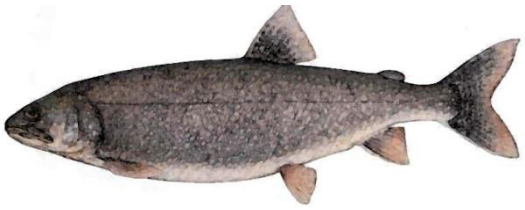
Technical Fisheries Committee Administrative Report 2022: Status of Lake Trout and Lake Whitefish Populations in the 1836 Treaty-Ceded Waters of Lakes Superior, Huron, and Michigan, with Recommended Yield and Effort Levels for 2021 and 2022



A Report Submitted by the Modeling Subcommittee to the Technical Fisheries Committee

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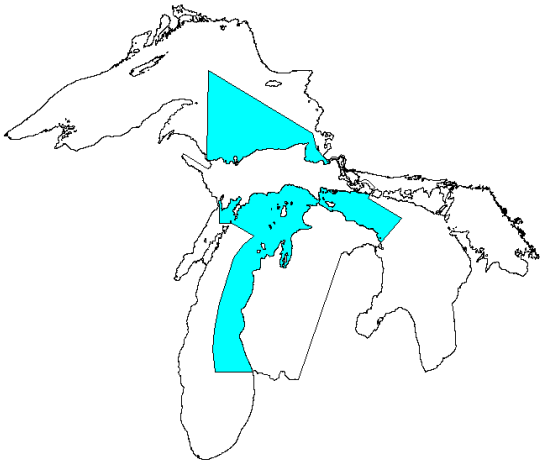
Editors



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EXECUTIVE SUMMARY

Prepared by Stephen J. Lenart and Jason B. Smith

This document describes the status of Lake Trout and Lake Whitefish stocks in the 1836 Treaty (hereafter "Treaty") waters of the Great Lakes as assessed by the 2000 Consent Decree's (Decree) Modeling Subcommittee (MSC). The primary objectives of this report are to 1) describe the status of each managed stock in the context of establishing recommended harvest limits according to the terms of the Decree; and 2) document important technical changes in the stock assessment process (for more in-depth technical detail on stock-assessment structure, see the 2012 version of this report available at https://www.michigan.gov/documents/dnr/2012StatusStocksReport_403608_7.pdf). This version of the report departs from the normal annual publication schedule to include recommended harvest and effort limits for the past two annual stock assessment cycles (2021 and 2022). Pandemic-related restrictions on agency field operations in 2020 resulted in a paucity of data that are integral to the stock assessment process, particularly for Lake Trout. As such, formal stock assessments were not conducted for Lake Trout in 2021 and recommended harvest limits for Lake Trout for 2021 were based on the 2020 stock assessment models.

Except in a few cases, statistical catch-at-age (SCAA) stock assessment models have been developed for each management unit where the provisions of the Decree apply. Estimates from the SCAA models are then used in projection models that incorporate the mortality target and allocation rules of the Decree to calculate model-derived harvest limits. Annual mortality rate targets for Lake Trout are either 40 or 45%, depending on the area (note that all parameters reported for Lake Trout in this document refer to the lean form). A 65% annual mortality target has been established for Lake Whitefish, though a complementary rule reduces mortality below the target rate if the spawning potential ratio (SPR) falls below 0.2. Of note is that the implementation of the target mortality rates specified in the Decree differs for Lake Trout and Lake Whitefish. For Lake Trout, the target rate is translated to a spawning stock biomass per recruit (SSBR) target, calculating by applying the target mortality rate to all ages at and above a certain age threshold (ie the "target age") and below which only natural mortality applies. Any projected mortality schedule that produces an SSBR value equivalent to this SSBR target is deemed to meet the mortality target for Lake Trout. For Lake Whitefish, the mortality target is implemented by limiting the mortality rate on the most vulnerable age(s) to the target rate.

Model-derived harvest limits for 2021 and 2022, along with the actual harvest and gill-net effort limits adopted via the management process under the Decree, are provided in Tables 1 and 2, respectively. In instances where the actual 2022 harvest limit for a Lake Trout or shared-allocation Lake Whitefish unit (WFS-04, WFS-05, WFM-01, WFM-06 and WFM-08) differs from model-derived limit, a brief explanation is provided in the sections that follow. For non-shared-allocation Lake Whitefish units, where the tribes have exclusive commercial fishing opportunities, harvest regulation guidelines (HRGs), as established by the Chippewa-Ottawa Resource Authority (CORA), serve as final harvest limits - these may differ from the model-derived limits. SCAA models for Lake Whitefish are on a one-year lag, so model-derived quantities (mortality, biological reference points, etc) reported in

this summary section, as well as in tables that accompany the individual unit summaries, are derived from models populated with data collected through 2020. Such quantities for Lake Trout are derived from models populated with data collected through 2021.

An additional section of tables that provide detailed output from the SCAA models has been added to this version of the report. Contact information for each stock assessment analyst is also provided.

Table 1. 2021 harvest and gill-net effort limits. Shading denotes management units where the allocation of Lake Whitefish is shared among State- and CORA-licensed commercial fisheries. Lake trout harvest limits apply to lean Lake Trout only.

Species	Lake	Management unit	Model-derived harvest limit (lb)[a]	Actual harvest limit (lb)	Gill-net effort limit (ft)[b]
Lake Trout	Superior	MI-5	124,571	124,571	NA
		MI-6	278,104	248,180	4,451,000
		MI-7	94,329	124,944	9,699,000
	Huron	MH-1	357,856	474,179	9,978,000
		MH-2	284,405	251,421	NA
	Michigan	MM-123	629,400	630,000	7,142,000
		MM-4	161,163	179,355	746,000
		MM-5	121,592	121,592	283,000
		MM-67	445,244	445,244	NA
Lake Whitefish	Superior	WFS-04[c,d]	144,000	144,000	NA
		WFS-05	203,800	203,800	NA
		WFS-06	NA	137,700	NA
		WFS-07	514,800	485,700	NA
		WFS-08	83,200	124,300	NA
	Huron	North Huron[d]	512,100	379,900	NA
		WFH-05	NA	295,500	NA
	Michigan	WFM-01[d]	1,285,000	1,285,000	NA
		WFM-02	838,000	204,000	NA
		WFM-03	1,080,000	450,225	NA
		WFM-04	527,300	240,300	NA
		WFM-05[d]	180,000	150,000	NA
		WFM-06[d]	74,000	125,000	NA
		WFM-07	NA	250,000	NA
		WFM-08[d]	248,000	500,000	NA

a. Model-derived limits for Lake Trout based on prior-year stock assessments
b. Gill-net effort limit for Tribal commercial fisheries, derived from recent gill-net fishery catch-per-unit effort of Lake Trout
c. Harvest limit for 1836 Treaty area of WFS-04
d. Model-derived harvest limit based on SPR 0.2 rule for Lake Whitefish

Table 2. 2022 harvest and gill-net effort limits. Shading denotes management units where the allocation of Lake Whitefish is shared among State- and CORA-licensed commercial fisheries. Lake trout harvest limits apply to lean Lake Trout only.

