery Commission, its staff, Bob Lamb & Marc Gaden, for their efforts in again convening and hosting the Lake Committee meetings in Ypsilanti, MI.

Lake Michigan – Part 1

Index of Reports

Highlights

- Age distribution of alewives remained truncated with no alewife age exceeding 5 years
- Bloater biomass was 2.60 kg/ha in 2018, unchanged from 2017, but still only 14% of the long-term average.
- Round goby biomass was 1.25 kg/ha in 2018, the 3rd largest estimate in the time series
- Rainbow smelt biomass was 0.45 kg/ha, the highest since 2006 but only 21% of the long-term average
- Deepwater sculpin biomass was 1.30 kg/ha in 2018, the highest since 2007 but only 20% of the long-term average
- Slimy sculpin biomass was only 0.07 kg/ha in 2018, similar to the very low levels since 2012 and only 17% of the long-term average
- Overall, the total prey fish biomass (sum of alewife, bloater, smelt, sculpins, slimy sculpin, and ninespine stickleback) in 2018 was 6.22 kg/ha, roughly 65% greater than in 2017 but still only 17% of the long-term average
- Total biomass density has trended downward since 1989, primarily due to a dramatic decrease in bloater biomass
- In 2018, no age-0 yellow perch were caught, indicating a weak year-class.
- A total of 9.44 million salmonines were stocked into Lake Michigan in 2018, the lowest number stocked since 1972
- In 2018, 1.64 million Chinook salmon were stocked, a 19% increase from 2017
- 0.89 million Brown Trout were stocked in 2018, a 12% decrease from 2017, a 44% and 29% decrease from the recent 5-year mean
- 2.52 million Lake Trout yearlings were stocked in 2018, a 9% decrease from 2017, the lowest since 2004
- 1.98 million Rainbow trout were stocked in 2018, a 33% increase from the recent 5-year mean in Michigan waters
- 2.41 million Coho salmon were stocked in 2018, a 9% decrease from the total stocked in 2017
- Lake whitefish Commercial harvest in Wisconsin waters was 1.23 million lbs in 2017, an increase of nearly 100,000 lbs. from 2016
- 555,000 eggs were taken from 510 Coho at the Root River weir in 2018
- 632,758 Chambers and 559,925 Ganaraska Rainbow Trout eggs were taken in April 2019 at the Root River weir
- 1.9 million eggs were taken from 3,866 Chinook Salmon at the Strawberry Creek Weir
- A total of 690 (10.6%) of the 6,528 1ake trout were unclipped and presumed to be wild.
- Wild fish accounted for 37% of lake trout in Illinois waters
- Widespread recruitment of wild fish is now occurring in the southern Lake Michigan where objectives for spawner abundance, age composition, percent spawning females, and thiamine egg concentrations have generally been achieved
- No live bighead or silver carp were found in any new locations immediately downstream of the electronic barrier

Abbreviation	Expansion
CPH	Catch per hectare
CWT	Coded Wire Tag
LMC	Lake Michigan Committee
KT	1,000 metric tons
MDNR	MI Dept. of Natural Resources
SLCP	Sea Lamprey Control Program
USFWS	U.S. Fish and Wildlife Service
WTG	Walleye Task Group
YAO	Age 1 and older
YOY	Young of the year (age 0)

Status/Trends of Prey Fish Populations in Lake Michigan, 2018 (USGS)

Abstract

The U.S. Geological Survey Great Lakes Science Center has conducted lake-wide surveys of the fish community in Lake Michigan each fall since 1973 using standard 12 m bottom trawls towed along contour at depths of 9 to 110 m at each of seven index transects. The survey provides relative abundance and biomass estimates between the 5 m and 114 m depth contours of the lake for prey fish populations, as well as for burbot and yellow perch. The resulting data are used to estimate various population parameters that are in turn used by state and tribal agencies in managing Lake Michigan fish stocks. All seven established index transects of the survey were completed in 2018, although depths 64 m and greater offshore of Frankfort could not be completed due to excessive dreissenid mussel biomass on our multiple tow attempts. Mean biomass of alewives in 2018 was estimated at 0.54 kg/ha, which was the highest value since 2013, but still only 6.7% of the long-term average (7.96 kg/ha).

Age distribution of alewives remained truncated with no alewife age exceeding 5 years. Bloater biomass was 2.60 kg/ha in 2018, relatively unchanged from 2017, but still only 14% of the long-term average. Round goby biomass was 1.25 kg/ha in 2018, the 3rd largest estimate in the time series and 62% higher than the average since they were first sampled in 2003. Rainbow smelt biomass was 0.45 kg/ha, which was the highest since 2006 but only 21% of the long-term average. Likewise, deepwater sculpin biomass was 1.30 kg/ha in 2018, which was the highest since 2007 but only 20% of the long-term average. Slimy sculpin biomass was only 0.07 kg/ha in 2018, and similar to the very low levels estimated since 2012 and only 17% of the long-term average. Ninespine stickleback remained very rare in 2018 (0.004 kg/ha), and only 1% of the long-term average. Overall, the total prey fish biomass (sum of alewife, bloater, rainbow smelt, deepwater sculpin, slimy sculpin, round goby, and ninespine stickleback) in 2018 was 6.22 kg/ha, roughly 65% greater than in 2017 but still only 17% of the long-term average. With respect to other species of interest, burbot biomass was only 0.04 kg/ha in 2018 (18% of the long-term average) and no age-0 yellow perch were caught in 2018, indicating a weak year-class.

Ages were estimated for alewives using otoliths from our bottom trawl catches. Although our surveys have included as many as nine index transects in any given year, we have consistently conducted the surveys at seven transects, and data from those seven transects are reported herein. These transects are situated off Manistique, Frankfort, Ludington, and Saugatuck, Michigan; Waukegan, Illinois; and Port Washington and Sturgeon Bay, Wisconsin **(Fig 1).** All seven transects were completed in 2018, although depths 64 m and greater offshore of Frankfort could not be completed due to excessive dreissenid mussel biomass on our multiple tow attempts.

Alewife

Since its establishment in the 1950s, the alewife has become a key member of the fish community. As a predator on larval fish, adult alewife can depress recruitment of native fishes, including burbot, deepwater sculpin, emerald shiner, lake trout and yellow perch. Additionally, alewife has remained the most important constituent of salmonine diet in Lake Michigan for the last 45 years. Most of the alewives consumed by salmonines in Lake Michigan are eaten by Chinook salmon. A commercial harvest was established in Wisconsin waters of Lake Michigan in the 1960s to make use of the then extremely abundant alewife that had become a nuisance and health hazard along the lakeshore. In 1986, a quota was implemented, and as a result of these restrictions, the estimated annual alewife harvest declined from about 7,600 metric tons in 1985 to an incidental harvest of only 12 metric tons after 1990. Lake Michigan currently has no commercial fishery for alewives.

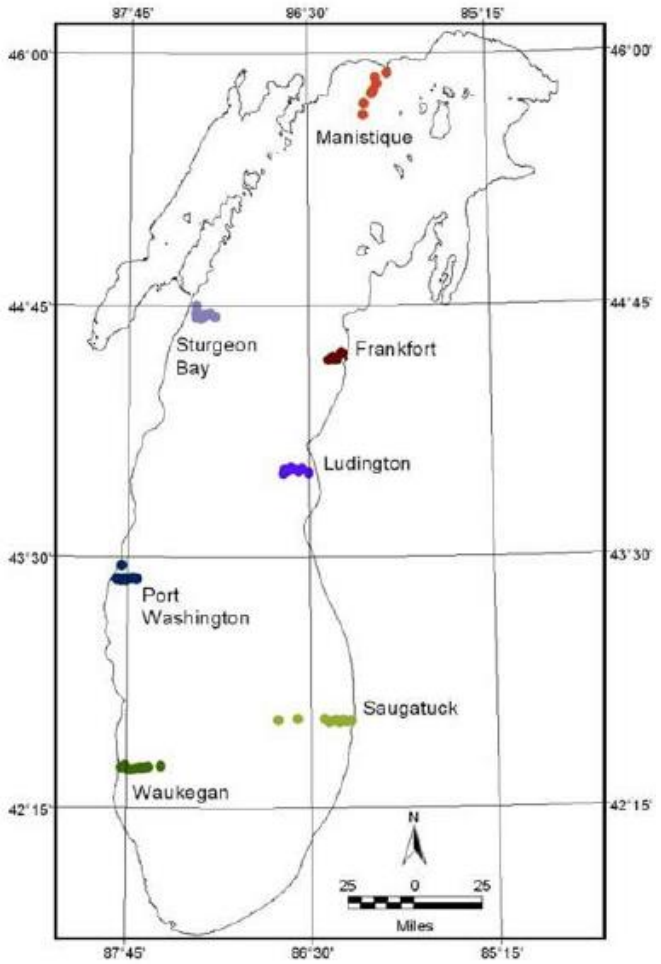


Fig 1- Sampling locations of GLSC bottom trawls in Lake *Michigan*

According to the bottom trawl survey results in 2018, adult alewife biomass density equaled 0.54 kg/ha **(Fig 2a)** and numeric density equaled 29.4 fish/ha **(Fig 2b**). For the 2nd time in 4 years, no age-0 alewives were captured during the survey, indicating these fish occupy the bottom of the lake during the day less than in previous years. Alewives were caught at all ports other than Saugatuck during 2018 **(Fig 3**), and the average densities were influenced by a substantial catch of nearly 46 kg/ha (1776 alewife) at the 46 m Sturgeon Bay site **(Fig 3**).

Since 2013, alewives have been sampled in 15 of the 30 non-standard "deep" tows. However, mean alewife biomass density at sites 128 m and deeper was only 0.12 kg/ha, which was lower than the mean of all other depths except 27 m. Over this time period, the depth with the highest mean alewife biomass (e.g., 12.57 kg/ha) was 9 m. Thus, these data do not support a hypothesis that the bottom trawl survey has underestimated alewife biomass because alewife have shifted to deeper waters than typically sampled by the bottom trawl survey (i.e., > 110 m).

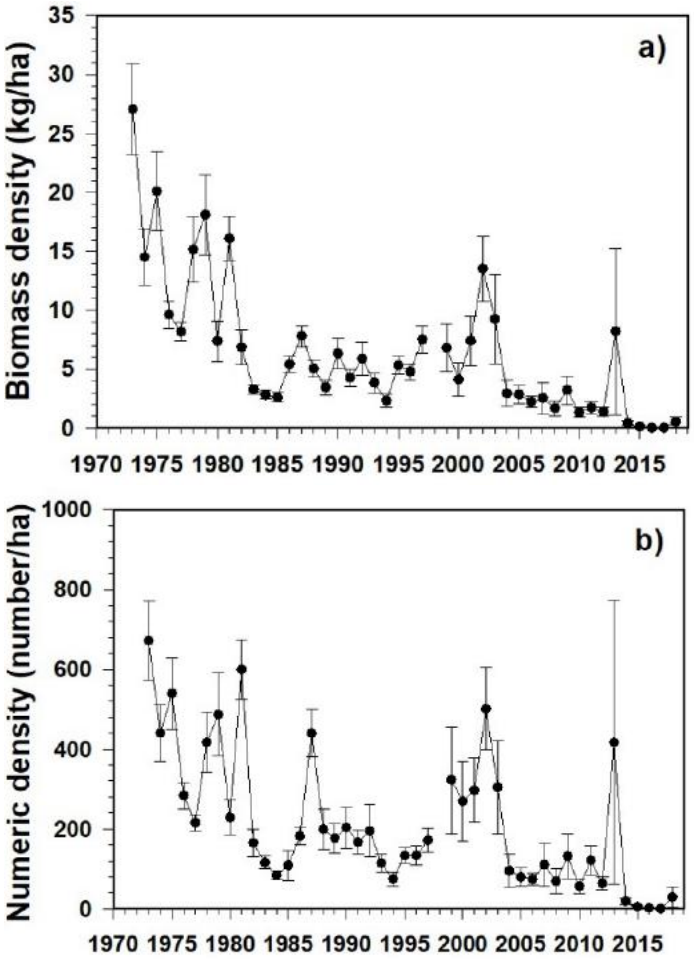


Fig 2- Density of adult alewives as biomass (a) and number (b) per ha (+/- standard error) in Lake Michigan, 1973-2018

The long-term temporal trends in adult alewife biomass, as well as in alewife recruitment to age 3, in Lake Michigan are attributable to consumption of alewives by salmonines. Several factors have likely maintained this high predation pressure in the 2000s including: a relatively high abundance of wild Chinook salmon in Lake Michigan, increased migration of Chinook salmon from Lake Huron in search of alewives, increased importance of alewives in the diet of Chinook salmon in Lake Michigan, a decrease in the energy density of adult alewives, and increases in lake trout abundance due to increased rates of stocking and natural reproduction. As adults, there is no evidence for starvation among alewives despite declining prey resources. The average weight of a 175 mm alewife has actually trended slightly upward ($F_{1,21}=4.81$; $P = 0.04$) since 1996 when alewife condition dropped to its lowest level.

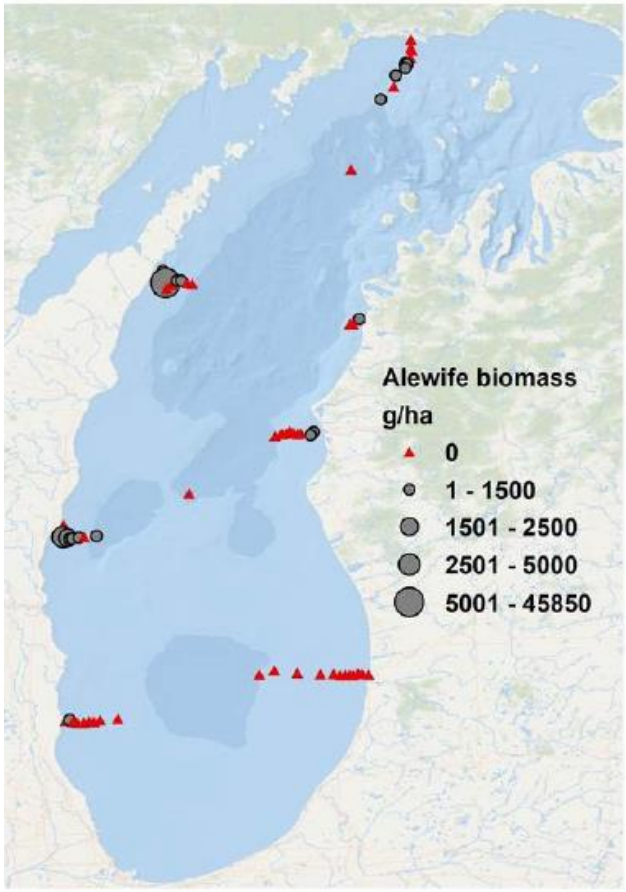


Fig 3- Scaled-symbol plot showing the biomass of alewife sampled during each of the 2018 bottom trawl sites

In 2018, 189 "adult" (i.e., >100 TL) alewives from the survey were aged to construct an age-length distribution. Similar to 2017, the age composition was dominated by age-1 (33%, 2017 year-class) and age-2 (62%, 2016 year-class) fish. Age-3 (2015 year-class), age-4 (2014 year-class), and age-5 (2013 year-class) fish represented 4%, 0.4% and 0.3%, respectively, of the remaining adults, **(Fig 4).** No alewives older than age 5 were caught in the survey; thus, the recent trend of age truncation in the alewife population continued through 2018. Likewise, no alewives older than age 5 were caught in the acoustics survey in 2018. Prior to 2009, age-8 alewives were routinely captured in the bottom trawl survey.

Both the acoustic and bottom trawl survey time series for total alewife biomass are in general agreement, indicating that biomass during 2004-2018 was relatively low compared with biomass during 1994-1996. Across the 22 years, however, the acoustic estimate has been higher than the bottom trawl survey estimate 82% of the time. The discrepancy between the two estimates has increased between 2014 and 2018, with the acoustic estimate ranging from 10 to nearly 200 times higher during this 4-year period. In 2018, the estimate for adult alewife biomass in the acoustic survey was 10 times higher than the estimate for the bottom trawl survey. Given that alewife historically have not fully recruited to the bottom trawl until age 3 and the majority of the alewife population we sampled was age-1 and 2, it is not surprising that the acoustic survey estimates a higher number of alewives. Thus, the recent higher discrepancy between the two surveys may partially be explained by the alewife population becoming younger in recent years.