Species	Lake	Management unit	Model-derived harvest limit (lb)	Actual harvest limit (lb)	Gill net effort limit (ft)[a]
Lake Trout	Superior	MI-5	140,878	140,878	NA
		MI-6	289,714	289,714	6,463,000
		MI-7	116,074	116,074	8,737,000
	Huron	MH-1	435,130	435,130	8,809,000
		MH-2	340,413	340,413	NA
	Michigan	MM-123[b]	625,029		
		MM-4	207,340	207,340	663,000
		MM-5	153,683	153,683	295,000
		MM-67	513,481	513,481	NA
Lake Whitefish	Superior	WFS-04[c,d]	177,000	177,000	NA
		WFS-05	237,700	237,700	NA
		WFS-06	NA	137,700	NA
		WFS-07	515,600	485,700	NA
		WFS-08	85,500	85,500	NA
	Huron	North Huron[d]	304,900	303,900	NA
		WFH-05	NA	236,400	NA
	Michigan	WFM-01[d]	717,000	717,000	NA
		WFM-02	292,000	204,000	NA
		WFM-03	288,000	337,668	NA
		WFM-04	397,300	240,300	NA
		WFM-05	70,300	112,500	NA
		WFM-06	57,400	57,400	NA
		WFM-07	NA	202,500	NA
		WFM-08[d]	275,400	275,400	NA

a. Gill-net effort limit for Tribal commercial fisheries, derived from recent gill-net fishery catch-per-unit effort of Lake Trout
b. The final 2022 Lake Trout harvest limit for MM-123 has yet to be determined.
c. Harvest limit for 1836 Treaty area of WFS-04
d. Model-derived harvest limit based on SPR 0.2 rule for Lake Whitefish

Lake Trout

Lake trout stock assessment models are populated with both fishery-dependent (commercial and recreational) and fishery-independent information. All Lake Trout assessments are supported by well-established agency survey indices, though the length of the survey time series varies by lake. For much of the modeled time series lake trout were not a primary target of fisheries in lakes Michigan and Huron, though this has changed in recent years. As a result, fishery monitoring data are sometimes sporadic in certain areas. Nonetheless, the integration of (multiple) fishery-dependent and fishery-independent sources tend to produce stock assessments of satisfactory quality.

In Lake Superior, lean Lake Trout are self-sustaining, and the SCAA models and target mortality rates apply to these wild fish in three management areas (MI-5, MI-6, and MI-7). There has been no effort to construct an assessment model for Lake Trout in unit MI-8 due to its status as a deferred area. Unit MI-5 spans waters in both 1836 and 1842 Treaty areas - to date, commercial harvest of Lake Trout from unit MI-5 has occurred exclusively in 1842 Treaty waters.

Lake Superior Lake Trout populations experience low overall mortality, with lamprey tending to be the dominant mortality source on mature lake trout, and population trends are largely driven by recruitment. Increased recruitment was evident in western Lake Superior Treaty waters after 2013, with an apparently large 2015 year-class being produced in both MI-5 and MI-6. There were early signs of a similar increase in unit MI-7 but the SCAA model there is on a three-year rotation and was last updated in 2020 (with data thru 2019) with data in 2019. Fishery harvests have declined since the late 2010s in all Superior units and mortality rates have followed suit, though we note that the most recent commercial harvest from MI-5 is carried forward from 2020. Sea lamprey-induced mortality (SLIM) remains a significant source of mortality in Lake Superior and recent instantaneous rates range between 0.1 and 0.13 yr^{-1} on the most vulnerable age class, which is always an older age than those included in the typical reporting metric (i.e average for ages 6-11) – the peak rate may be a more suitable reporting metric for future status reports. Despite the low overall mortality regime, Lake Trout spawning biomass in Lake Superior treaty waters is stable to declining, as recent large recruit classes have yet to mature to the spawning stock.

Lake Trout populations in Lake Huron are composed of a mix of hatchery and naturally produced fish, the latter dominating proportions of fish up to age 15 captured in fisheries and surveys. Mortality in Lake Huron is estimated to be quite low, with annual rates less than 30% for the past two decades, which is much more similar to Lake Superior than Lake Michigan. Consequently, estimated female spawning biomass has been quite stable during 2010-2021 (range 1.1 to 1.3 million lb). SLIM has remained below 0.05 yr^{-1} since 2000, though it is worth noting that such rates reflect a 57% reduction from the base rate based on assumed lower susceptibility of Seneca-strain Lake Trout (the dominant strain in Lake Huron) to sea lamprey predation. Commercial fishery yields from 1836 waters have been consistent since roughly 2007, ranging between 200-300K pounds. Recreational yield of Lake Trout, which increased markedly after 2015, was the highest in the time series in 2021 at 160K lb. Extractions from the commercial fishery Ontario waters included in the SCAA model are assumed to have been constant since 2018. Survival of stocked fish, which had declined significantly after 2001, may have improved slightly in past few years, though additional observations will be necessary to confirm. Given the current

approach to modeling this mixed hatchery-wild stock, the survival of stocked fish, and hence the overall scaling of recruitment, remains an open area of investigation for the Lake Huron Lake Trout stock assessment. Research targeted at better defining post-stocking survival is expected to commence within the next few years.

The dynamics of Lake Trout populations in Lake Michigan continue to vary based on location. Mortality has been above target in MM-123 and MM-4 for nearly every year of the 2000 Consent Decree, though recent mortality rates are among the lowest in the time series in both units. High levels of stocking have sustained populations in these areas. Mortality is lower in units to the south, with recent maximum annual rates in the range of 35% in units MM-5 and MM-67. A decline in SLIM has been a major contributor to these patterns. Maximum instantaneous SLIM has remained below 0.1 yr^{-1} since 2015 in all Lake Michigan units and current rates range between zero and 0.04 yr^{-1}, an unprecedented circumstance in contemporary times. Age compositions have expanded in all Lake Michigan areas in recent years, albeit modestly in the northern units, where the accumulation of fish to the (fully) mature fraction of the population is largely due to survival of a few year classes after increased stocking targets were implemented in the late 2000s. Natural reproduction of Lake Trout continues to increase in Lake Michigan, although most of the gains are coming in the southern portion of the lake. Recruitment of wild fish, as measured by change in relative abundance, began to increase in MM-67 after 2015, a few years later in MM-5, and most recently in MM-4. In MM-123, recruitment of wild fish has remained low. Lakewide yield of Lake Trout has remained fairly stable (890-980K lb) in Lake Michigan since 2016, though we note that modest reductions in MM-123 and MM-67 were offset by increased yield in MM-5, which was the highest in the time series in 2021 due to increased recreational and commercial harvest. Fishing remains the highest source of mortality in units MM-123 and MM-4 and a significant source in units MM-5 and MM-67. Nonetheless, Lake Trout populations in Lake Michigan are in a much more favorable position than was the case as recently as the mid-2010s.

Lake Whitefish

Lake Whitefish populations are supported by natural reproduction throughout the Treaty waters and stock assessments are presently populated with only fishery-dependent information from commercial fishery sources. Potential mismatches between biological stock and management unit-boundaries, coupled with the small scale of certain fisheries and/or limited monitoring information, presents some challenges to the stock assessment process for Lake Whitefish. The quantity and quality of the fishery monitoring data is of utmost importance to ensuring quality results- something that deserves continued scrutiny in the future. Though data sources may not be of the same quality across all modeled units, the best available data and consistent model structures and procedures are used to estimate stock parameters for each unit.