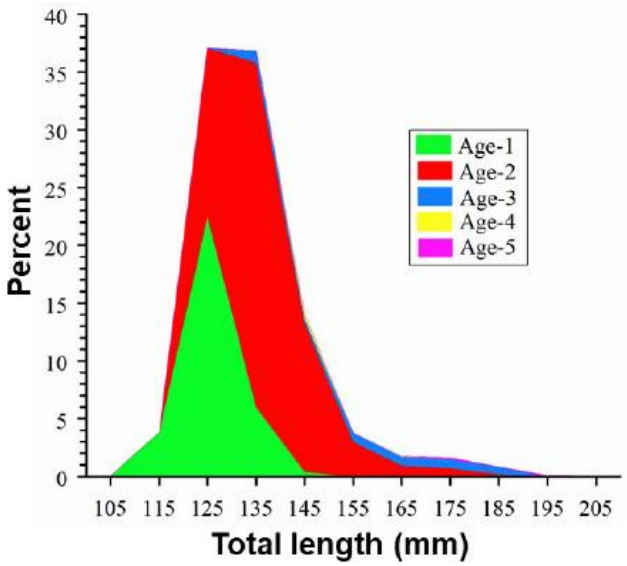
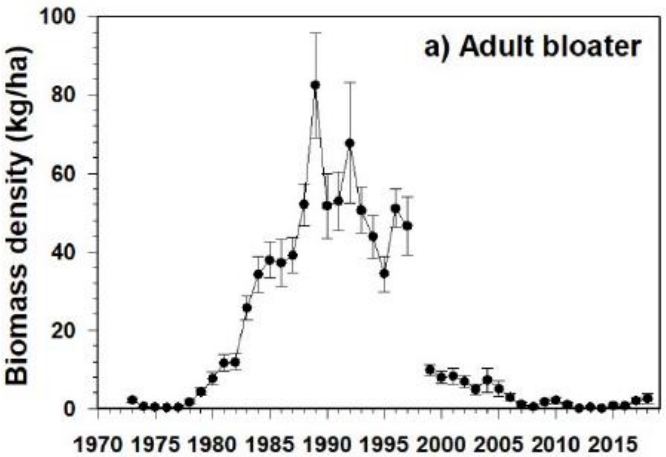


Fig 4 - Age-length distribution of alewives ≥ 100 mm total length caught in bottom trawls in Lake Michigan, 2018

Bloater

Bloaters are eaten by salmonines in Lake Michigan, but are far less prevalent in salmonine diets than alewives. For large (≥ 600 mm) lake trout, over 30% of the diets offshore of Saugatuck and on Sheboygan Reef were composed of adult bloaters during 1994-1995, although adult bloaters were a minor component of lake trout diet at Sturgeon Bay. For Chinook salmon, the importance of bloater (by wet weight) in the diets has declined between 1994-1995 and 2009-2010. For small (< 500 mm) Chinook salmon the proportion declined from 9% to 6% and for large Chinook salmon the proportion declined from 14% to <1%. The bloater population in Lake Michigan also supports a valuable commercial fishery, although its yield has declined sharply since the late 1990s.



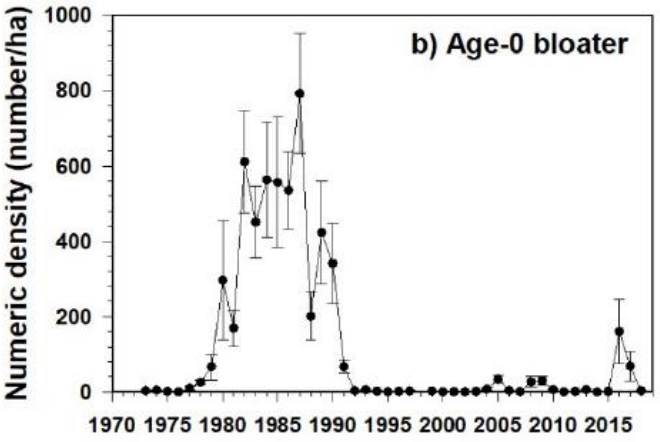


Fig 5-Density per ha of adult bloater (a, in terms of biomass) and age-0 bloater (b, number) in Lake Michigan, 1973-2018

Adult bloater biomass density in our survey has been < 10 kg/ha since 1999 **(Fig 5a).** Nevertheless, adult bloater biomass has exceeded 2 kg/ha since 2017, a nearly fivefold increase over the record-low levels measured from 2012-2016. This increase in adult bloater biomass was attributable to the relatively strong 2016 and 2017 year-classes **(Fig 5b**). In 2018, however, densities of age-0 bloater were only 3 fish/ha, more comparable to the low levels of recruitment observed from 2010-2015. Bloaters were sampled in all ports in 2018 except Frankfort where deeper tows could not be completed **(Fig 6).** The highest mean biomass was at Port Washington at 55 and 64 m.

Since 2013, bloaters have been sampled in 11 of 30 deep tows. However, mean bloater biomass density at sites 128 m and deeper was only 0.15 kg/ha, which was lower than the mean biomass of each of the depths from 46 to 110 m. The depth with the highest mean biomass since 2013 was 64 m (e.g., 3.89 kg/ha). Thus, the data do not support a hypothesis that the bottom trawl survey has underestimated bloater biomass because it does not sample a large proportion of the bloater population that occupies the bottom of the lake in depths deeper than 110 m.

The exact mechanisms underlying the apparently poor bloater recruitment from 1992-2015 period (**Fig 5b**), and the low biomass of adult bloater since 2007 **(Fig 5a),** remain unknown proposed that the Lake Michigan bloater population may be cycling in abundance, with a period of about 30 years, although the exact mechanism by which recruitment is regulated remains unknown. Of the mechanisms that have been recently evaluated, reductions in fecundity associated with poorer condition and egg predation by slimy and deepwater sculpins may be contributing to the reduced bloater recruitment, but neither one is the primary regulating factor.

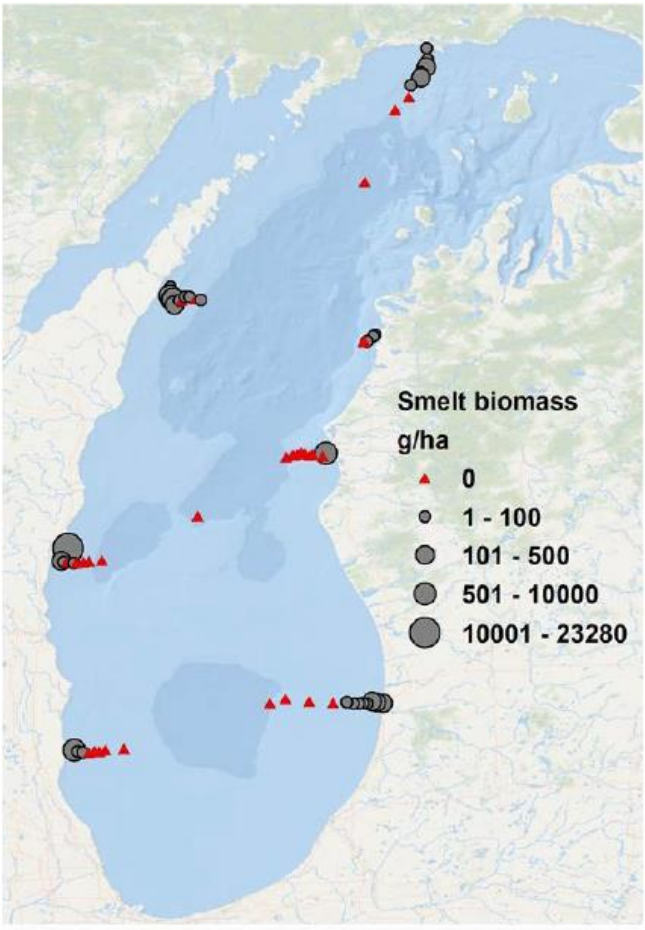


Fig 6-Scaled-symbol plot showing the biomass of Bloater sampled during each of the 2018 bottom trawl sites

An important consideration when interpreting the bottom trawl survey results is that bloater catchability may have decreased in recent years, in response to the proliferation of quagga mussels and the associated increased water clarity and decreased *Diporeia* spp. densities, which could be responsible for a shift to the more pelagic calanoid copepods in their diets. Hence, one hypothesis is that bloaters are less vulnerable to our daytime bottom trawls either because of behavioral changes (more pelagic during the day) or increased ability to avoid the net while on the bottom (due to clearer water). Further, vulnerability of bloaters to our bottom trawl survey may have decreased more for large bloaters than for small bloaters. In recent years, nearly all of the bloaters captured by our bottom trawls were less than 240 mm in TL, whereas commercial fishers using gill nets continue to harvest bloaters well over 300 mm in TL. Perhaps, in recent years, bloaters have become more pelagic and/or better able to avoid the net as they grow.

Both the acoustic and bottom trawl survey have assessed that bloater biomass was more than an order of magnitude higher during 1992-1996 than during 2001-2018. A comparison of the two surveys during 1992-2006 revealed that the biomass estimate from the bottom trawl survey was always higher

(about 3 times higher, on average) than the acoustic survey estimate. Since 2007, either survey was just as likely to yield the higher estimate as the other survey. In 2018, total biomass density estimated for bloater from the bottom trawl survey (2.60 kg/ha) was relatively similar to that from the acoustic survey.

Rainbow smelt

Adult rainbow smelt have been an important part of the diet for intermediate-sized (400 to 600 mm) lake trout in the nearshore waters of Lake Michigan. For Chinook salmon, rainbow smelt comprised as much as 18% in the diets of small individuals in 1994-1996, but that dropped precipitously to 2% in 2009-2010. Rainbow smelt has been consistently rare in the diets of larger Chinook salmon since 1994. The rainbow smelt population has traditionally supported commercial fisheries in Wisconsin and Michigan waters, but its yields have also declined through time. Between 1971 and 1999, more than 1.3 million lbs were annually harvested on average. Between 2000 and 2011, the annual average dropped to about 375,000 lbs. Since 2013, less than 2,000 pounds have been harvested per year.

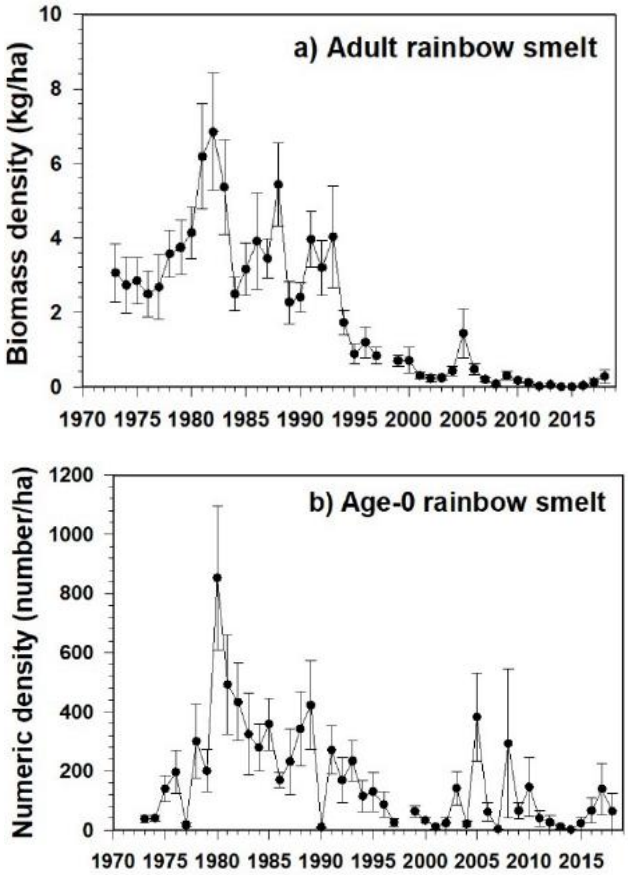


Fig 7-Density per ha (+/- standard error) of adult smelt (a, in terms of biomass) and age-0 smelt (b, in terms of number) in Lake Michigan, 1973-2018.

Similar to the commercial yields, adult rainbow smelt biomass density in the bottom trawl has remained at low levels since 2001, aside from a relatively high estimate in 2005 **(Fig 7a).** Biomass in 2018 was 0.27 kg/ha, more than double the mean from 2017 and the highest estimate since 2009. This recent uptick was due to the high densities of age-0 (< 90 mm TL) rainbow smelt sampled in 2016 and 2017 **(Fig 7b**), and the 2018 estimate (63 fish/ha) was also relatively high compared to 2011-2015. Rainbow smelt were sampled at all seven ports in 2017 (**Fig 8**), with the highest mean biomass densities at 18 m at Port Washington, Ludington, Waukegan. Rainbow smelt have only been sampled in 2 of the 30 non-standard deep tows since 2013. Their highest mean biomass over this period has been at 18 m. Causes for the long-term decline in rainbow smelt biomass since 1993 remain unclear. Consumption of rainbow smelt by salmonines was higher in the mid-1980s than during the 1990s, yet adult and age-0 rainbow smelt abundance remained high during the 1980s (**Fig 7b**). Results from a recent population modeling exercise suggested that predation by salmonines was not the primary driver of long-term temporal trends in Lake Michigan rainbow smelt abundance. Furthermore, a recent analysis of our time series suggested that the productivity of the population has actually increased since 2000 (relative to 1982-1999), yet those recruits do not appear to be surviving as well to the adult population.

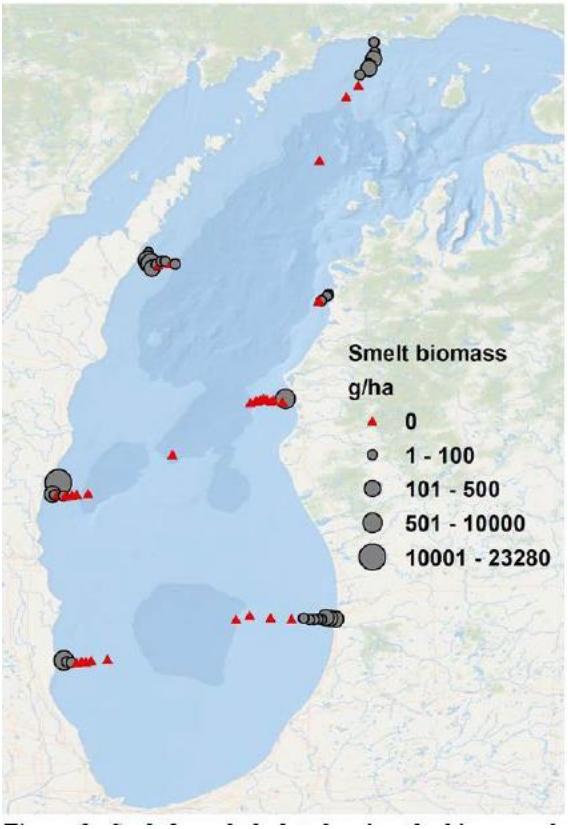


Fig 8-Scaled-symbol plot showing the biomass of smelt sampled during each of the 2017 bottom trawl sites.

The bottom trawl and acoustic surveys detected similar temporal trends, with total (age-0 and adult pooled) rainbow smelt biomass densities more than 7 times higher, on average, during 1992-1996 than during 2001-2017. A

comparison of the two survey estimates revealed that the acoustic survey estimate generally exceeds that of the bottom trawl survey, on average by a factor of about 6. This difference is not surprising given that rainbow smelt tend to be more pelagic than other prey species during the day. In 2018, however, the total biomass estimate for all rainbow smelt was 0.09 kg/ha for the acoustic survey, which was actually lower than the bottom trawl survey estimate of (0.45 kg/ha).

Sculpins

From a biomass perspective, the cottid populations in Lake Michigan have been dominated by deepwater sculpins, and to a lesser degree, slimy sculpins. Spoonhead sculpins, once fairly common, suffered declines to become rare to absent by the mid-1970s. Spoonhead sculpins were encountered in small numbers in our survey between 1990 and 1999, but have not been sampled since 1999.

Slimy sculpin is a favored prey of juvenile lake trout in Lake Michigan, but is only a minor part of adult lake trout diets. When abundant, deepwater sculpin can be an important diet constituent for burbot in Lake Michigan, especially in deeper waters.

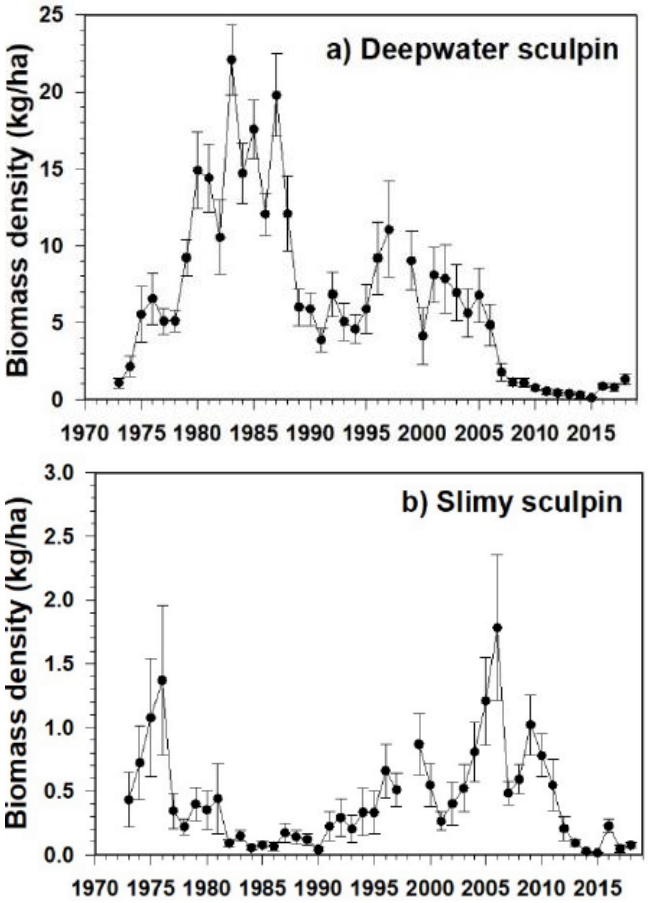


Fig 9-Biomass density (+/- standard error) for deepwater sculpin (a) and slimy sculpin (b) in Lake Michigan, 1973-2018

Deepwater sculpin biomass density in 2018 was 1.30 kg/ha, the highest biomass estimated since 2007 **(Fig 9a),** and a continuation of increasing biomass since 2015. Relative to historical values from 1979-1988 (mean = 14.7 kg/ha) and 1989-2006 (mean = 6.3 kg/ha), however, deepwater sculpin remain at relatively low levels since 2007 (mean = 0.78 kg/ha). Previous analysis of the time series indicated deepwater sculpin density is negatively influenced by alewife and burbot. Madenjian and Bunnell demonstrated that deepwater sculpins have been captured at increasingly greater depths since the 1980s. Therefore, one potential explanation for the decline since 2007 is an increasing proportion of the population occupying depths deeper than those sampled by our survey (i.e., 9-110 m), perhaps in response to the decline of *Diporeia* and proliferation of dreissenid mussels. Our sampling at deeper depths since 2013 has been supportive of this hypothesis given that deepwater sculpins have been sampled in all 30 deep tows. Moreover, among these years the mean biomass density increased with depth out to the sites 128 m and deeper. Hence, the hypothesis that the bulk of the deepwater sculpin population in Lake Michigan now occupies waters deeper than 110 m is supported by our data and the long-term trend of declining deepwater sculpin biomass illustrated in the survey may be an artifact of our standard sampling out to only 110 m.

Slimy sculpin biomass density in 2018 was 0.07 kg/ha, similar to the extremely low densities estimated in 2013-2015 and 2017. Overall, slimy sculpin biomass density has substantially declined since 2009 **(Fig 9b).** Slimy sculpin abundance in Lake Michigan is regulated, at least in part, by predation from juvenile lake trout. We attribute the slimy sculpin recovery that occurred during the 1990s to, in part, the 1986 decision to emphasize stocking lake trout on offshore reefs (as opposed to the areas closer to shore where our survey samples. Likewise, the slimy sculpin decline that began in 2009 coincided with a substantial increase in the rate of stocking juvenile lake trout into Lake Michigan and an increase in natural reproduction by lake trout. Since 2013, slimy sculpins have been sampled in 15 out of 30 deep tows. However, mean biomass density at sites 128 m and deeper (e.g., 0.02 kg/ha) were an order of magnitude lower than the biomass estimated at 73, 82, 91, and 110 m sites. Since 2013, the highest mean biomass has been estimated at 82 m (e.g., 0.18 kg/ha). These results suggest that a relatively small proportion of the population resides in waters deeper than 110 m.

Round goby

The round goby is an invader from the Black and Caspian Seas. Round gobies have been observed in bays and harbors of Lake Michigan since 1993 and were captured in the southern main basin of the lake as early as 1997. Round gobies were not captured in the bottom trawl survey until 2003; our survey likely markedly underestimates round goby abundance given their preferred habitat includes rocky and inshore (i.e., < 9 m bottom depth) areas that we do not sample. By 2002, round gobies had become an integral

component of yellow perch diets at nearshore sites (i.e., < 15 m depth) in southern Lake Michigan. Recent studies have revealed round gobies are an important constituent of the diets of Lake Michigan burbot, yellow perch, smallmouth bass, lake trout, lake whitefish, and even cisco.

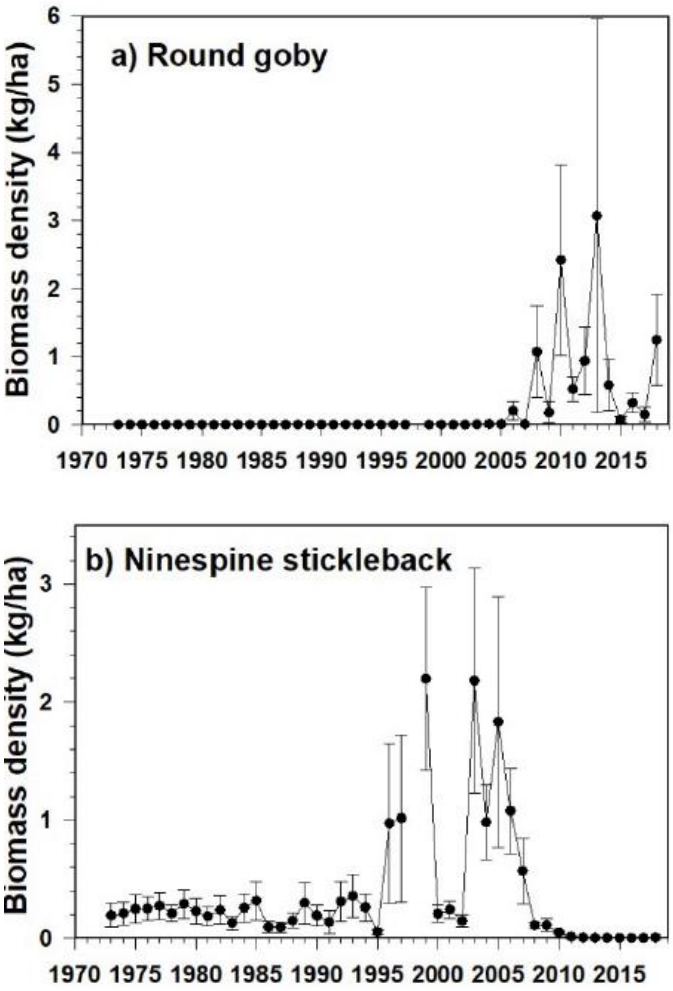


Fig 10- Biomass density (+/- standard error) of round goby (a) and ninespine stickleback (b) in Lake Michigan, 1973-2018

Round goby biomass density equaled 1.25 kg/ha in 2018 **(Fig 10a**), the 3rd highest estimate of the time series. Round gobies were sampled at all seven ports in 2018 (Figure 12), with the highest mean biomass densities near the western shoreline which generally has rockier habitat. We hypothesize that round goby abundance in Lake Michigan is controlled by predation. This hypothesis was supported by annual mortality rates of between 79 and 84% estimated in 2008-2012, which are comparable to the mortality rates currently experienced by Lake Michigan adult alewives.

Ninespine stickleback

Two stickleback species occur in Lake Michigan. Ninespine stickleback is native, whereas threespine stickleback is non-native and was first collected in the GLSC bottom trawl survey during 1984, but has been extremely rare in recent sampling years. Biomass density of ninespine stickleback in 2017 was only 4.5 g per ha, continuing a trend of very low biomass since 2011 **(Fig 10b**). Biomass of ninespine stickleback remained fairly low from 1973-1995 and then increased dramatically through 2007, perhaps attributable to dreissenid mussels enhancing ninespine stickleback spawning and nursery habitat through proliferation of *Cladophora*. One plausible explanation for the low ninespine stickleback abundance since 2011 is that piscivores began to incorporate ninespine sticklebacks into their diets as the abundance of alewives declined to a lower level. For example, Jacobs et al. (2013) found ninespine sticklebacks in large Chinook salmon diets (i.e., 2% occurrence) during 2009-2010 after 0% occurrence in 1994-1996.

Community Trends

The prey fish community includes alewife, bloater, rainbow smelt, deepwater sculpin, slimy sculpin, ninespine stickleback, and round goby. In 2018, we estimated a total biomass density of prey fish available to the bottom trawl equal to 6.22 kg/ha (**Fig 11a**,), which is a 65% increase relative to 2017 but still far below the long-term average total biomass of 36.9 kg/ha. Total biomass density has trended downward since 1989, primarily due to a dramatic decrease in bloater biomass **(Fig 11a**).

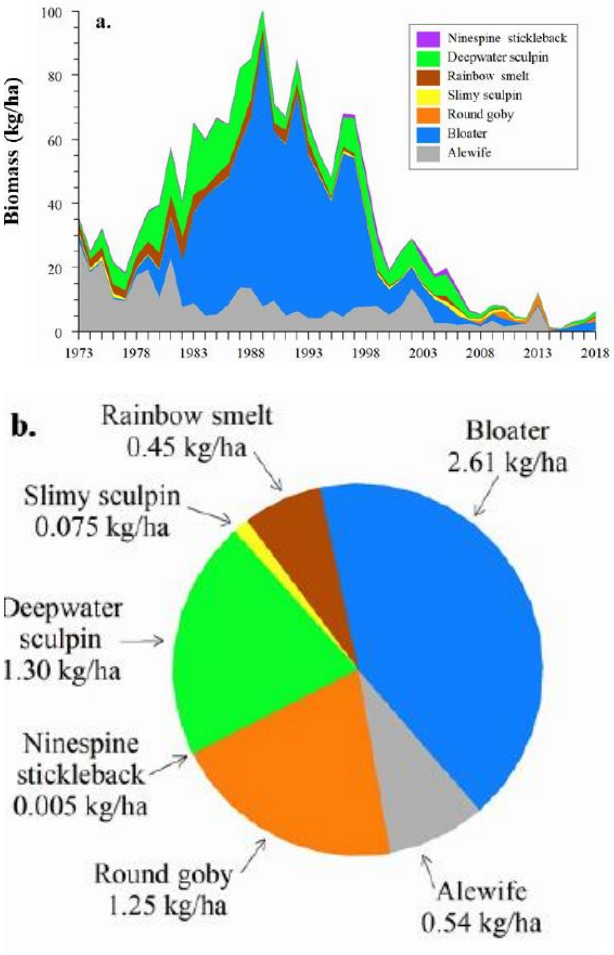


Fig 11-Estimated biomass of prey fishes, 1973-2018 (a) and species composition, 2018 (b*)*

Total biomass density first dropped below 13 kg/ha in 2007 and has since remained below that level with the exception of 2013 (when the biomass estimates for alewife and round goby were highly uncertain). In previous reports, we have reported "lake-wide" biomass of preyfish in terms of kilotonnes, but we now have ceased usage of this term in the report to reduce confusion. To be clear, the bottom trawl survey has never sampled lake-wide, but since 2014 a new predator-prey model has been developed that uses information from this bottom trawl prey fish survey, the acoustic prey fish survey, and a predator consumption model to provide a more realistic "lake-wide" biomass for alewife, a key prey fish.

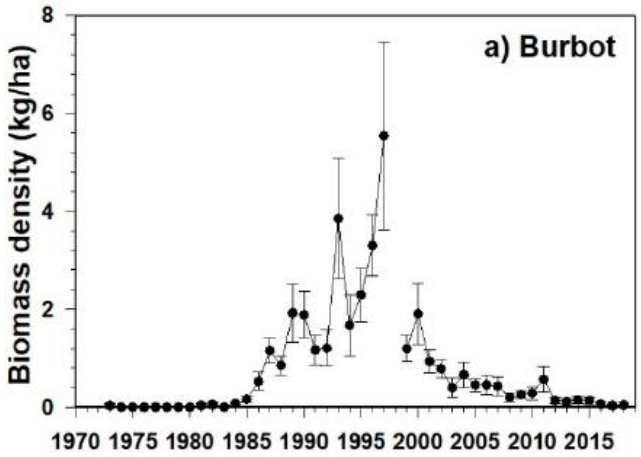
For the fourth straight year, the composition of the 2018 prey fish community (as assessed by the bottom trawl) was dominated by bloater (42%, **Fig 11b**). Deepwater sculpin (21.7%) and round goby (20%) each made considerable contributions to the biomass, whereas alewife (9%), rainbow smelt (7%), slimy sculpin (1%), and ninespine stickleback (<1%) each comprised less than 10% of the community.

Other Species Of Interest

Burbot

Burbot and lake trout represent the native top predators in Lake Michigan. The decline in burbot abundance in Lake Michigan during the 1950s has been attributed to sea lamprey predation. Sea lamprey control was a necessary condition for recovery of the burbot population in Lake Michigan, however Eshenroder and Burnham-Curtis (1999) proposed that a reduction in alewife abundance was an additional prerequisite for burbot recovery.

Burbot collected in the bottom trawls are typically large individuals (>350 mm TL); juvenile burbot apparently inhabit areas not usually covered by the bottom trawl survey. Burbot biomass density was 0.04 kg/ha in 2018, c,onsistent with extremely low estimates since 2012. After a period of low biomass density in the 1970s, burbot showed a strong recovery in the 1980s **(Fig 12a).** Densities increased through 1997 but declined thereafter. It is unclear why burbot catches in the bottom trawl survey have declined in the face of relatively low alewife densities.



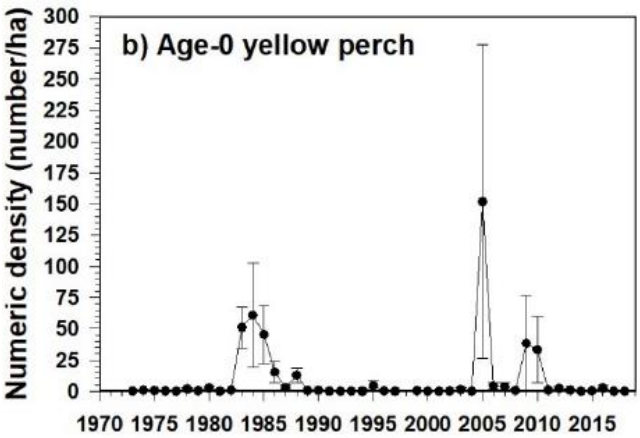


Fig 12-Biomass density of burbot (a) and numeric density of age-0 yellow perch (b) in Lake Michigan, 1973-2018

Age-0 yellow perch

The yellow perch population in Lake Michigan has supported valuable recreational and commercial fisheries. GLSC bottom trawl surveys provide an index of age-0 yellow perch numeric density, which serves as an indication of yellow perch recruitment success. The 2005 year-class of yellow perch was the largest ever recorded **(Fig 12b**) and the 2009 and 2010 year-classes also were higher than average. In 2018, no age-0 yellow perch were caught, indicating a weak year-class.

Conclusions

In 2018, total prey fish biomass was estimated to be 6.22 kg/ha, which is a 65% increase over 2017 and a five-fold increase over the record-low estimate from 2015. Every species was estimated to attain a higher biomass density in 2018 than in 2017, with round goby providing the largest percentage increase. Relative to the long-term average of 36.9 kg/ha, however, the 2018 estimate indicates relatively low biomass densities of prey fish in Lake Michigan.

This low level of prey fish biomass can be attributable to a suite of factors, two of which can be clearly identified: (1) a prolonged period of poor bloater recruitment during 1992-2015 and (2) intensified predation on alewives by salmonines during the 2000s and 2010s. Adult alewife density has been maintained at a relatively low level over the last 15 years and the age distribution of the adult alewife population has become especially truncated in recent years. As recent as 2007, alewives as old as age 9 were sampled in this survey, whereas the oldest alewife sampled since 2013 has been age 6 or younger, with age 5 being the oldest in 2013, 2014, 2017, and 2018.

We also note that the striking decrease in deepwater sculpin biomass after 2006 appears to have been due, at least in part, to a substantial portion of the population moving to waters deeper than 110 m. Results from the deep tows that we have conducted since 2013 corroborate the contention that the bulk of the deepwater sculpin population in Lake Michigan now inhabits waters deeper than 110 m.

In addition to the importance of top-down forces, prey fishes also may be negatively influenced by reduced prey resources (i.e., "bottom-up" effects). For example, several data sets are indicating a reduction in the base of the food web, particularly for offshore total phosphorus and phytoplankton, as a consequence of long-term declines in phosphorus inputs and the proliferation of dreissenid mussels. Grazing of phytoplankton by dreissenid mussels and reduced availability of phosphorus in offshore waters appeared to be the primary drivers of the 35% decline in primary production in offshore waters between the 1983-1987 and 2007-2011 periods. The quagga mussel expansion into deeper waters may have been partly responsible for this reduced availability of phosphorus in offshore waters.