Lake Superior Lake Whitefish unit WFS-04 spans both the 1836 and 1842 Treaty areas and commercial extractions are higher in the western (1842) portion of the unit. Recruitment has been cyclical here and both surveys and commercial monitoring indicate an increase in recruitment recently. Consequently, fishery yield and catch rates increased markedly in 2020 and 2021. No signal for increased recruitment yet exists in adjacent unit WFS-05, where fishery yield has declined the past few years, primarily due to reduced effort. Mortality remains low (<30%) in these western 1836 treaty areas and spawning biomass is stable.

Further east in the Grand Marais area (WFS-06), fisheries are small, sporadic and generally difficult to sample. As a result, the assessment model for this area has not been updated since the mid-2000s. Since then, yields have ranged from zero to 68K lb.

In eastern Lake Superior, fisheries are more intense, and mortality is higher than in the western treaty waters. In WFS-07, the current assessment model estimates that recruitment has largely been stable since the early 1990s, but growth rates have declined (although less so than for stocks in the lower lakes), contributing to the steady, long-term decline in spawning biomass evident here. Mortality averaged 61% over the last 10 years, which is somewhat higher than the previous 2 decades. Recent (2019-2020) yields are the lowest since 2009, with reduced effort a contributing factor. In WFS-08, recruitment has steadily increased over the last four decades, with the last four years being near the average. The average decadal mortality has been near to or higher than 60% for each of the last 4 decades with the highest in the most recent decade (average 60% during 2010-2020) and stock and spawning biomass have declined over the past two decades. As in WFS-07 yield declined during 2019-2020 to levels last observed in 2009, primarily because of lower effort.

In northern Lake Huron Treaty waters (WFH-01 thru WFH-04), there is little evidence that a strong year class has been produced since the late 1990s, precipitating the long-term decline in adult biomass that has been well described in this report series. Spawning biomass stabilized somewhat after 2016 due to declining mortality rates, a consequence of reduced fishery effort the past few years, and particularly so in 2020. Current spawning biomass is approximately 10% of the peak observed in the mid-1990s and 2020 commercial yield (132K lb) was 6% of 1995 peak. Yield declined further in 2021, to roughly 115K lb. Commercial monitoring data indicate that age composition is now composed primarily of fish less age 15 and the strong year classes produced in the late 1990s are no longer supporting the fishery. In adjacent unit WFH-05, many of the same patterns described for North Huron were evident during the last assessment (2018 cycle with data through 2016) for this stock, but low fishing effort, coupled with a lack of monitoring data, limits what can be stated about recent stock status. Fishery yield declined quickly in WFH-05 after the 2007 peak (nearly 900K lb) to roughly 30K lb in 2016. Little to no monitoring data were obtained during 2016-2019. Despite recent yield being at 1% of the peak, some monitoring samples were collected during 2020 and 2021, and an attempt will be made to populate the WFH-05 SCAA model during the 2022 cycle. This historically important stock can only be adequately assessed if data collection consistently improves in the years to come.

There are eight whitefish management units in Lake Michigan, spanning a diverse range of habitats, productivity, and fishery dynamics. For simplicity, we refer here to units WFM-01 through WFM-05 as the "north" and areas from Leland south as the "south". Lake Whitefish recruitment patterns are broadly similar throughout Lake Michigan: declines from all-time highs began in the late 1990s and early 2000s, with the last year class of any consequence being produced in 2003. Trends in biomass follow those of recruitment, though spawning biomass started to decline somewhat sooner in the north, where the relative size of the 2003 year-class was lower than in the south and mortality rates were higher. After the inception of the Decree, yields increased in all major fishing areas through the late 2000s/early 2010s and maximum mortality rates were in the 40-60% range during this post-Decree peak in fishery yield (except in unit WFM-08, where estimated rates

remained below 30%). Declining catch rates, and subsequently, declining effort, began to impact fishery yields after 2012 and the lack of recruitment resulted in continued erosion of the fishable stock in most areas, a pattern that continues to the present time. Yield of Lake Whitefish from Lake Michigan treaty waters was less than 500K lb in both 2020 and 2021, roughly 13% of the 2009 value. Current maximum mortality rates range from 22% to 35%, well below the established target. For some of the smaller stocks, fisheries have declined to levels that make obtaining monitoring samples challenging. Conversely, a trap-net fishery operation in WFM-07 (Ludington), for which no assessment model has been developed, has recently become active after seven years of inactivity. Despite the minimal effort, the fishery in Ludington was responsible for roughly 10% of the lakewide harvest during 2020 and 2021. Collection of biological information will be crucial for development of a future stock assessment, whether this area is treated as a separate unit, or combined with other units for stock assessment purposes.

Technical Changes

Information in this section is generally reserved for technical changes that were implemented across multiple assessments. The individual unit summaries provide detail on major structural changes or assumptions that affect a particular assessment; for this reason, certain individual unit summaries provide more detail than others.

Recruitment modeling in Lake Whitefish stock assessments

SCAA models for Lake Whitefish have, since their development, incorporated a Ricker stock-recruit function (SR) to provide recruitment predictions based on an estimated stock-recruit relationship (note that no environmental covariates are incorporated into the SR function). Abundance estimates for the first modeled age derived during fitting of the catch and age-composition data and compared to the SR-predicted values are deviations are penalized in the model's likelihood function. Once sufficient data observations are obtained for a cohort, the estimates of abundance for the cohort are less constrained by the SR-predicted values - thus, the SR predictions were envisioned to provide a forecast of recruitment for recent cohorts that were not yet recruited to the fisheries. The SR relationship was assumed to be stationary for the entire modeled time series, thereby assuming that stock productivity was time-invariant. As growth declined in lakes Michigan and Huron, and fish recruited to the fisheries over multiple years, often not becoming fully vulnerable until age 8 or 9, the period of uncertainty at the end of the time series expanded relative to the period when the models were developed, when fish were recruiting at age 4 or 5. Furthermore, given the fundamental changes that occurred in the lower-trophic ecology of lakes Michigan and Huron in the mid-2000s, it seemed unlikely that any underlying stock-recruit relationship had remained constant. In fact, in response to nuisance bounding issues or an inability to estimate SR parameters, the WFM-01 and North Huron models had abandoned the SR recruitment sub-model in favor of a version in which each annual recruitment value was the product of an estimated time-series average and an estimated annual deviation, with the annual deviations following a white noise (WN) pattern. Note that such an approach did not relax the assumption about stock productivity being generally stationary. A wholesale evaluation, using candidate models in each lake, was needed to address outstanding questions about the adequacy of the current SR approach given the ecological changes that have occurred through time.