The evidence for declines in "fish food" (e.g., zooplankton and benthic invertebrates) in offshore waters of Lake Michigan is somewhat less clear. *Diporeia* has undoubtedly declined in abundance, but whether or not crustacean zooplankton and mysids have declined depends on which data set is examined. Crustacean zooplankton biomass density in nearshore waters appeared to decrease during 1998-2010, likely due to a reduction in primary production mainly stemming from grazing of phytoplankton by dreissenid mussels. The above-mentioned decline in *Diporeia* abundance appeared to have led to reductions in growth, condition, and/or energy density of lake whitefish, alewives, bloaters, and deepwater sculpins during the 1990s and 2000s. Of course, decreases in growth, condition, and energy density do not necessarily cause declines in fish abundance. The challenge remains to quantify bottom-up effects on prey fish abundances and biomasses in Lake Michigan. Given the complexities of the food web, disentangling the effects of the dreissenid mussel invasions and the reduction in nutrient loadings from other factors influencing the Lake Michigan food web will require a substantial amount of ecological detective work. ✧

Summary of 2018 Salmonine Stocking in Lake Michigan

A total of 9.44 million salmonines were stocked into Lake Michigan in 2018, the lowest number stocked since 1972. The Fish and Wildlife Service stocked 96% of the lake trout while state agencies stocked all Pacific salmon (chinook & coho), brown trout, and rainbow trout.

Lakewide salmonine stocking trends

Chinook salmon

In 2018, 1.64 million were stocked, a 19% increase from 2017. Since 2014, the annual average number of Chinook salmon stocked has also been 1.64 million.

Brown trout

0.89 million were stocked in 2018, a 12% decrease from 2017. This also represents a 44% and 29% decrease from the recent 5-year mean in Wisconsin and Michigan waters, respectively.

Lake trout

2.52 million yearlings were stocked in 2018, a 9% decrease from 2017. Lake trout stockings were the lowest they have been since 2004.

Rainbow trout

1.98 million were stocked in 2018, a 7% increase from the recent 5-year mean in Wisconsin waters and a 33% increase from the recent 5-year mean in Michigan waters.

Coho salmon

2.41 million were stocked in 2018, a 9% decrease from the total stocked in 2017.

1997 2000 2003 2006 2009 2012 2015 2018

	BNT	CHS	COS	LAT.FF	LAT.Y	RBT	Total
1997	1.80	5.74	2.62	-	2.24	1.86	14.27
1998	1.74	5.72	2.06	-	2.30	1.62	13.44
1999	1.65	4.32	2.76	0.07	2.27	1.68	12.77
2000	1.67	4.05	2.5	-	2.26	1.24	11.72
2001	1.75	4.52	2.77	-	2.38	1.85	13.26
2002	1.75	4.02	2.69	0.09	2.14	1.86	12.54
2003	1.65	4.42	3.12	0.25	2.35	2.08	13.88
2004	1.60	4.30	1.69	-	2.35	1.58	11.53
2005	1.52	4.31	2.56	0.14	2.75	2.17	13.45
2006	1.61	3.25	2.43	0.49	2.77	1.79	12.34
2007	1.47	3.17	2.27	0.52	3.10	2.00	12.54
2008	1.47	2.73	2.03	0.24	2.88	1.62	10.96
2009	1.63	3.02	1.75	0.41	2.77	2.07	11.64
2010	1.43	3.29	2.52	0.43	3.00	1.68	12.34
2011	1.34	3.22	2.57	0.53	2.93	1.83	12.41
2012	1.52	3.24	2.74	0.55	3.05	1.93	13.04
2013	1.44	1.76	2.55	0.42	3.02	1.91	11.09
2014	1.22	1.81	2.38	0.48	3.00	1.93	10.82
2015	1.54	1.79	2.76	0.46	3.01	1.71	11.26
2016	1.62	1.78	2.49	-	2.99	2.00	10.88
2017	1.02	1.37	2.66	-	2.77	1.94	9.76
2018	0.89	1.64	2.41	-	2.52	1.98	9.44

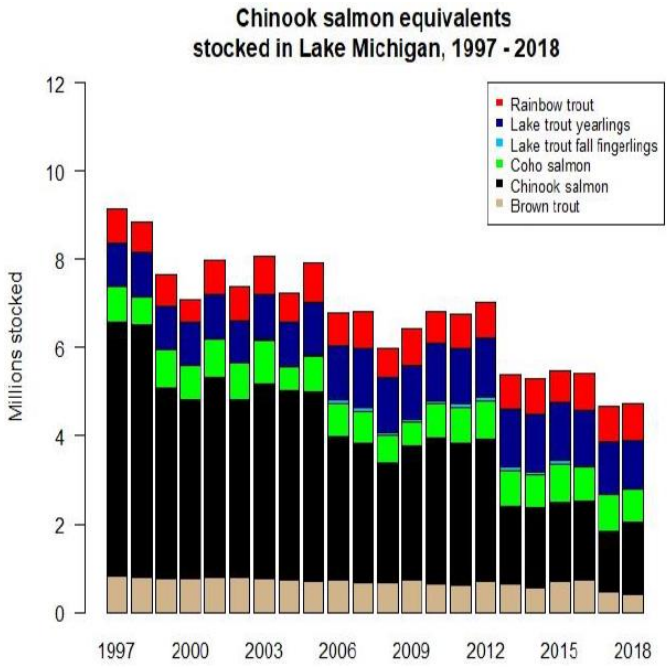


Fig 1- Numbers of trout and salmon stocked in Lake Michigan from 1997-2018

Chinook salmon equivalents

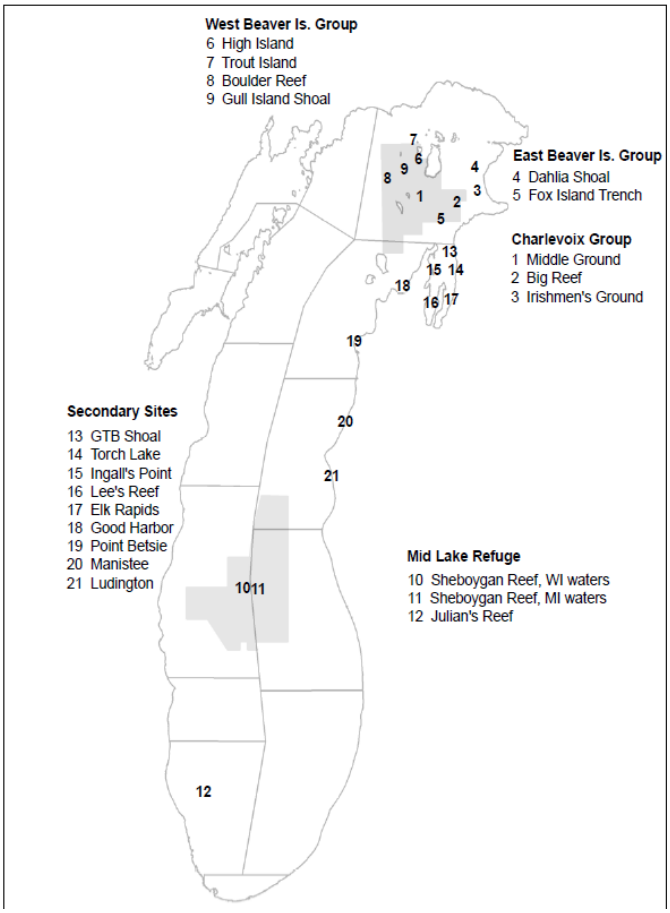
Salmonine stocking directly influences predator-prey ratios in Lake Michigan and this is important in light of long-term declines in the forage base. Salmonids differ in species-specific prey consumption and total prey consumption over their life span. Therefore, we also report salmonid stocking in terms of "chinook salmon equivalents", a standardized metric that expresses total salmonid stocking in terms of their demand on the forage base.

Species-specific conversion values (number of fish required to equal the prey consumption of 1 Chinook salmon) for each species stocked are as follows:

- 3.2 Coho salmon
- 2.4 rainbow trout
- 2.3 yearling lake trout
- 5.8 fall fingerling lake trout
- 2.2 brown trout

For example, 2.4 rainbow trout consume the same amount of prey as one Chinook salmon over their lifetime. Chinook equivalents of all trout and salmon stocked in a given year are calculated by dividing the total number of each species stocked by its conversion factor.

In 2018, 9.44 million salmonids were stocked, but this number is roughly halved when expressed as Chinook equivalents. In 2018, stocking of 4.72 chinook equivalents was just above the number stocked in 2017, which was the lowest since 1972 and should result in decreased demand on the forage base. Conversion values are currently being reassessed with more contemporary diet, stable isotope data and bio-energetic model simulations.



Map 1

First and 2nd priority areas as described in A Fisheries Management Implementation Strategy for the Rehabilitation of Lake Trout in Lake Michigan (Dexter et al. 2011). Northern and Mid Lake Refuges are indicated with shading and the gray lines subdivide the lake into statistical districts. In 2017, stocking efforts were moved from the Hog Island Reef and Ile aux Galets in the East Beaver Island Group to the Fox Island Trench to avoid excessive by-catch from commercial fishing.

Lake trout stocking locations

Per the *Implementation Strategy*, roughly 2/3 of the lake trout are stocked offshore in 1st Priority areas for rehabilitation efforts. These areas include reefs within the Northern Refuge (West Beaver, East Beaver, and Charlevoix Reef Complex groupings) and the Mid Lake Refuge. The remaining 1/3 are stocked in 2nd Priority nearshore areas to support both recreational fisheries and rehabilitation efforts **(Map 1)**.

In 2018, 1.44 million yearling lake trout were stocked at the Northern 1st Priority sites and 0.48 million yearlings at the mid-lake refuge 1st Priority sites. Nearshore areas (2nd Priority) received an additional 0.49 million yearlings. MIDNR stocked just over 0.1 million into the 2nd priority area. Lake trout numbers stocked, locations, strains, and CWT numbers are provided in **Table 1**.

In 2018, the FWS and MIDNR stocked a total 2.52 million lake trout yearlings in first and second priority sites.

Since 2010, all stocked lake trout have been marked with an adipose clip and a coded wire tag (CWT) was implanted in the fish's snout. For all lake trout a unique CWT code was used to indicate strain and stocking location. All 1st Priority sites have distinct CWT's as do all 2nd priority sites within each statistical district. The current tagging plan was designed to measure the movement, growth, and relative survival of among genetic strains, year classes, and stocking locations from subsequent recoveries in assessment surveys, and commercial and recreational fisheries. ✧

Harvest of fishes from Lake Michigan during 2018

Fig 1- Total harvest of fish by method from Lake Michigan, 1985 – 2018

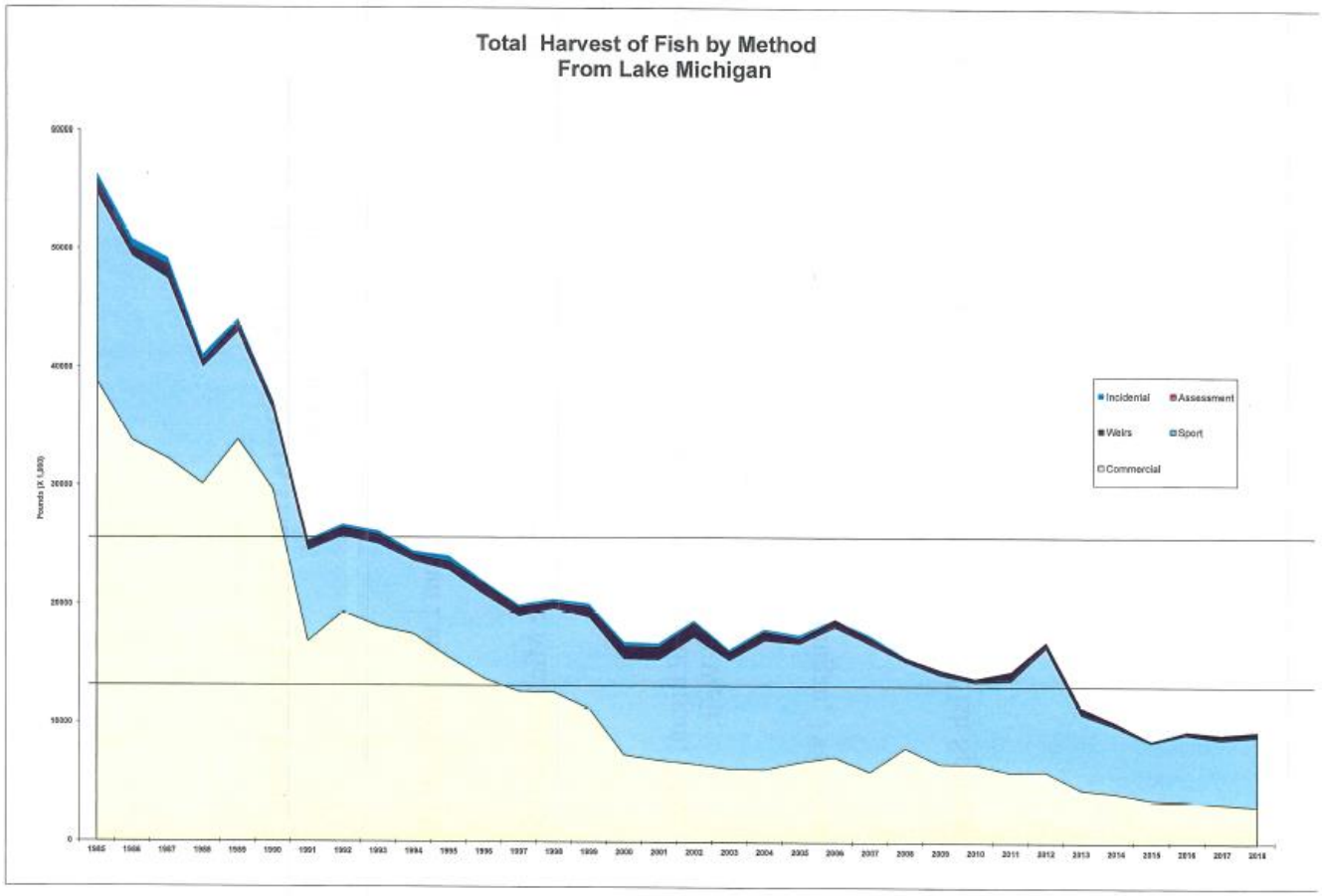


Fig 2- Harvest of Benthivore fishes from Lake Michigan, 1985-2018

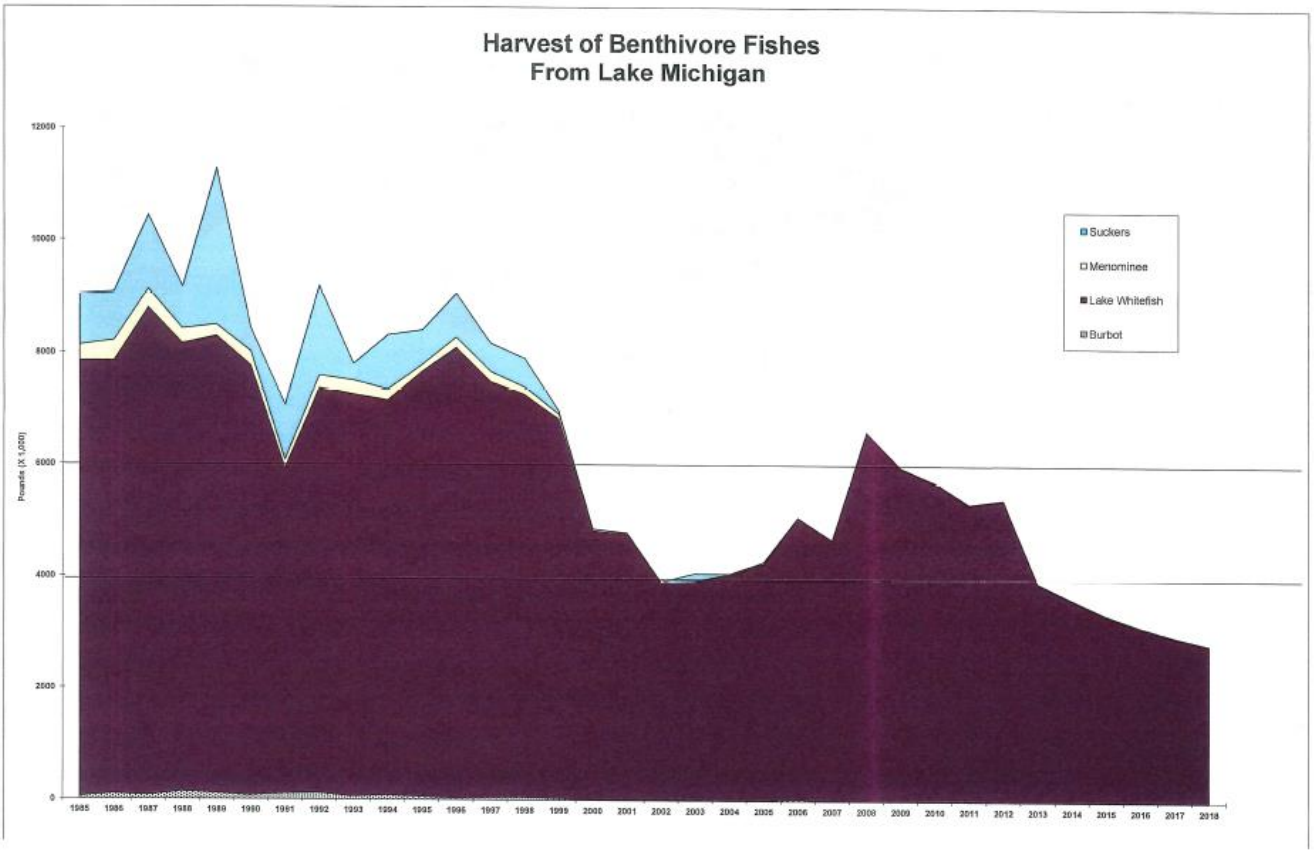


Fig 3- Harvest of Salmonine fishes from Lake Michigan, 1985-2018, Sport, Commercial, Assessment and Weir.

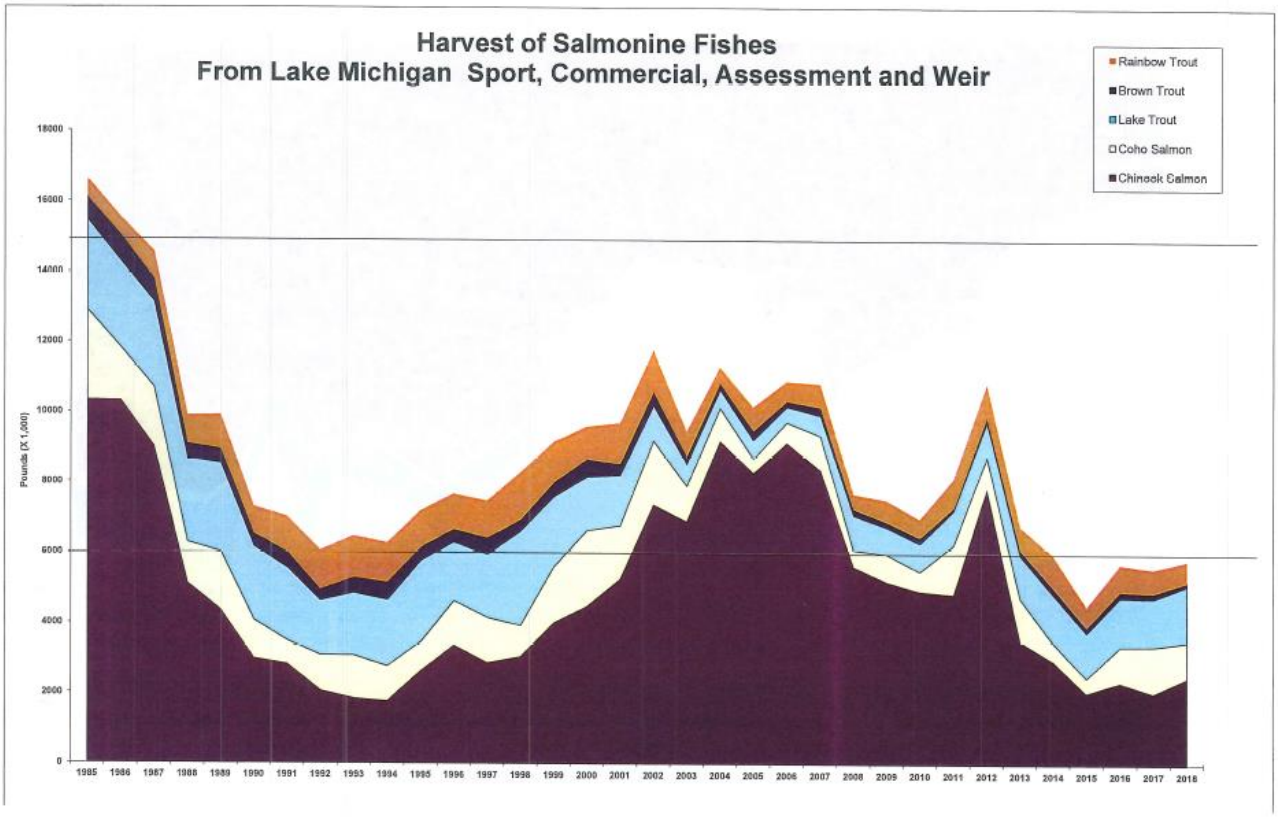


Fig 4- Harvest of Inshore fishes from Lake Michigan, 1985-2018

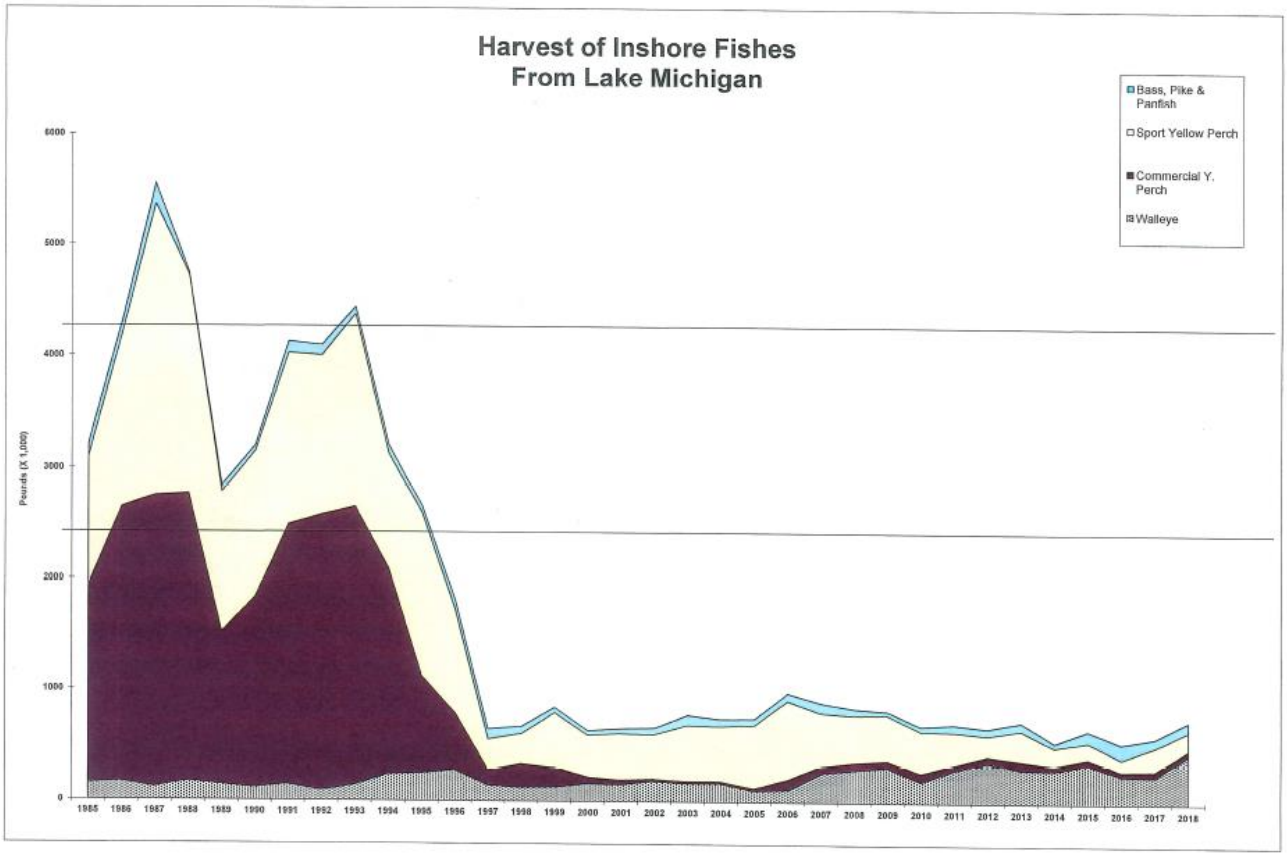
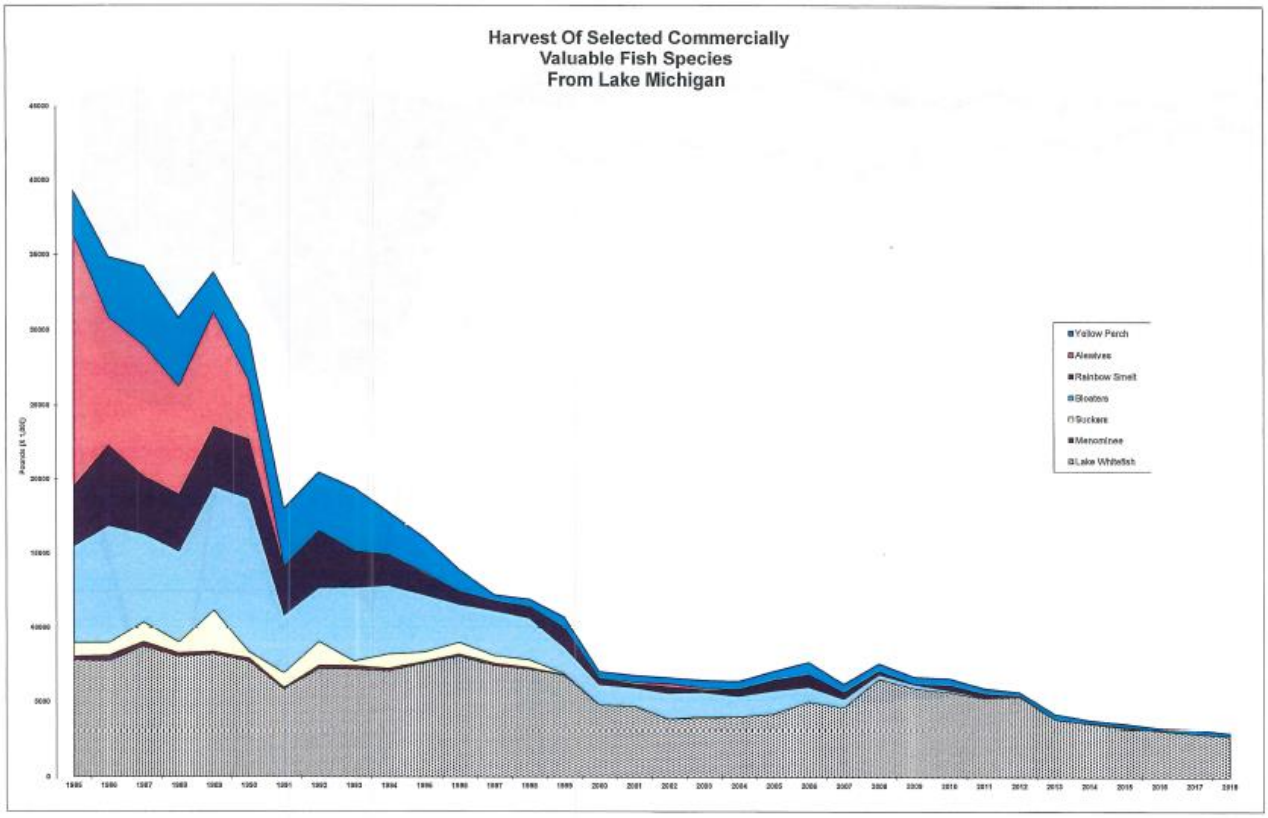


Fig 5- Harvest of Selected Commercially valuable fish spieces from Lake Michigan, 1985-2018



Summary of Lakewide Harvest for All Agencies in 1000's of Pounds; This Includes Commercial, Sport, Weir, Assessment And Incidental Catch, (X 1,000 Pounds) -- 1 of 3

FIGURE 1.	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Commercial	38793.8	33812.1	32272.3	30117.4	33877.2	29641.2	16857.6	19373	18156.1	17508	15561.43	13779.79	12679.9
Sport	15787.48	15584.65	15216.65	9923.226	9154.657	6704.035	7680.261	6393.237	6946.551	6211.409	7387.109	7126.884	6376.512
Weirs	1140.5	724	1130.7	534.8	717.7	641.6	696.5	683.9	753.3	522.352	698.52	885.5	740.5
Assessment	58.8	59.4	59.1	70.5	84.8	56.7	73.7	65.8	60.9	53.074	55.136	90.534	54.643
Incidental	498.6	645.3	540.6	456.2	231.7	205	98.2	199.707	261.6	199.7	414.2	110.5	130.5
Total	56279.18	50825.45	49219.35	41102.13	44066.06	37248.54	25406.26	26715.64	26178.45	24494.54	24116.4	21993.21	19982.05
FIGURE 2.	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Burbot	49.4	96.5	69.3	141.6	109.7	71.7	103.4	120.2	52.25	84.22	54.4	31.52	38.8
Lake Whitefish	7802.4	7756.7	8732.1	8023.8	8189.5	7695.2	5822.3	7248.1	7199.1	7062.752	7609.864	8063.126	7447.29
Menominee	284	366	329.4	260.5	200.8	254.8	147.4	223.6	253.9	196.1	118.4	184.4	183.303
Suckers	905.8	859.1	1313.4	744.5	2773.1	416.8	983.3	1599.5	292.3	973.532	621.25	774.91	505.93
Total	9041.6	9078.3	10444.2	9170.4	11273.1	8438.5	7056.4	9191.4	7797.55	8316.604	8403.914	9053.956	8175.323
FIGURE 3.	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Chinook Salmon	10335.76	10312.38	8994.268	5116.938	4351.454	2977.711	2822.937	2059.618	1842.279	1762.109	2627.977	3353.066	2859.061
Coho Salmon	2564.587	1515.623	1696.118	1167.456	1664.531	1101.644	676.445	1018.48	1229.13	1003.687	826.997	1269.251	1295.416
Lake Trout	2570.738	2461.434	2427.063	2382.343	2512.094	2084.818	2057.36	1542.95	1775.482	1875.4	2302.307	1667.49	1785.474
Brown Trout	629.498	740.519	664.47	430.281	413.378	366.829	452.44	321.987	444.134	510.368	381.538	372.338	473.206
Rainbow Trout	548.295	512.3	788.187	801.528	971.126	757.881	991.562	1112.673	1168.025	1115.302	1037.888	996.283	1044.925
Total	16648.88	15542.25	14570.11	9898.546	9912.583	7288.883	7000.744	6055.708	6459.05	6266.866	7176.707	7658.428	7458.082
% Lake Trout	0.154409	0.15837	0.166578	0.240676	0.253425	0.286027	0.293877	0.254793	0.274883	0.299256	0.320803	0.217733	0.239401
FIGURE 4.	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Walleye	147.496	163.105	114.945	170.239	137.712	112.679	143.926	89.544	138.563	234.704	246.427	274.482	139.144
Commercial Y. Perch	1795.2	2483.4	2634.9	2596.8	1379.6	1719.3	2348.8	2490.1	2513	1865.5	877.03	517.04	136.196
Sport Yellow Perch	1151.504	1538.677	2624.872	1967.633	1266.549	1315.172	1533.716	1426.183	1728.177	1033.422	1476.855	938.086	277.95
Bass, Pike & Panfish	119.1	112.7	181.9	20.343	61.422	49.864	102.788	93.145	64.891	74.827	61.747	87.069	90.805
Total	3213.3	4297.882	5556.617	4755.015	2845.283	3197.015	4129.23	4098.972	4444.631	3208.453	2662.059	1816.677	644.095
FIGURE 5.	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Lake Whitefish	7802.4	7756.7	8732.1	8023.8	8189.5	7695.2	5822.3	7248.1	7199.1	7062.752	7609.864	8063.126	7447.29
Menominee	284	366	329.4	260.5	200.8	254.8	147.4	223.6	253.9	196.1	118.4	184.4	183.303
Suckers	905.8	859.1	1313.4	744.5	2773.1	416.8	983.3	1599.5	292.3	973.532	621.25	774.91	505.93
Bloaters	6524.6	7919.4	5987.1	6138.7	8360.7	10342.3	3885.7	3630.2	4971.2	4631.98	3890.64	2567.71	3030.94
Rainbow Smelt	4028.4	5421.1	3876.1	3847.6	4070.3	4017.6	3246.6	3845	2491.7	2049.661	1422.35	889.31	663.44
Alewives	16802.4	8539.4	8743.9	7268.5	7579.9	3934.9	76.6	40.9	3.5	9.38	101.757	1.16	5.5
Yellow Perch	2952.504	4028.077	5265.372	4568.133	2650.749	3038.772	3886.516	3920.503	4244.877	2899.722	2354.485	1458.99	416.586
Total	39300.1	34889.78	34247.37	30851.73	33825.05	29700.37	18048.42	20507.88	19456.58	17823.13	16118.75	13939.61	12252.99