To address these questions, a subgroup of the MSC evaluated a suite of alternative approaches to modeling recruitment, including single-period and two-period (lower-lakes only) white noise (WN) and first-order auto-regressive (AR) options. These alternative models were evaluated against the existing 2021 status-quo version (SR or WN, depending on the unit) for candidate models within each lake, with model fit and retrospective bias serving as the primary performance metrics. For the lower-lake (MI and HU) candidate models, the alternative AR1 version was consistently favored (lower retrospective bias in measures associated with the fishable stock), while the WN version was weakly favored for the Lake Superior units, though estimates of stock size were generally similar among the alternative versions evaluated for Lake Superior. This was not so for lower-lake models: estimated stock size was consistently much lower for the favored AR1 alternatives. The results of the evaluation mirrored our working assumptions about recruitment dynamics in Lake Superior, which has been a much more stable system ecologically, versus lakes Michigan/Huron, where ecological perturbations are much more prevalent. In lakes Michigan and Huron, the stationary SR (or WN) assumption was unable to adequately respond to the ecological changes that occurred in the mid-2000's and model estimates of abundance were likely biased for cohorts not yet fully vulnerable to fishing gear, or for which age composition data were insufficient. This bias would be exacerbated during the projection of harvest limits, which for Lake Whitefish, relied on a two-year projection from the last data year. Consequently, the favored alternative AR1 version resulted in lower estimates of abundance for the fishable stock and projected harvest limits were 30% to 70% lower for units in lakes Michigan and Huron. In Lake Superior, the favored WN version tended to produce larger estimated stock size and projected harvest limits were up to 25% higher (the AR1 produced similar results). Despite the substantial impact on projected harvest limits, within a given lake the evaluation produced very consistent results across multiple evaluation units and there was strong analytical support for adopting the favored alternative recruitment models for the 2022 assessment cycle. The reduced harvest recommendations produced by the favored alternative models for the lakes Michigan and Huron were still substantially higher than current yields.

We noted that for each alternative recruitment model, a two-period variant was evaluated for the Lake Michigan and Lake Huron units: for these variants recruitment parameters were estimated separately for each of two periods, designated by a switch year in the model code. The switch year was chosen to correspond to a year assumed to best represent the commencement of significant ecological change (2004 was chosen for the evaluation). Although there seemed to be reasonable justification for this approach, the two-period versions performed similarly to the single-period versions and the decision was made to retain the simpler single-period variant, which relied on fewer assumptions. Testing of alternative switch years did not substantively alter the results. We will continue to evaluate these various options as more information is gathered. It is important to acknowledge that, regardless of the modeling approach, in the absence of a viable fishery-independent recruitment index for Lake Whitefish, abundance estimates for recent cohorts will remain uncertain. The MSC continues to evaluate existing data sources for their potential utility as an index of recruitment.

Treatment of the refuge stock in Lake Michigan Lake Trout stock assessments for units MM-123 and MM-67

Portions of Lake Michigan units MM-123 and MM-67 encompass areas that have been set aside as Lake Trout refuges, where retention of Lake Trout by commercial and recreational fishers is prohibited. The Northern Refuge is located entirely in 1836 Treaty waters, encompassing roughly 30% of surface area of statistical district MM-3. The Midlake Refuge spans the Lake Michigan border between Wisconsin and the 1836 waters of statistical district MM-7 and is distinct from nearshore areas, from which it is separated by depths up to 130m. Current assessments for management units MM-123 and MM-67 are structured to model only the non-refuge portion of the stock (though fishery-independent survey data are available for both refuge areas, although only from Wisconsin waters of the Midlake Refuge). However, refuge and non-refuge portions of the stock act as both stocking and recruitment sites in the Lake Michigan migration estimation, so recruitment of age-1 fish is assumed known for reach fraction of the stock.

Since the inception of the Decree, projection models for MM-123 and MM-67 have incorporated an adjustment for the refuge fraction of the stock when determining allowable harvest for the fishable stock. This is accomplished by calculating a blended Refuge/Non-refuge SSBR target (for use in the projection) based on the number of age-1 fish recruited to each fraction relative to the total recruitment for the stock (natural mortality, SLIM and maturity are assumed to be equivalent for both fractions). The consequence of using this approach is that the non-refuge fraction of the stock can be fished at a higher rate due to the spawning stock that resides in the refuge.

Historically, the weighting factor was determined by using the most recent three years of stocking data. Since stocking rates had remained fairly consistent through time, there was likely little consequence to using such a short-term average. In light of a temporary change in stocking practices due to pandemic-related restrictions (ie offshore stocking at the refuges did not occur, or was substantially reduced in 2020 and 2021), the MSC determined that using a short-term average for the weighting factor was inconsistent with the intent of SSBR target control rule, which is based on the amount of spawning biomass than an individual recruit is expected to contribute during its projected lifespan. The MSC determined that a ten-year average (commencing with cohorts being projected into the fishable stock beginning at age 3) was more appropriate.

The justification/appropriateness of this approach for treatment of the refuges deserves more attention in the future. Much more information is now available on the dynamics of populations in the refuges, and more detailed information on movement of Lake Trout between refuge and non-refuge areas of MM-3 is expected to be available within the next few years. A wholesale evaluation of how (or whether) the refuges should be incorporated into the stock assessment and harvest policy processes appears warranted, the latter being outside the purview of the MSC.

MANAGEMENT UNIT DESCRIPTIONS

The Great Lakes are divided into spatially explicit management units, which differ for Lake Trout and Lake Whitefish. The provisions of the 2000 Consent Decree apply to each of the individual management units either partially or wholly contained within the 1836 Treaty-ceded (Treaty) waters of the Great Lakes. What follows are descriptions of the nine Lake Trout management units (Figure 1) and 15 Lake Whitefish management units (Figure 2) that are assessed by the Modeling Subcommittee, with an emphasis on major physical features and landmarks. Table 2 provides area estimates for each management unit as derived from spatial analysis of available shapefile layers in ArcGIS™ (ESRI).

Lake Trout Management Units

MI-5: Lake trout management unit MI-5 extends from Pine River Point (west of Big Bay) to Laughing Fish Point (east of Marquette). This management unit includes Stannard Rock, an offshore shoal about 72 km north of Marquette, and is in both the 1836 (250,000 ha) and 1842 Treaty waters (124,000 ha). The 1836 Treaty area extends east from the north-south line established by the western boundaries of grids 1130, 1230, 1330, 1430, and 1530. This unit has a wide bathymetric range with depths beyond 235 m.

MI-6: Lake trout management unit MI-6 extends from Laughing Fish Point (east of Marquette) to Au Sable Point (east of Munising). This management unit includes Big Reef, an offshore reef complex about 32 km northeast of Munising. This management unit contains the deepest waters of Lake Superior with soundings deeper than 400 m.

MI-7: Lake trout management unit MI-7 extends from Au Sable Point (west of Grand Marais) to Little Lake Harbor (east of Grand Marais). This management unit has complex bathymetry with many lacustrine ridges, trenches, and slopes.

MH-12: Lake trout assessment unit MH-12 comprises Lake Huron statistical districts MH-1 and MH-2 and includes biological data from adjacent Ontario quota management areas 4-1, 4-2, and 4-3 (no detailed description is provided here for these Ontario units). MH-1 is located in northern Lake Huron and extends from the Mackinac Bridge south to the border between grids 607 and 608. The management unit has a wide bathymetric range with areas in grids 407 and 408 as deep as 130 m. This statistical district lies completely within 1836 Treaty waters. On the Michigan shore this district encompasses the ports of Saint Ignace, Mackinaw City, Cheboygan, Hammond Bay, and Rogers City. The St. Marys River, connecting Lakes Superior and Huron, flows into Lake Huron in grid 306. The majority of Lake Huron's historically important Lake Trout spawning reefs and shoals are located in MH-1. The Drummond Island Refuge is located in grids 307, the northern ½ of grid 407, and Michigan waters of grids 308, 408, 409, and 410, and covers 72,000 ha of 1836 Treaty waters. Retention of Lake Trout in the refuge is prohibited. Statistical district MH-2 lies directly to the south of MH-1 and includes both 1836 Treaty waters and non-treaty waters, divided by a NE line running near the tip of Thunder Bay's North Point to the international border. The Michigan ports of Presque Isle and Alpena are contained in this statistical district. MH-2 also has a wide bathymetric range, with areas in grids 714 and 814 deeper than 210 m. District MH-2 contains a limited number of historically important nearshore Lake Trout spawning reefs and shoals. These reefs are located near Middle Island

and along Thunder Bay's North and South Points. Six Fathom Bank, a large offshore reef complex, bisects districts MH-2 and MH-3. A portion of the Six Fathom Bank Refuge is contained in unit MH-2, covering the eastern half of grid 913 grid 914 and Michigan waters of grid 915. Retention of Lake Trout is prohibited in the refuge. Canadian waters adjacent to the refuge are a commercially protected area where commercial fishers are prohibited from fishing in waters shallower than 40 fathoms.