2 of 3

FIGURE 1.	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Commercial	12641.45	11256.38	7333.937	6893.822	6583.917	6164.763	6111.18	6735.312	7180.809	5943.786	7955.726	6603.572	6572.605
Sport	7095.2	7746.965	8143.368	8515.9	10739.96	9204.677	10941.46	10061.5	10990.32	10832.7	7348.65	7560.966	7006.4
Weirs	515.268	840.701	1124	1100.048	1210.463	688.937	746.908	442.572	603.323	518.467	314.06	386.1	225.63
Assessment	29.4646	39.884	34.856	38.8249	34.981	33.612	35.6	34.701	41.358	32.963	30.017	30.704	38.535
Incidental	178.94	229.7	231.445	192.42	129	133.6	130	175.4	0	104.2	32.37	0	0
Total	20460.32	20113.63	16867.61	16741.01	18698.32	16225.59	17965.14	17449.49	18815.81	17432.12	15680.82	14581.34	13843.17
FIGURE 2.	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Burbot	47.893	33.601	15.046	18.674	13.645	20.875	11.728	14.682	31.283	11.533	11.887	12.811	12.541
Lake Whitefish	7205.642	6793.035	4816.243	4745.976	3882.623	3909.841	4022.944	4215.897	5037.782	4660.22	6575.914	5945.74	5686.741
Menominee	135.347	85.75	27.154	12.515	8.651	6.715	21.093	12.702	1.36	2.21	7.654	9.286	6.881
Suckers	514.9876	47.899	8.962	17.711	7.111	125.931	3.481	29.414	6.769	4.574	4.209	2.681	6.239
Total	7903.87	6960.285	4867.405	4794.876	3912.03	4063.362	4059.246	4272.695	5077.194	4678.537	6599.664	5970.518	5712.402
FIGURE 3.	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook Salmon	3038.005	4008.256	4473.565	5252.121	7359.653	6886.199	9186.923	8273.101	9142.229	8367.931	5622.706	5192.508	4921.566
Coho Salmon	895.077	1582.163	2155.828	1509.109	1835.275	1012.308	952.387	423.76	595.326	985.842	466.296	784.87	570.662
Lake Trout	2666.321	1987.835	1518.253	1436.249	1010.683	633.752	523.389	533.263	447.684	581.214	990.346	771.485	800.803
Brown Trout	317.836	407.701	513.562	330.12	392.858	222.207	183.797	260.806	158.108	231.861	176.22	146.06	155.39
Rainbow Trout	1353.609	1161.788	928.576	1167.748	1173.176	711.085	456.905	679.921	561.825	656.847	420.75	596.31	515.75
Total	8270.848	9147.743	9589.784	9695.347	11771.65	9465.551	11303.4	10170.85	10905.17	10823.7	7676.318	7491.233	6964.171
% Lake Trout	0.322376	0.217303	0.15832	0.148138	0.085857	0.066954	0.046304	0.052431	0.041052	0.053698	0.129013	0.102985	0.114989
FIGURE 4.	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Walleye	121.649	125.465	158.091	152.546	181.167	162.272	164.94	101.064	111.14	257.115	286.646	311.946	188.319
Commercial Y. Perch	211.052	176.65	57.98	38.99	19.99	19.349	17.981	23.575	90.695	65.296	69.109	62.276	75.994
Sport Yellow Perch	270.54	492.937	375.741	415.375	399.814	503.87	492.97	563.92	708.86	478.981	424.29	408.51	376.47
Bass, Pike & Panfish	65.145	48.045	41.208	44.768	56.235	92.779	65.668	56.05	67.582	92.67	61.24	35.92	42.49
Total	668.386	843.097	633.02	651.679	657.206	778.27	741.559	744.609	978.277	894.062	841.285	818.652	683.273
FIGURE 5.	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Lake Whitefish	7205.642	6793.035	4816.243	4745.976	3882.623	3909.841	4022.944	4215.897	5037.782	4660.22	6575.914	5945.74	5686.741
Menominee	135.347	85.75	27.154	12.515	8.651	6.715	21.093	12.702	1.36	2.21	7.654	9.286	6.881
Suckers	514.9876	47.899	8.962	17.711	7.111	125.931	3.481	29.414	6.769	4.574	4.209	2.681	6.239
Bloaters	2817.428	1792.945	1335.534	1226.781	1701.834	1626.466	1385.654	1531.916	986.635	583.809	304.347	246.756	137.779
Rainbow Smelt	701.48	1336.399	387.918	251.244	452.632	184.766	408.929	676.416	836.38	428.76	179.28	44.745	325.034
Alewives	92.903	16.857	48.904	109.097	200.129	97.6	63.81	44.262	28.774	20.321	62.489	6.487	17.356
Yellow Perch	484.249	680.803	437.909	460.711	421.802	526.103	513.301	591.831	802.854	546.654	495.391	472.712	454.202
Total	11952.04	10753.69	7062.624	6824.035	6674.782	6477.422	6419.212	7102.438	7700.554	6246.548	7629.284	6728.407	6634.232

3 of 3

FIGURE 1.	2011	2012	2013	2014	2015	2016	2017	2018
Commercial	5907.782	5970.909	4507.774	4202.217	3682.144	3563.444	3371.528	3007.633
Sport	7788.191	10530.17	6391.274	5609.4	4791.533	5623.861	5406.011	5847.784
Weirs	711.898	437.589	514.826	314.13	68.608	208.332	376.32	376.851
Assessment	38.5699	34.633	38.034	33.2601	44.5023	54.454	47.372	45.96
Incidental	0	0	0	0	15.6	12.405	10.44	5.65
Total	14446.44	16973.3	11451.91	10159.01	8602.387	9462.506	9211.671	9283.878
FIGURE 2.	2011	2012	2013	2014	2015	2016	2017	2018
Burbot	19.054	13.131	10.59	9.075	10.209	10.32	11.516	6.2591
Lake Whitefish	5282.207	5367.268	3890.744	3594.493	3315.897	3099.86	2953.126	2727.888
Menominee	11.088	4.809	2.704	4.161	5.53	4.317	5.456	2.0253
Suckers	3.321	3.738	8.6294	15.1144	18.405	22.719	17.875	5.154
Total	5315.67	5388.946	3912.667	3622.843	3350.041	3137.216	2987.973	2741.326
FIGURE 3.	2011	2012	2013	2014	2015	2016	2017	2018
Chinook Salmon	4835.711	7818.958	3525.012	2954.228	2037.314	2339.382	2035.075	2459.409
Coho Salmon	1405.332	925.7438	1220.322	530.56	441.2033	1025.979	1341.957	1030.168
Lake Trout	972.607	1006.715	1231.361	1372.295	1296.934	1397.374	1371.357	1556.702
Brown Trout	77.0645	143.001	147.055	194.745	146.296	174.295	157.532	98.742
Rainbow Trout	814.08	921.736	645.482	901.17	574.917	757.621	665.007	590.531
Total	8104.795	10816.15	6769.232	5952.998	4496.664	5694.651	5570.928	5735.552
% Lake Trout	0.120004	0.093075	0.181906	0.230522	0.288421	0.245384	0.246163	0.271413
FIGURE 4.	2011	2012	2013	2014	2015	2016	2017	2018
Walleye	291.279	359.151	302.12	293.0571	345.478	254.376	243.527	434.91
Commercial Y. Perch	50.789	59.672	77.484	46.884	55.151	36.961	52.741	39.776
Sport Yellow Perch	291.486	184.629	270.35	157.84	148.126	107.57	211.076	169.521
Bass, Pike & Panfish	69.33	64.348	75.742	45.6	104.156	138.063	79.891	90.121
Total	702.884	667.8	725.696	543.3811	652.911	536.97	587.235	734.328
FIGURE 5.	2011	2012	2013	2014	2015	2016	2017	2018
Lake Whitefish	5282.207	5367.268	3890.744	3594.493	3315.897	3099.36	2953.126	2727.888
Menominee	11.088	4.809	2.704	4.161	5.53	4.317	5.456	2.0253
Suckers	3.321	3.738	8.6294	15.1144	18.405	22.719	17.875	5.154
Bloaters	48.358	24.291	19.535	33.317	71.917	54.618	14.867	9.936
Rainbow Smelt	270.524	32.004	1.947	0.013	0.515	0.11	0.096	17.951
Alewives	0.996	42.565	5.948	0.37	7.572	3.741	0.23	1.1863
Yellow Perch	343.019	245.149	348.728	205.376	203.802	145.276	264.186	209.9391
Total	5959.513	5719.824	4278.235	3852.844	3623.638	3330.641	3255.836	2974.08

Summary of Lakewide Harvest for All Agencies in 1000's of Pounds; Includes Commercial, Sport, Weir, Assessment And Incidental -1 of 3

SPECIES	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
chinook salmon	10335.76	10312.38	8994.268	5116.938	4351.454	2977.711	2822.937	2059.618	1842.279	1762.109	2627.977	3353.066	2859.061
coho salmon	2564.587	1515.623	1696.118	1167.456	1664.531	1101.644	676.445	1018.48	1229.13	1003.687	826.997	1269.251	1295.416
pink salmon	2.4	0.1	6.5	0	2	0	0.1	0	0.2	0	0	0	0
lake trout	2570.738	2461.434	2427.063	2382.343	2512.094	2084.818	2057.36	1542.95	1775.482	1875.4	2302.307	1667.49	1785.474
brook trout	8.9	9.681	2.944	7.029	4.061	9.551	5.601	16.08	5.306	9.62	2.385	0.732	0.669
brown trout	629.498	740.519	664.47	430.281	413.378	366.829	452.44	321.987	444.134	510.368	381.538	372.338	473.206
rainbow trout	548.295	512.3	788.187	801.528	971.126	757.881	991.562	1112.673	1168.025	1115.302	1037.888	996.283	1044.925
walleye	147.496	163.105	114.945	170.239	137.712	112.679	143.926	89.544	138.563	234.704	246.427	274.482	139.144
yellow perch	2952.504	4028.077	5265.372	4568.133	2650.749	3038.772	3886.516	3920.583	4244.877	2899.722	2354.485	1458.99	416.586
smb, musky, northern	0	0	0	0	0	0	0	0	0	0	0	0	0
pike, and panfish	119.1	112.7	181.9	20.343	61.422	49.864	102.788	93.145	64.891	74.827	61.747	87.069	90.805
burbot	49.4	96.5	69.3	141.6	109.7	71.7	103.4	120.2	52.25	84.22	54.4	31.52	38.8
lake whitefish	7802.4	7756.7	8732.1	8023.8	8189.5	7695.2	5822.3	7248.1	7199.1	7062.752	7609.864	8063.126	7447.29
menominee	284	366	329.4	260.5	200.8	254.8	147.4	223.6	253.9	196.1	118.4	184.4	183.303
sturgeon	0	0.437	0.882	0.836	0.73	0.686	1.186	1.784	1.414	1.071	1.883	1.371	1.552
suckers	905.8	859.1	1313.4	744.5	2773.1	416.8	983.3	1599.5	292.3	973.532	621.25	774.91	505.93
alewives	16802.4	8539.4	8743.9	7268.5	7579.9	3934.9	76.6	40.9	3.5	9.38	101.757	1.16	5.5
bloaters	6524.6	7919.4	5987.1	6138.7	8360.7	10342.3	3885.7	3630.2	4971.2	4631.98	3890.64	2567.71	3030.94
lake herring	2.9	10.9	25.4	11.8	12.8	14.8	0.1	1.6	0.2	0.1	0.1	0	0.01
rainbow smelt	4028.4	5421.1	3876.1	3847.6	4070.3	4017.6	3246.6	3845	2491.7	2049.661	1422.35	889.31	663.44
TOTAL	56545.1	50825.45	49219.35	41102.13	44066.06	37248.54	25406.26	26885.94	26178.45	24494.54	23662.4	21993.21	19982.05

2 of 3

SPECIES	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
chinook salmon	3038.005	4008.256	4473.565	5252.121	7359.653	6886.199	9186.923	8273.101	9142.229	8367.931	5622.706	5192.508	4921.566
coho salmon	895.077	1582.163	2155.828	1509.109	1835.275	1012.308	952.387	423.76	595.326	985.842	466.296	784.87	570.662
pink salmon	0	0	0	0.05	0.041	0	0.01	0	0	0	0	0	0
lake trout	2666.321	1987.835	1518.253	1436.249	1010.683	633.752	523.389	533.263	447.684	581.214	990.346	771.485	800.803
brook trout	0.667	0.648	0.633	1.163	0.411	0.5	0	0	0.051	0.1	0	0	0
brown trout	317.836	407.701	513.562	330.12	392.858	222.207	183.797	260.806	158.108	231.861	176.22	146.06	155.39
rainbow trout	1353.609	1161.788	928.576	1167.748	1173.176	711.085	456.905	679.921	561.825	656.847	420.75	596.31	515.75
walleye	121.649	125.465	158.091	152.546	181.167	162.272	164.94	101.064	111.14	257.115	286.646	311.946	188.319
yellow perch	484.249	680.803	437.909	460.711	421.802	526.103	513.301	591.831	802.854	546.654	495.391	472.712	454.202
smb, musky, northern	0	0	0	0	0	0	0	0	0	0	0	0	0
pike, and panfish	65.145	48.045	41.208	44.768	56.235	92.779	65.668	56.05	67.582	92.67	61.24	35.92	42.49
burbot	47.893	33.601	15.046	18.674	13.645	20.875	11.728	14.682	31.283	11.533	11.887	12.811	12.541
lake whitefish	7205.642	6793.035	4816.243	4745.976	3882.623	3909.841	4022.944	4215.897	5037.782	4660.22	6575.914	5945.74	5686.741
menominee	135.347	85.75	27.154	12.515	8.651	6.715	21.093	12.702	1.36	2.21	7.654	9.286	6.881
sturgeon	2.031	3.523	0	4.322	0	6.038	0.151	4.3	0.03	0.01	0.03	0	0.02
suckers	514.9876	47.899	8.962	17.711	7.111	125.931	3.481	29.414	6.769	4.574	4.209	2.681	6.239
alewives	92.903	16.857	48.904	109.097	200.129	97.6	63.81	44.262	28.774	20.321	62.489	6.487	17.356
bloaters	2817.428	1792.945	1335.534	1226.781	1701.834	1626.466	1385.654	1531.916	986.635	583.809	304.347	246.756	137.779
lake herring	0.05	0.92	0.22	0.11	0.394	0.152	0.033	0.1	0	0.445	15.418	1.025	1.397
rainbow smelt	701.48	1336.399	387.918	251.244	452.632	184.766	408.929	676.416	836.38	428.76	179.28	44.745	325.034
TOTAL	20460.32	20113.63	16867.61	16741.01	18698.32	16225.59	17965.14	17449.49	18815.81	17432.12	15680.82	14581.34	13843.17

3 of 3

SPECIES	2011	2012	2013	2014	2015	2016	2017	2018
chinook salmon	4835.711	7818.958	3525.012	2954.228	2037.314	2339.382	2035.075	2459.409
coho salmon	1405.332	925.7438	1220.322	530.56	441.2033	1025.979	1341.957	1030.168
pink salmon	0	0	0	0	0.032	0	0.108	0.036
lake trout	972.607	1006.715	1231.361	1372.295	1296.934	1397.374	1371.357	1556.702
brook trout	0	0	1.2	0	0	0	0	0
brown trout	77.0645	143.001	147.055	194.745	146.296	174.295	157.532	98.742
rainbow trout	814.08	921.736	645.482	901.17	574.917	757.621	665.007	590.531
walleye	291.279	359.151	302.12	293.0571	345.478	254.376	243.527	434.91
yellow perch	343.019	245.149	348.728	205.376	203.802	145.276	264.186	209.9391
smb, musky, northern	0	0	0	0	0	0	0	0
pike, and panfish	69.33	64.348	75.742	45.6	104.156	138.063	79.891	90.121
burbot	19.054	13.131	10.59	9.075	10.209	10.32	11.516	6.2591
lake whitefish	5282.207	5367.268	3890.744	3594.493	3315.897	3099.86	2953.126	2727.888
menominee	11.088	4.809	2.704	4.161	5.53	4.317	5.456	2.0253
sturgeon	0.02	0.004	0	0	0	0	0	0
suckers	3.321	3.738	8.6294	15.1144	18.405	22.719	17.875	5.154
alewives	0.996	42.565	5.948	0.37	7.572	3.741	0.23	1.1863
bloaters	48.358	24.291	19.535	33.317	71.917	54.618	14.867	9.936
lake herring	2.45	0.689	14.789	5.433	22.21	34.455	49.865	42.92
rainbow smelt	270.524	32.004	1.947	0.013	0.515	0.11	0.096	17.951
TOTAL	14446.44	16973.3	11451.91	10159.01	8602.387	9462.506	9211.671	9283.878