MM-123: Management unit MM-123 is made up of statistical districts MM-1, MM-2 and MM-3 and encompasses Michigan's waters of northern Lake Michigan and northern Green Bay. Water depths in the northern portion of the unit are generally less than 45 m. In southern portions of the unit, depths can be greater than 170 m. Most of the historically important Lake Trout spawning reefs in Lake Michigan are located in MM-123. The unit contains many islands including the Beaver Island complex (Beaver, Hat, Garden, Whiskey, Trout, High and Squaw Islands), North and South Fox Islands, and Gull Island in Lake Michigan. Another series of islands form a line separating Green Bay from Lake Michigan; these include Little Gull, Gravely, St. Martins, Big and Little Summer and Poverty Islands. Except for the southern one-half of MM-1 in Green Bay, this management unit is entirely in 1836 Treaty waters, and contains a Lake Trout refuge. The "northern refuge" is nearly 233,000 ha and occupies the southern ½ of grids 313 and 314, grids 413, 414, 513-516, the northwest quarter of grid 517, grid 613, and the northern ½ of grid 614. Retention of Lake Trout by sport or commercial fisheries is prohibited in the refuge. Both commercial and subsistence gill-net fishing are prohibited in the refuge, while commercial trap-net operations are permitted to harvest Lake Whitefish.

MM-4: Lake trout management unit MM-4 encompasses the Grand Traverse Bay region of Lake Michigan. There are two islands in this management unit, Bellow and Marion Island. A large peninsula bisects the southern half of the bay. For the most part water depths in the bay range up to 85 m. However, waters on either side of the peninsula are much deeper, ranging to 134 m in the west arm and 195 m in the east arm. This management unit is entirely in 1836 Treaty waters. There are no refuge areas allocated, however commercial fishing is prohibited in the southern most portion of the bay (grids 915 and 916). Based on estimates from historical commercial catch rates only a small amount of Lake Trout spawning habitat is located in the management unit.

MM-5: Lake trout management unit MM-5 is located in eastern central Lake Michigan and corresponds to the MM-5 statistical district. This area constitutes an area of high use by both Tribal and State interests. The unit includes Michigan's waters of Lake Michigan from Arcadia north to the tip of the Leelanau Peninsula, extending to the state line bisecting the middle of the lake. There are two islands in this management unit, the North and South Manitou Islands. Some of the deepest waters and largest drop-offs in Lake Michigan occur in MM-5. Water depths range to 250 m and for the most part are greater than 120 m. The entire area is in 1836 Treaty waters and there are no refuges allocated within the management unit. Only a small amount of Lake Trout spawning habitat is located here, most of which is located in the near shore zone and around the North and South Manitou Islands.

MM-67: Lake trout management unit MM-67 is located in eastern central Lake Michigan, comprising statistical districts MM-6 and MM-7. The area covers

Michigan's waters of Lake Michigan from Arcadia to Holland, extending to the state line bisecting the middle of the lake. The northern section of the region (MM-6) is deeper, with depths up to 275 m, and is characterized by greater slope than the southern section (MM-7). For the most part, water depths in MM-7 are less than 122 m. There are no islands or structures in southern treaty waters, and there is little Lake Trout spawning habitat, with the exception of offshore deep-water spawning reefs located within the mid-lake refuge. The southern treaty management unit is not entirely comprised of 1836 waters- the northern section (MM-6) is entirely treaty ceded territory while only the northern two-thirds of the southern section (MM-7) is within the 1836 treaty territory. A total of 179,000 ha in the unit are outside treaty waters. A line running parallel to the northern side of the Grand River (located approximately ¾ of the way through grids in the 1900 series) out to the state line in the middle of the lake delineates the southern boundary of the 1836 Treaty area in the unit. Management unit MM-67 contains a portion of the mid-lake Lake Trout refuge, which comprises 850 square miles of the unit (grids 1606, 1607, 1706, 1707, 1806, 1807, 1906 and 1907). It is illegal for recreational, commercial and subsistence fishers to retain Lake Trout when fishing in the refuge area. Gill-net fishing (both commercial and subsistence) is prohibited in the refuge, State- and Tribal-licensed commercial trap-net operations are permitted to fish in the refuge; however, the retention of Lake Trout is prohibited.

Lake Whitefish Management Units

WFS-04: Lake whitefish unit WFS-04 is located in Lake Superior near Marquette, roughly between Big Bay and Laughing Fish Point. Near shoreline features of this zone include many points, bays, islands, and in-flowing rivers. Habitat suitable for Lake Whitefish growth and reproduction is associated with many of these features. This unit holds waters both within and outside the 1836 Treaty area. Based partly on the number of statistical grids on either side of the 1836 treaty line and partly on established protocol for a similar situation with Lake Trout, 70% of WFS-04 is considered to be in 1836 waters.

WFS-05: The WFS-05 Lake Whitefish management unit extends approximately from Laughing Point to Au Sable Point in Michigan waters of Lake Superior. Several bays (Shelter Bay, Au Train Bay, South Bay, and Trout Bay) and islands (Au Train Island, Wood Island, Williams Island, and Grand Island) are prominent in this area, providing substrate and depth contours suitable for Lake Whitefish habitat and spawning. Different whitefish stocks exist within this unit, including a smaller, slower-growing stock identified in Munising (South) Bay.

WFS-06: The Grand Marais stock of Lake Whitefish is probably one of the smallest in the 1836 ceded waters, certainly the smallest in terms of harvest levels in Lake Superior waters. There are typically only small aggregations of spawning Lake Whitefish in WFS-06, based on anecdotal information from commercial fishers that have regularly fished WFS-06 throughout the year.

WFS-07: WFS-07 is located in the Whitefish Bay area of Lake Superior. There is a substantial commercial fishery in adjacent Canadian management unit SO-11. WFS-07 contains a single, large stock of whitefish that spawns in the southwest portion of Whitefish Bay.

WFS-08: WFS-08 is located in the southeast portion of Whitefish Bay, Lake Superior. WFS-08 is spatially the smallest of the management units in the 1836 ceded waters of Lake Superior. A substantial commercial fishery targeting whitefish also

exists in adjacent Canadian management units SO-11 and SO-12. It is thought that four reproductively isolated stocks of whitefish contribute to the commercial fishery in WFS-08. There are two spawning areas in WFS-08, a probable contributing spawning population in Canadian waters of management unit SO-12, as well as contributions from spawning fish in WFS-07 directly west of WFS-08.

Northern Huron (WFH-01 thru WFH-04): Management unit WFH-01 is located in the northwest portion of the main basin of Lake Huron. Management unit WFH-02 is located along the northern shore of the main basin of Lake Huron. Much of WFH-02 is deeper than 45 m and maximum depth is slightly more than 90 m. WFH-02 is a small unit made up of only three statistical grids. The unit has an irregular shoreline with many small, rocky points, small bays, and scattered boulders. Management unit WFH-03 is small and encompasses only the area around Drummond Island. A Lake Trout refuge is located along the south shore of Drummond Island where large-mesh gill-net fishing is prohibited and retention of Lake Trout by trap-net fisheries is prohibited. The south side of WFH-03 is deep with much of the water exceeding 45 m in depth, whereas the north and west sides of Drummond Island are relatively shallow. WFH-03 contains six statistical grids. WFH-04 is the largest whitefish management unit in the 1836 Treaty waters of Lake Huron. Spawning concentrations of whitefish are scattered throughout the unit with concentrations being found from Cheboygan to Hammond Bay.

WFH-05: WFH-05 extends from Presque Isle south to the southern end of grids 809-815 in US waters and includes some waters of Lake Huron that lie outside the 1836 Treaty waters. WFH-05 contains multiple spawning aggregates, most of which are likely associated with the numerous islands (Crooked, Gull, Middle, Sugar and Thunder Bay) or small embayments that are found in the southern part of the unit.

WFM-01: Lake whitefish management unit WFM-01 is located in the 1836 Treaty waters of northern Green Bay. Prominent features of this area include two large bays (Big and Little Bay de Noc), numerous small embayments, several islands (including St. Martins Island, Poverty Island, Summer Island, Little Summer Island, Round Island, Snake Island, and St. Vital Island), as well as various shoal areas (Gravelly Island Shoals, Drisco Shoal, North Drisco Shoal, Minneapolis Shoal, Corona Shoal, Eleven Foot Shoal, Peninsula Point Shoal, Big Bay de Noc Shoal, Ripley Shoal, and shoals associated with many of the islands listed above). Little Bay de Noc is the embayment delineated by statistical grid 306. Shallow waters characterize the northern end and nearshore areas, but there is a 12- to 30-m deep channel that runs the length of the bay. Rivers that flow into Little Bay de Noc include the Whitefish, Rapid, Tacoosh, Days, Escanaba, and Ford. Big Bay de Noc is a larger embayment delineated by statistical grids 308 and 309. Big Bay de Noc is relatively shallow with over half the area less than 10-m deep and a maximum depth of 21 m. Rivers that empty into Big Bay de Noc include the Big, Little, Ogontz, Sturgeon, Fishdam, and Little Fishdam. Only grids 308, 309, 407 and 408 are entirely within 1836 Treaty waters

WFM-02: WFM-02 is located in the northwest portion of Lake Michigan. The only known spawning population of whitefish in the management unit is located in Portage Bay; this population is not as abundant as other stocks in Lake Michigan. Many of the whitefish inhabiting WFM-02 move into the unit from adjacent units.

WFM-03: WFM-03 is located in northern Lake Michigan. The unit extends from the Straits of Mackinac west to Seul

Choix Point and is bounded on the south by Beaver Island and a complex of shoals and islands surrounding it. Nearly the entire unit is shallow water less than 27 m deep.

WFM-04: WFM-04 is located in central northern Lake Michigan and contains a very diverse range of habitat. The Beaver Island archipelago, which consists of eight named islands, is the dominant feature of the unit. These islands, located mainly along the northern edge of the unit, are associated with a large, rocky reef complex that extends about 15 miles west from Waugoshance Point near the northwestern tip of Michigan's Lower Peninsula. This northern reef complex is shallow, ranging from 2- to 9-m deep. Many smaller submerged reefs extend from the northern reef complex to the south, running along the east and west sides of Beaver Island, a 14,245-ha landmass that bisects the unit. These latter reefs are surrounded by deep water.

WFM-05: Management unit WFM-05 encompasses the area from Little Traverse Bay through Grand Traverse Bay and offshore waters of Lake Michigan north and west of the Leelanau Peninsula. Much of WFM-05 contains water greater than 80-m deep, including both the east and west arms of Grand Traverse Bay. The deepest parts of WFM-05 exceed 183 m, both in the offshore waters west of the Leelanau Peninsula, as well as within the east arm of Grand Traverse Bay. Several small shallow reef areas are located in the offshore waters, and there is an extensive shallow water area associated with the Fox Islands. Seventeen statistical grids make up WFM-05. Much of the offshore waters of WFM-05 are part of the northern Lake Michigan Lake Trout refuge.

WFM-06: Lake whitefish management unit WFM-06 is located in 1836 Treaty waters west of the Leelanau Peninsula from about Cathead Point south to Arcadia. These waters of Lake Michigan include Good Harbor Bay, Sleeping Bear Bay, and Platte Bay. Two large islands, North Manitou and South Manitou, are contained in this management zone, as are three large shoal areas including North Manitou Shoal, Pyramid Point Shoal, and Sleeping Bear Shoal. Major rivers flowing into WFM-06 include the Platte and the Betsie. Betsie Lake is a drowned river mouth formed where the Betsie River flows into Lake Michigan. Except for areas near shore or around the islands, most of the waters in WFM-06 are deep (greater than 60 m). Bays, islands, and shoal areas offer the best habitat for Lake Whitefish spawning in this management area.

WFM-07: Lake whitefish management unit WFM-07 is located within the 1836 Treaty Ceded Waters of eastern central Lake Michigan from Arcadia in the north to just south of Stony Lake, and west to the Michigan/Wisconsin state line bisecting the middle of the lake. This Lake Whitefish management unit includes part or all of grids 1107-1111, 1207-1211, 1306-1310, 1406-1410, 1506-1510 and 1606-1609. There are several inflows from the Big Manistee, Little Manistee, Big Sable, Pere Marquette, and Pentwater Rivers, and drowned river mouths at Manistee Lake, Pere Marquette Lake, and Pentwater Lake.

WFM-08: Management unit WFM-08 is the Lake Michigan whitefish zone that extends from Montague south past Port Sheldon; only those waters north of the Grand River lie within 1836 Treaty waters. Apart from the shoreline, and inflows from the White, Muskegon, and Grand Rivers, and drowned river mouths at White Lake, Muskegon Lake, Mona Lake, and Pigeon Lake, this area has few other distinguishing features relevant to Lake Whitefish biology. Depth gradients west from shore are relatively gradual, but most of the waters in WFM-08 are 61-m deep or deeper.