Commercial Harvest for All Agencies in 1000's of Pounds; This Includes Illinois, Indiana, Michigan, Tribal Fisheries, and Wisconsin, (X 1,000 Pounds)-- 1 of 3

SPECIES	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
chinook salmon	11.6	18.7	142.1	512.7	535.5	442.1	20.6	9	4.8	39.9	82.4	46.6	17.7
coho salmon	0.7	4	3	29.3	31.1	23.1	0	0	0	0	0	0	0
pink salmon	0	0	0	0	0	0	0	0	0	0	0	0	0
lake trout	894	664.2	576.3	627	680.9	751.8	303.9	382.5	411.8	616.8	626.8	748.3	694.7
brook trout	0	0	0	0	0	0	0	0	0	0	0	0	0
brown trout	0	0	0	0	0	0	0	0	0	0	0	0	0
rainbow trout	0	0	0	0	0	0	0	0	0	0	0	0	0
walleye	11.5	12.5	6.6	7.7	19.7	6.1	1.8	1.7	3.8	3.7	1.1	3	8.5
yellow perch	1795.2	2483.4	2634.9	2596.8	1379.6	1719.3	2348.8	2490.1	2513	1865.5	877.03	517.04	136.196
smb, musky, northern	0	0	0	0	0	0	0	0	0	0	0	0	0
pike, and panfish	11	6	6.8	5.7	1.2	0.3	1	0.7	0	0	0	0	0
burbot	48.9	94	65.1	137.2	105	68.9	98.2	117.7	50.7	83.1	53.6	27.5	36.4
lake whitefish	7520.7	7587.2	8682	7996.1	8158.6	7671.4	5795.4	7235.2	7189.6	7045.1	7596.8	8033.7	7414.28
menominee	258.2	322.5	298.9	254.7	191.3	249.3	144.4	222.3	245.6	195.4	118.1	184.3	182.2
sturgeon	0	0	0	0	0	0	0	0	0	0	0	0	0
suckers	903.4	858.4	1312.7	743.7	2772.2	415.7	968.9	1598.2	287.3	972.9	621.1	774.6	505
alewives	16801.5	8536.2	8739.1	7265.2	7577.3	3933	68.6	38.3	2.1	8.7	0	0.15	3.8
bloaters	6507.5	7906.6	5979.6	6129	8342.9	10328.4	3861	3602.1	4956.6	4627.3	3708.1	2555.4	3017.9
lake herring	2.9	10.9	25.4	11.8	12.8	14.8	0.1	1.6	0.1	0.1	0.1	0	0
rainbow smelt	4026.7	5307.5	3799.8	3800.5	4069.1	4017	3244.9	3843.9	2490.7	2049.5	1422.3	889.2	663.22
TOTAL	38793.8	33812.1	32272.3	30117.4	33877.2	29641.2	16857.6	19373	18156.1	17508	15561.43	13779.79	12679.9

2 of 3

SPECIES	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
chinook salmon	27.432	8.25	34.78	29.11	15.747	2.949	1.307	4.036	5.623	3.893	137.963	3.073	2.382
coho salmon	0	0	0	0	0	0	0.005	0	0.007	0	2.32	0	0
pink salmon	0	0	0	0	0	0	0	0	0	0	0	0	0
lake trout	902.723	979.39	622.29	490.52	290.329	182.378	169.916	198.288	236.563	270.301	651.175	391.213	425.699
brook trout	0	0	0	0	0	0	0	0	0	0	0	0	0
brown trout	0	0	0	0	0	0	0	0	0	0.008	0	0	0
rainbow trout	0	0	0	0	0	0	0	0	0	0	0	0	0
walleye	1.55	1.33	12.72	12.86	15.235	9.141	21.968	17.851	2.536	20.223	62.157	11.117	9.447
yellow perch	211.052	176.65	57.98	38.99	19.99	19.349	17.981	23.575	90.695	65.296	69.109	62.276	75.994
smb, musky, northern	0	0	0	0	0	0	0	0	0	0	0	0	0
pike, and panfish	0	0	0	0	0	0.01	0	0	0	0	0	0	0
burbot	47.529	32.39	12.8	17	11.95	19.7	10.84	13.634	13.316	10.8	11.075	12.2	12
lake whitefish	7196.453	6782.548	4789.295	4703.814	3869.955	3893.483	4010.202	4192.007	4979.796	4642.753	6483.964	5815.437	5558.974
menominee	134.807	85.57	26.51	10.526	8.065	6.116	20.616	11.753	0.989	1.919	7.259	8.933	6.687
sturgeon	0	0	0	0	0	0	0	0	0	0	0	0	0
suckers	514.559	47.252	7.845	8.558	2.23	125.1	2.401	24.503	0.687	0.208	2.912	1.918	4.999
alewives	89.9	15	47.4	106	197.4	96	62.5	42.9	28.1	0	30.825	5.4	16.1
bloaters	2814.035	1790.858	1334.278	1225.153	1700.122	1625.785	1384.801	1530.865	986.227	499.25	302.639	246.49	137.276
lake herring	0.048	0.92	0.22	0.11	0.394	0.152	0.032	0	0	0.435	15.108	0.815	0.047
rainbow smelt	701.359	1336.225	387.819	251.181	452.5	184.6	408.611	675.9	836.27	428.7	179.22	44.7	323
TOTAL	12641.45	11256.38	7333.937	6893.822	6583.917	6164.763	6111.18	6735.312	7180.809	5943.786	7955.726	6603.572	6572.605

3 of 3

SPECIES	2011	2012	2013	2014	2015	2016	2017	2018
chinook salmon	6.662	3.427	3.177	0.598	0.286	3.06	7.37	2.098
coho salmon	0.398	0	0.093	0	0.004	0.004	0.06	0.007
pink salmon	0	0	0	0	0	0	0	0
lake trout	487.775	506.513	657.808	668.876	443.102	551.3	559.502	499.869
brook trout	0	0	0	0	0	0	0	0
brown trout	0	0	0	0	0	0	0	0
rainbow trout	0	0	0	0	0	0	0	0
walleye	9.274	9.148	10.418	7.307	5.41	7.14	3.508	5.257
yellow perch	50.789	59.672	77.484	46.884	55.151	36.961	52.741	39.776
smb, musky, northern	0	0	0	0	0	0	0	0
pike, and panfish	0	0	0.05	0	0.035	0	0.022	0
burbot	18.27	12.032	9.448	8.418	0.258	0.14	0.036	0
lake whitefish	5007.474	5274.197	3714.599	3418.841	3078.979	2880.884	2707.272	2423.712
menominee	9.664	4.327	2.336	3.769	5.04	3.959	5.251	1.781
sturgeon	0	0	0	0	0	0	0	0
suckers	2.242	2.793	3.5414	13.3594	15.375	21.3	16.685	4.634
alewives	0.5	42	5.3	0	0	0	0	0
bloaters	48.194	24.272	19.352	33.294	71.11	53.976	14.111	9.559
lake herring	0.04	0.528	2.227	0.863	6.894	4.72	4.97	3.229
rainbow smelt	266.5	32	1.941	0.008	0.5	0	0	17.711
TOTAL	5907.782	5970.909	4507.774	4202.217	3682.144	3563.444	3371.528	3007.633

Sport Harvest for All State Agencies in 1000's of Pounds; This Includes Illinois, Indiana, Michigan and Wisconsin, (X 1,000 Pounds)-- 1 of 3

SPECIES	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
chinook salmon	9539.863	9731.578	8003.968	4098.538	3378.054	2068.011	2314.737	1587.318	1414.179	1412.814	2148.767	2769.766	2404.061
coho salmon	2029.587	1200.923	1294.818	949.156	1284.431	850.744	445.745	759.773	844.33	771.257	501.043	913.751	959.226
pink salmon	2.4	0.1	6.5	0	2	0	0.1	0	0.2	0	0	0	0
lake trout	1362.438	1318.034	1432.163	1431.243	1640.494	1177.718	1673.36	999.45	1161.082	1061.26	1537.489	772.53	983.374
brook trout	7.9	8.881	2.744	6.929	3.861	9.051	5.401	15.78	3.006	8.214	2.385	0.732	0.669
brown trout	615.398	711.919	646.67	420.281	403.478	344.529	436.74	307.487	424.134	507.558	377.275	365.738	466.706
rainbow trout	537.695	499.1	772.687	795.228	965.326	754.087	984.262	1103.273	1152.325	1099.182	1024.154	981.283	1029.745
walleye	128.296	146.605	104.245	161.639	111.112	106.079	142.026	87.844	134.763	231.004	245.327	271.382	130.524
yellow perch	1151.504	1538.677	2624.872	1967.633	1266.549	1315.172	1533.716	1426.183	1728.177	1033.422	1476.855	938.086	277.95
smb, musky, northern	0	0	0	0	0	0	0	0	0	0	0	0	0
pike, and panfish	107.8	106.4	174.8	14.543	60.122	49.464	101.788	92.445	64.891	74.827	61.747	87.069	90.795
burbot	0	0	0	0	0.3	0.2	0.7	0	0.05	0	0	0	0
lake whitefish	278.6	167	48	25.9	29	23	25.8	11.9	7.4	10.8	10.184	25.176	31.61
menominee	25	42.7	29.6	5.1	9	5	2	0	7.1	0	0	0	0
sturgeon	0	0.437	0.882	0.836	0.73	0.686	1.186	1.784	1.414	1.071	1.883	1.371	1.552
suckers	0	0	0	0	0.2	0.3	12.7	0	3.4	0	0	0	0.3
alewives	0	0	0	0	0	0	0	0	0	0	0	0	0
bloaters	0	0	0	0	0	0	0	0	0	0	0	0	0
lake herring	0	0	0	0	0	0	0	0	0.1	0	0	0	0
rainbow smelt	1	112.3	74.7	46.2	0	0	0	0	0	0	0	0	0
TOTAL	15787.48	15584.65	15216.65	9923.226	9154.657	6704.035	7680.261	6393.237	6946.551	6211.409	7387.109	7126.884	6376.512

2 of 3

SPECIES	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
chinook salmon	2738.134	3520.723	4055.161	4618.725	6591.548	6306.87	8503.02	7820.87	8567.94	8015.651	5227.47	4909.8	4751.05
coho salmon	615.953	1191.972	1397.491	1003.436	1353.335	875.344	858.2	350.15	559.21	818.272	409.61	680.2	512.71
pink salmon	0	0	0	0.05	0.041	0	0	0	0	0	0	0	0
lake trout	1614.825	796.891	667.415	752.582	600.404	328.28	239.71	233.82	195.29	295.847	322.59	362.77	354.41
brook trout	0.667	0.648	0.633	1.163	0.411	0.5	0	0	0.051	0.1	0	0	0
brown trout	313.331	407.158	511.898	329.143	391.308	221.78	183.35	253.87	157.42	231.486	176.1	145.86	155.05
rainbow trout	1347.189	1152.596	922.039	1157.826	1166.406	702.55	450.2	674.42	556.49	649.547	414.89	589.81	512.56
walleye	120.096	124.055	145.355	139.6	165.697	152.87	142.845	83.1	108.36	236.599	224.42	300.4	178.5
yellow perch	270.54	492.937	375.741	415.375	399.814	503.87	492.97	563.92	708.86	478.981	424.29	408.51	376.47
smb, musky, northern	0	0	0	0	0	0	0	0	0	0	0	0	0
pike, and panfish	65.145	48.045	41.128	44.768	56.215	92.71	65.56	55.95	67.58	92.58	61.08	35.7	42.05
burbot	0	0	1.362	0.5	0.3	0	0	0	17	0	0	0	0
lake whitefish	7.289	8.417	25.145	39.91	10.08	14	5.6	18.2	47.7	10	88.2	127.916	120.5
menominee	0	0	0	0	0	0	0	0	0	0	0	0	0
sturgeon	2.031	3.523	0	4.322	0	5.903	0	4.1	0	0	0	0	0
suckers	0	0	0	8.5	4.3	0	0	3.1	4.421	3.637	0	0	0
alewives	0	0	0	0	0	0	0	0	0	0	0	0	0
bloaters	0	0	0	0	0	0	0	0	0	0	0	0	0
lake herring	0	0	0	0	0	0	0	0	0	0	0	0	1.1
rainbow smelt	0	0	0	0	0.1	0	0	0	0	0	0	0	2
TOTAL	7095.2	7746.965	8143.368	8515.9	10739.96	9204.677	10941.46	10061.5	10990.32	10832.7	7348.65	7560.966	7006.4

3 of 3

SPECIES	2011	2012	2013	2014	2015	2016	2017	2018
chinook salmon	4299	7510.306	3190.229	2689.32	1997.106	2239.533	1870.182	2314.474
coho salmon	1222.319	796.5398	1038.121	485.37	416.387	916.55	1126.527	801.625
pink salmon	0	0	0	0	0.032	0	0.108	0.036
lake trout	466.736	477.4982	556.306	683.24	824.79	811.536	778.924	1025.447
brook trout	0	0	0	0	0	0	0	0
brown trout	76.75	142.423	146.65	194.43	145.793	173.265	156.542	97.912
rainbow trout	807.815	916.502	636.54	894.9	570.467	751.561	658.036	580.571
walleye	281.4	349.622	291.03	285.55	339.587	246.214	239.42	429.2
yellow perch	291.486	184.629	270.35	157.84	148.126	107.57	211.076	169.521
smb, musky, northern	0	0	0	0	0	0	0	0
pike, and panfish	69.085	64.143	75.61	45.29	103.799	137.586	79.511	89.704
burbot	0	0	0	0	0	0	0	0
lake whitefish	267.6	88.507	170.321	169.11	230.268	210.411	240.94	299.542
menominee	0	0	0	0	0.101	0.05	0	0.143
sturgeon	0	0	0	0	0	0	0	0
suckers	0	0	3.89	0	0	0	0	0
alewives	0	0	0	0	0	0	0	0
bloaters	0	0	0	0	0	0	0	0
lake herring	2	0	12.227	4.35	15.077	29.585	44.745	39.609
rainbow smelt	4	0	0	0	0	0	0	0
TOTAL	7788.191	10530.17	6391.274	5609.4	4791.533	5623.861	5406.011	5847.784

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Status of Yellow Perch in Lake Michigan, 2018

Adult Relative Abundance

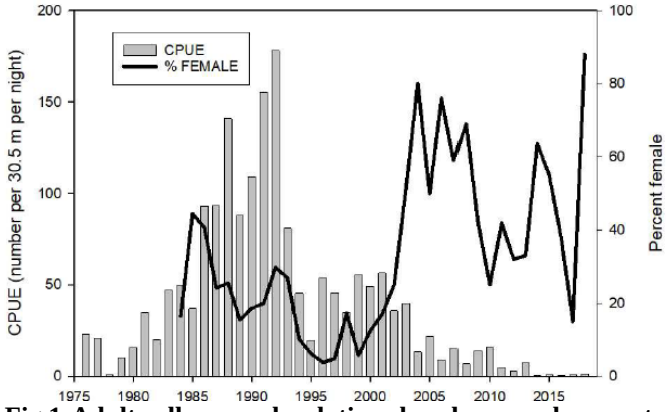


Fig 1-Adult yellow perch relative abundance and percent female in the Illinois waters of Lake Michigan. (ILDNR; data from spring gill net assessment, Chicago and Lake Bluff, IL, 1976 – 2018.)

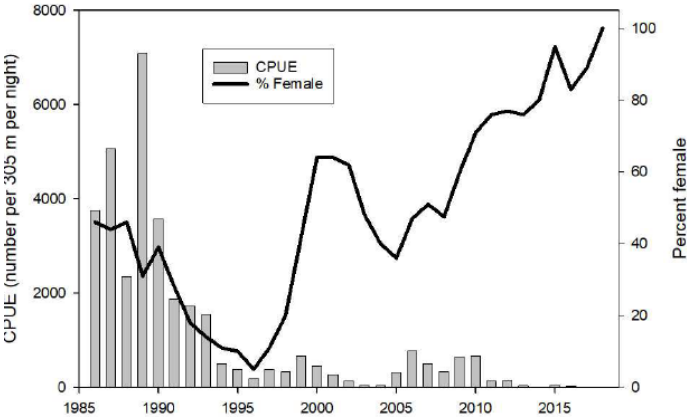


Fig 2- Adult yellow perch relative abundance and percent female in the Wisconsin waters of Lake Michigan. (WDNR; data from winter gill net assessment, Milwaukee, WI, 1986 – 2018.)