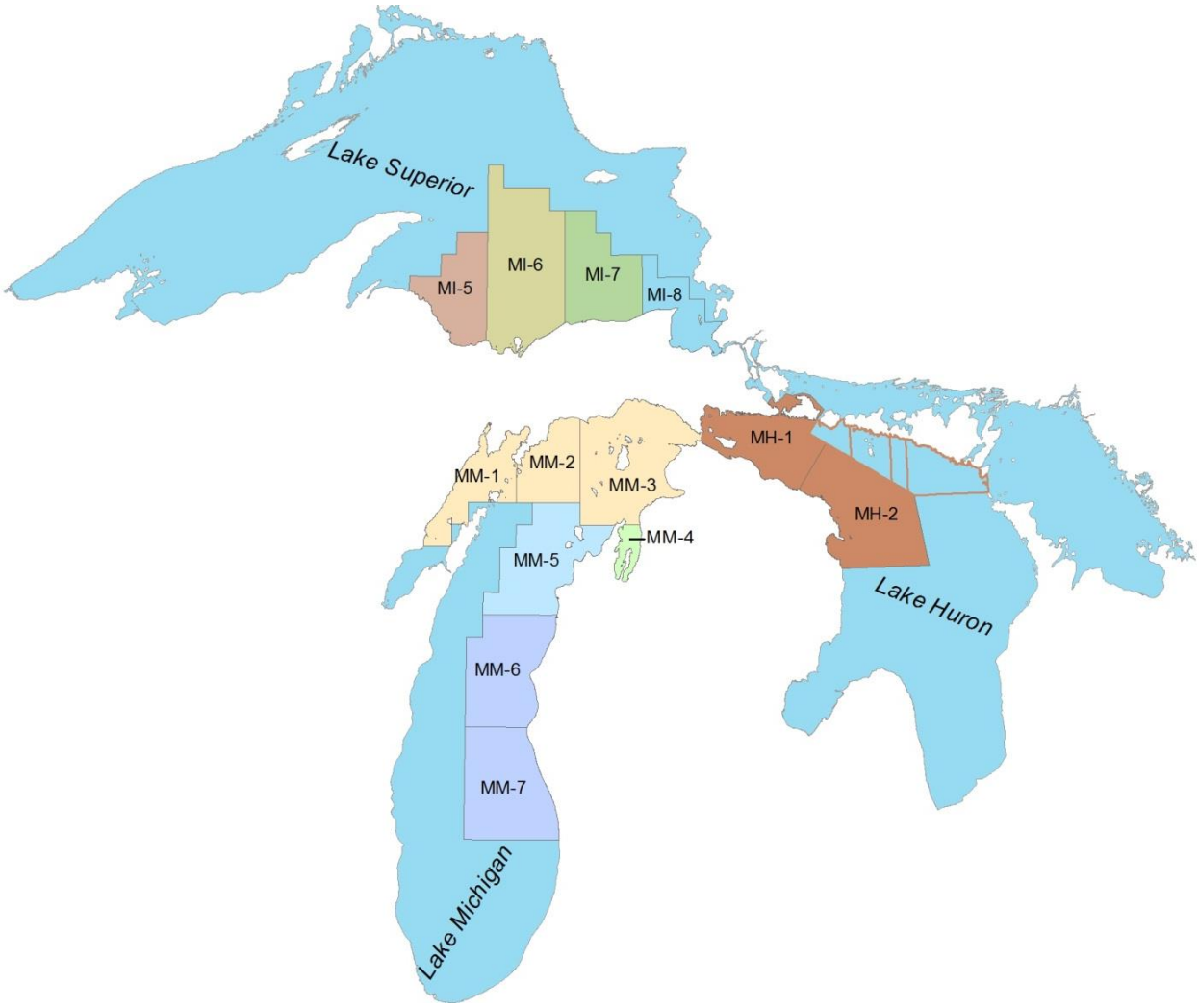


Figure 1. Lake Trout Management Units. Shading denotes units subject to provisions of the 2000 Consent Decree. Like shading indicates where statistical districts have been combined into a single management unit for stock assessment purposes. In the case of Lake Huron, outlined areas adjacent to statistical districts MH-1 and MH-2 denote where fishery data from Ontario waters are included in the single stock assessment unit for Lake Trout in Lake Huron. No stock assessment has been developed for Lake Superior unit MI-8.

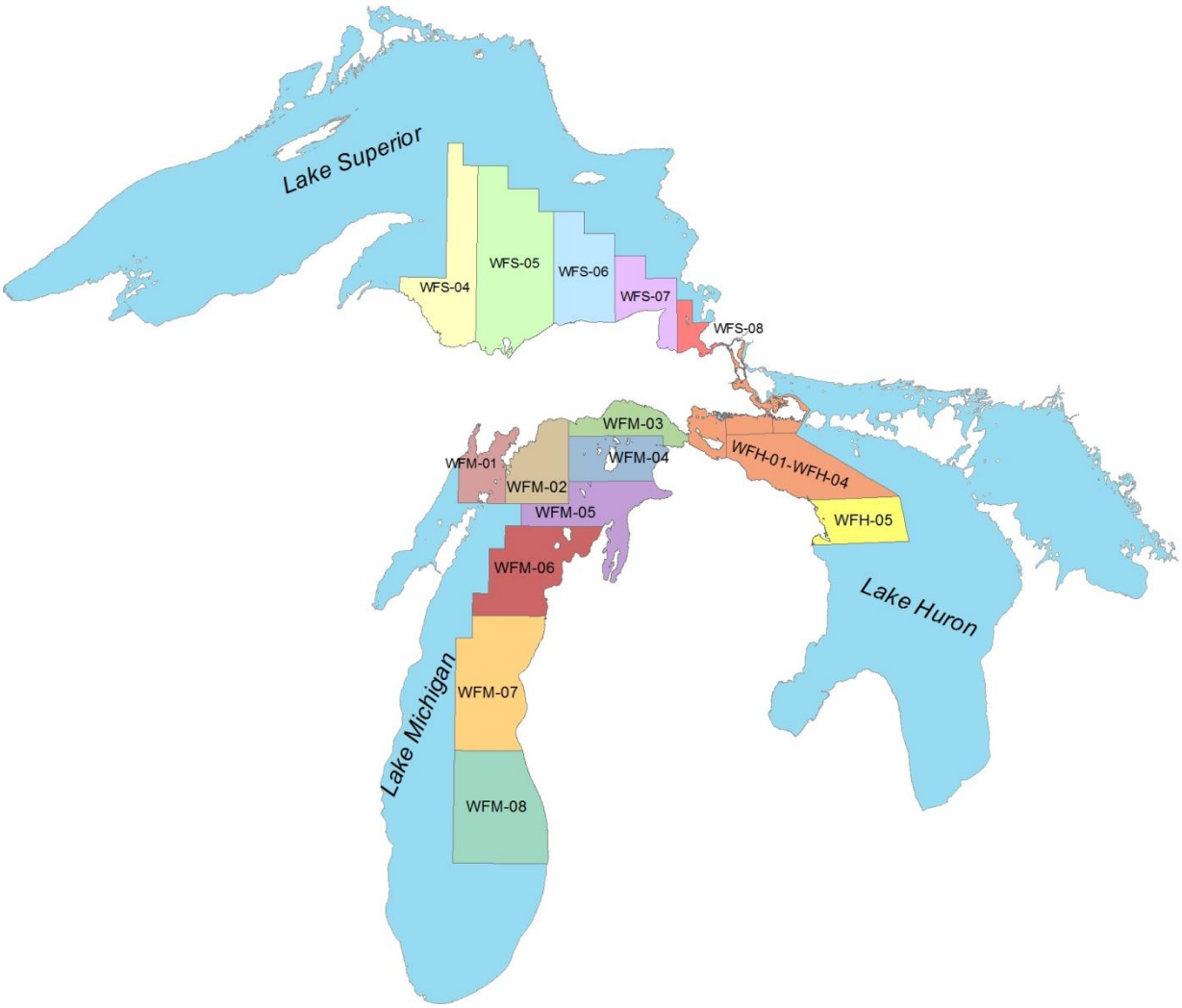


Figure 2. Lake Whitefish Management Units. Shading denotes units subject to provisions of the 2000 Consent Decree. Like shading indicates where units have been combined into a single management area for stock assessment purposes. No stock assessment model has been developed for Lake Michigan unit WFM-07 and the stock assessment models for Lake Superior unit WFS-06 and Lake Huron unit WFH-05 have not been populated recently due to the lack of available monitoring data.