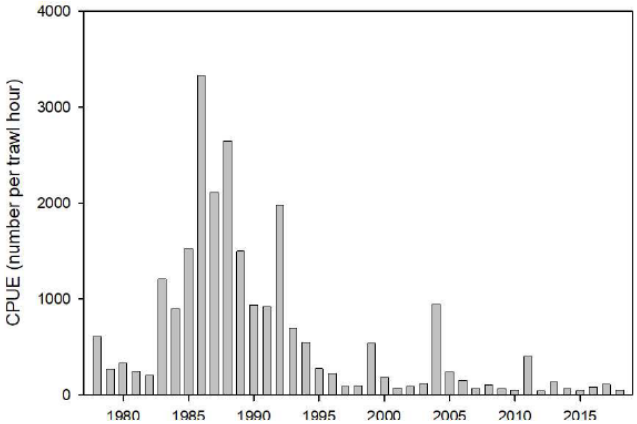


Fig 3-Adult yellow perch relative abundance in the Wisconsin waters of Green Bay.(WDNR; data from summer trawl assessment, Green Bay, WI, 1978 – 2018.)

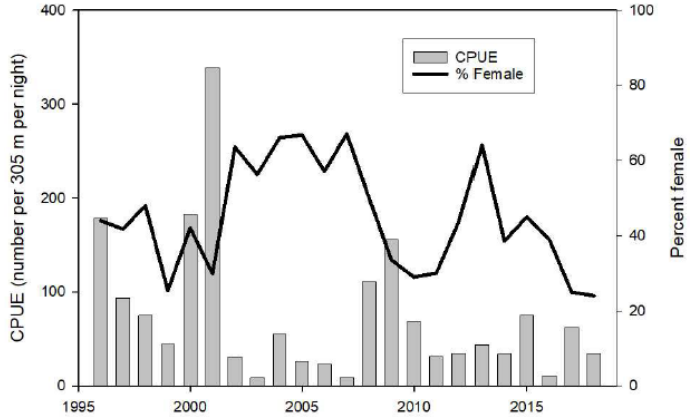


Fig 4-Adult yellow perch gill net catch-per-unit-effort and percent female in the catch at four southern Lake Michigan ports (Grand Haven, Saugatuck, South Haven, and St. Joseph, MI). (MDNR; data from April-June, 1996 – 2018.)

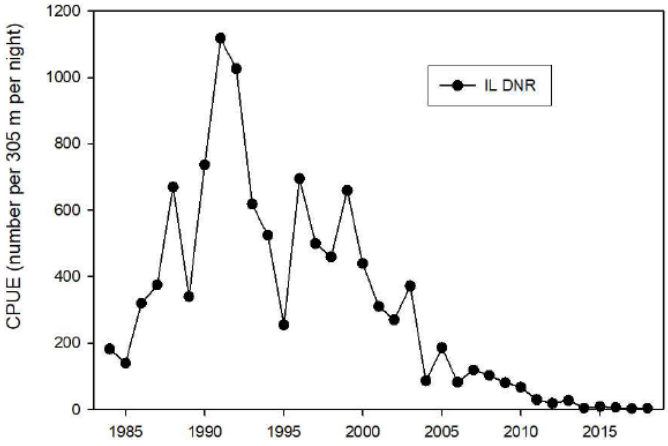


Fig 5-Yellow perch CPE (number of fish per 305 m) in graded mesh gill net consisting of equal length panels of 51-mm, 64-mm, and 76-mm stretched mesh, 1984-2018. (Data from ILDNR)

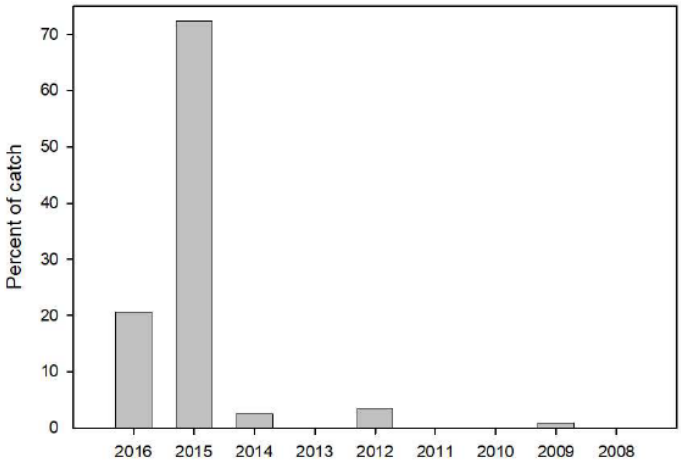


Fig 6-Yellow perch age structure from the Illinois waters of Lake Michigan. (ILDNR; data from spring gill net assessment, Chicago and Lake Bluff, IL, 2018; Ages determined using otoliths.)

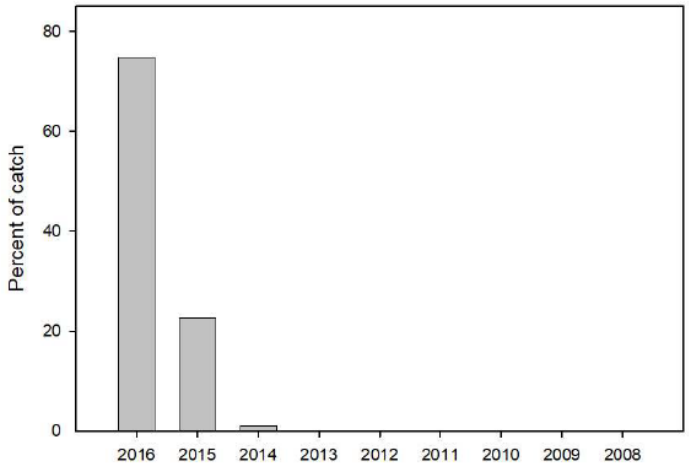


Fig 7-Yellow perch age structure from the Wisconsin waters of Green Bay. (WDNR; data from commercial harvest – all gear types, Green Bay, WI – 2018. Ages determined using spines.)

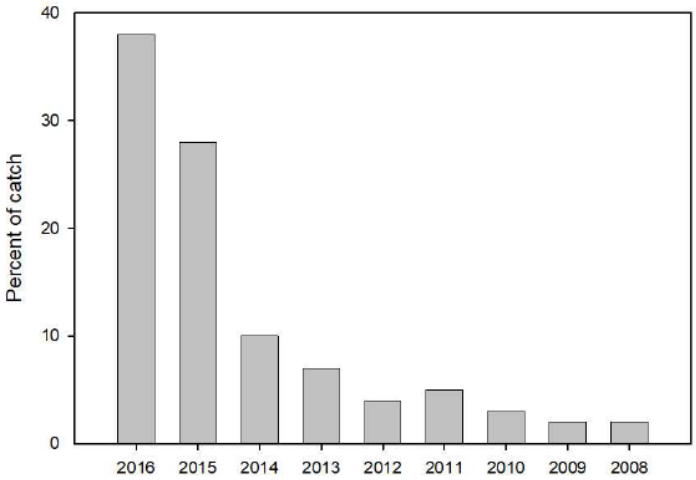


Fig 8-Yellow perch age structure from the Michigan waters of Lake Michigan. (MDNR data from spring gill net assessment, combined three southern Lake Michigan ports – Grand Haven, Saugatuck, and South Haven, MI – 2018. Age determined using spines)

Recruitment

Having a reliable indicator of future inputs to an adult population is vital to understanding the dynamics of the fish population and helping predict changes in abundance. An early indicator of recruitment is most beneficial to managers. In Lake Michigan, indicators of yellow perch recruitment have traditionally been collected using bottom trawls or beach seines. In addition, the YPTG agreed to implement a lakewide summer "micromesh" gill net assessment (beginning in summer 2007) to standardize assessment of young-of-year yellow perch production, especially in areas where standard trawl and seine surveys cannot be implemented. Preliminary evaluation of five years of data from this assessment were included in the 2012 report; this survey is continuing, and additional data analyses are ongoing.

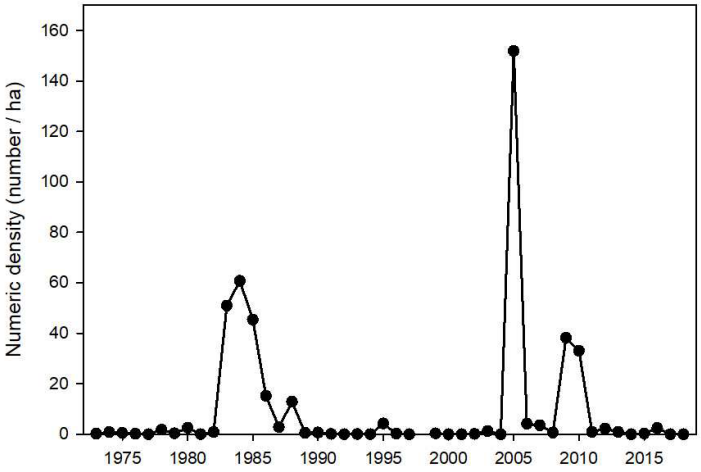


Fig 9-Density of age-0 yellow perch, lakewide (USGS; data from fall bottom trawl assessments, 1973 – 2018.)

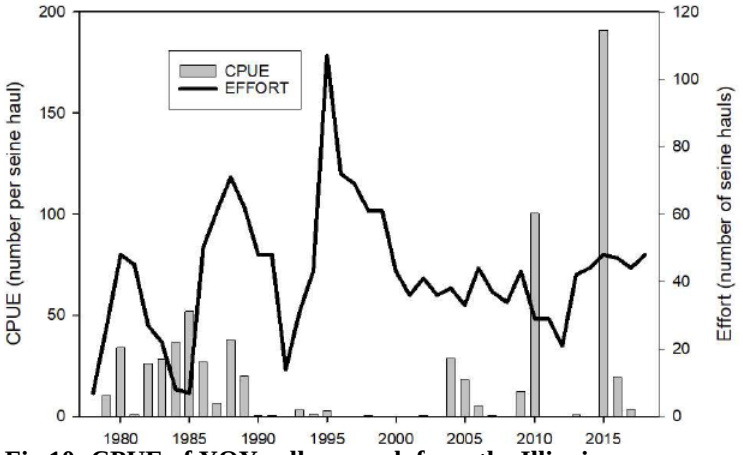


Fig 10- CPUE of YOY yellow perch from the Illinois waters of Lake Michigan. (ILDNR; data from summer beach seining along the Illinois shoreline, 1978 – 2018.)

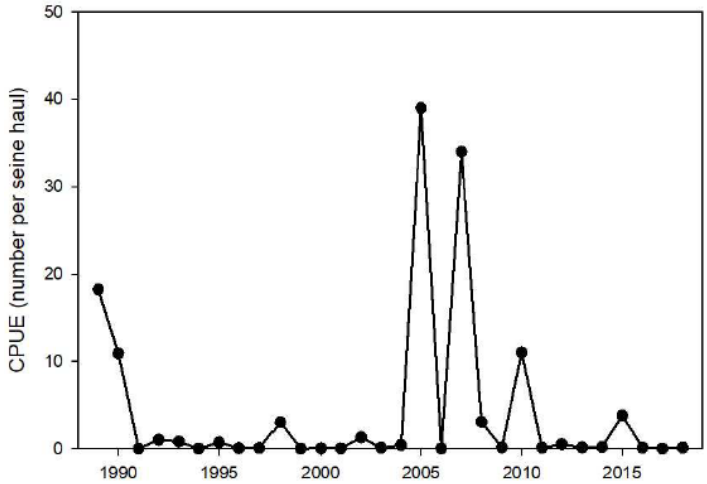


Fig 11-CPUE of age-0 yellow perch from the Wisconsin waters of Lake Michigan. (WDNR; data from summer beach seine assessments along the southern Wisconsin shoreline, 1989 –2018)

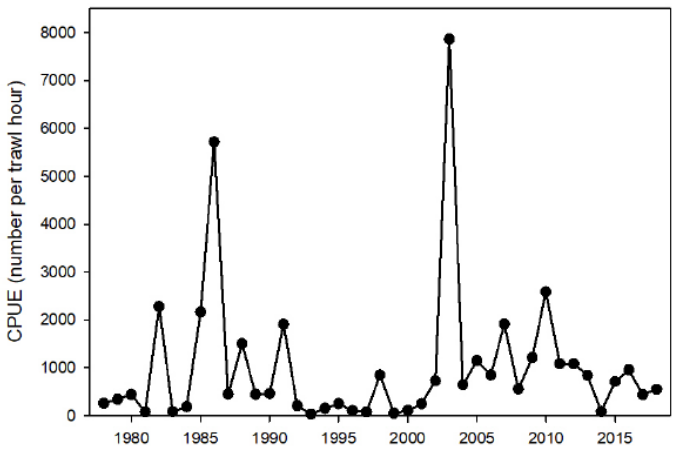


Fig 12- CPUE of age-0 yellow perch from the Wisconsin waters of Green Bay. (WDNR; data from summer trawl assessments, 1978 – 2018)

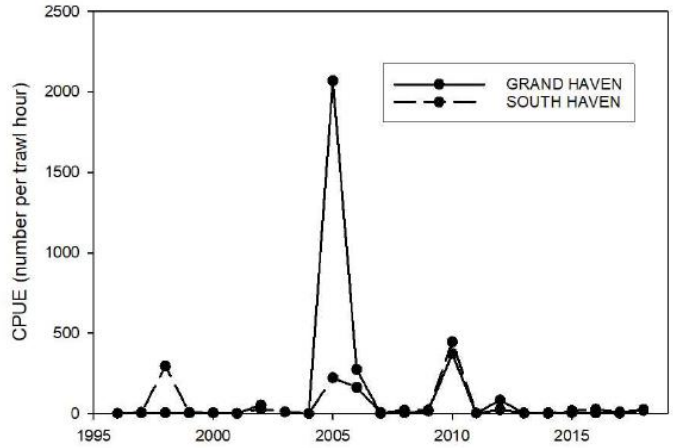


Fig 13- CPUE of age-0 yellow perch in the Michigan waters of Lake Michigan

2019 Yellow Perch Regulations/Harvest Trends

Sportfishing regulations:

➢ Illinois
- May 1-June 15; closed to sportfishing for yellow perch
- Daily bag limit 15 fish

➢ Indiana
- No closed season for yellow perch
- Daily bag limit 15 fish

➢ Michigan
- No closed season for yellow perch
- Daily bag limit; 25 fish

➢ Wisconsin (Lake Michigan)
- May 1-June 15; closed to sportfishing for yellow perch
- Daily bag limit 5 fish

➢ Wisconsin (Green Bay)
- March 16 - May 19; closed to sportfishing for perch
- Daily bag limit 15 fish

Commercial regulations:

✧ Illinois perch fishery remained closed
✧ Indiana perch fishery remained closed
✧ Michigan does not allow a commercial harvest (outside of 1836 Treaty waters)
✧ Wisconsin perch fishery remained closed (outside of Green Bay, where quota for 2019 is 100,000 pounds)

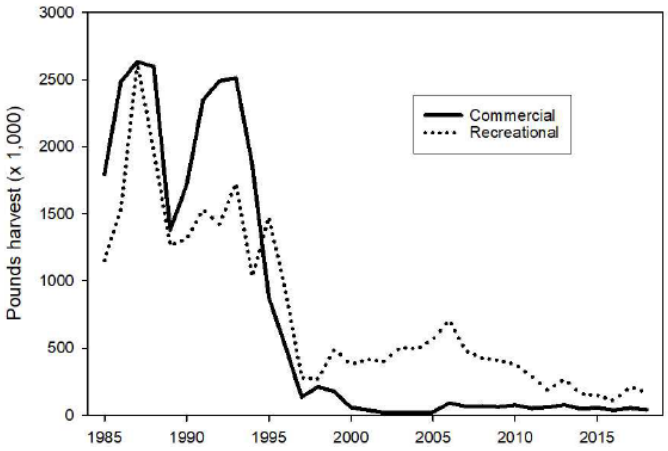
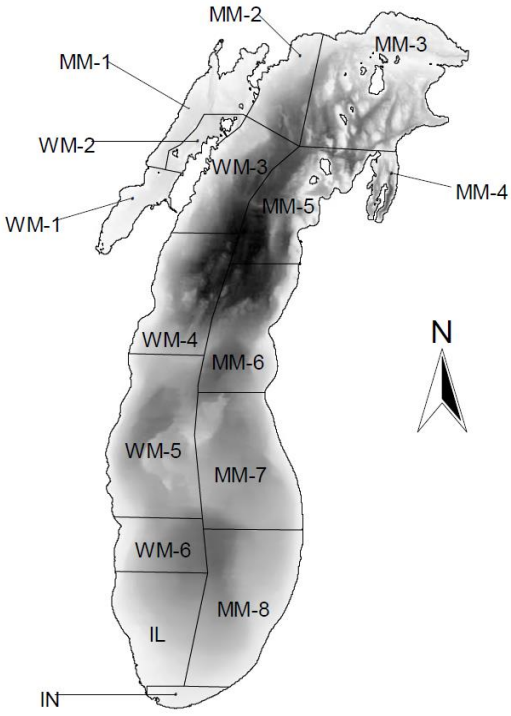


Fig 14- Lake Michigan harvest (lakewide) of yellow perch by commercial and recreational fisheries, 1985-2018

Appendix 1. Lake Michigan statistical districts



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