Table 3. Surface area (hectares) estimates for Lake Trout and Lake Whitefish management units associated with 1836 waters of the Great Lakes.

Species	Lake	Management unit	Total Area (ha)	Area<= 80m (ha)
Lake Trout	Superior	MI-5	374,100	117,000
		MI-6	803,300	105,100
		MI-7	459,300	157,800
	Huron	MH-12	1,073,800	563,000
		OH-1*	353,800	196,300
	Michigan	MM-123	1,293,200	910,200
		MM-4	66,100	50,200
		MM-5	548,000	125,400
		MM-67	1,155,500	270,200
Lake Whitefish	Superior	WFS-04	396,300	116,800
		WFS-05	730,000	96,400
		WFS-06	416,900	123,200
		WFS-07	239,200	148,800
		WFS-08	78,200	70,400
	Huron	North Huron	677,300	385,700
		WFH-05	262,700	86,300
	Michigan	WFM-01	190,700	190,700
		WFM-02	293,000	146,800
		WFM-03	200,500	200,500
		WFM-04	259,200	228,900
		WFM-05	366,100	174,100
		WFM-06	475,300	116,600
		WFM-07	643,800	117,800
		WFM-08	656,800	145,700

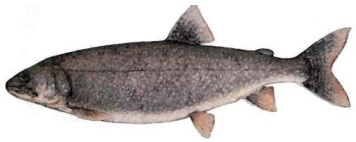
*Ontario statistical district OH-1 presented as a surrogate for the three Ontario quota-management areas (4-1, 4-2 and 4-3) included in the North-central Lake Huron (MH-12) model.

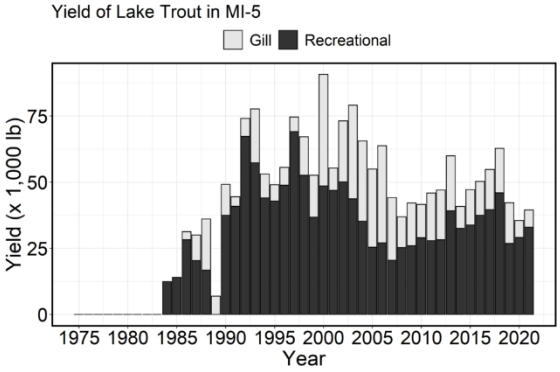
STATUS OF LAKE TROUT POPULATIONS

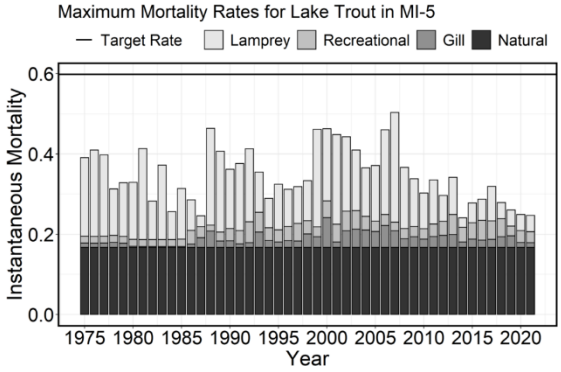
Lake Superior

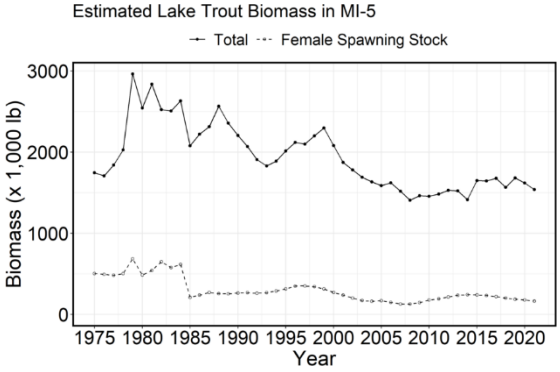
MI-5 (Marquette)

Shawn Sitar



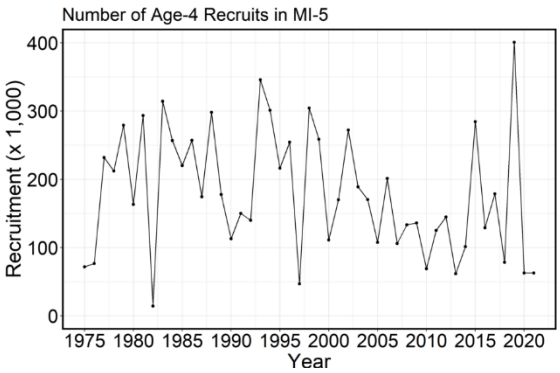






Parameter	Value
Base SSBR	4.58 lb
Current SSBR	1.77 lb
SSBR at target mortality	0.22 lb
Current SPR	0.39
M	0.17 y^{-1}
F, Commercial (2019-2021)	<0.01 y^{-1}
F, Recreational (2019-2021)	0.02 y^{-1}
Sea Lamprey Mort (2018-2020)	0.04 y^{-1}
Z (2021)	0.22 y^{-1}
2022 Model-derived Limit	140,878 lb
2022 Actual Harvest Limit	140,878 lb
Model Rating	Medium

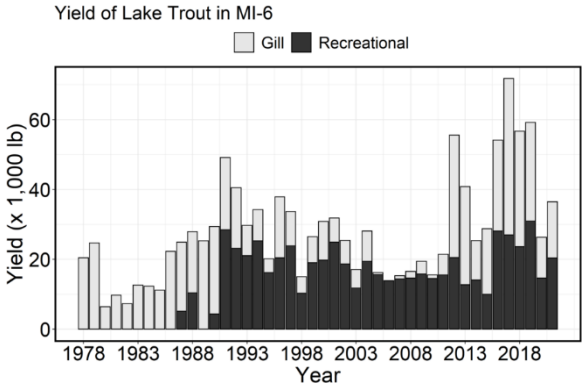
Mortality rates represent averages for Lake Trout ages 6-11. Commercial fishing mortality includes Lake Trout harvested from all commercial fishery gear types.

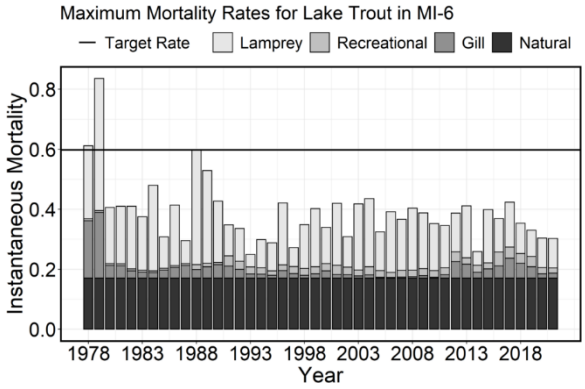


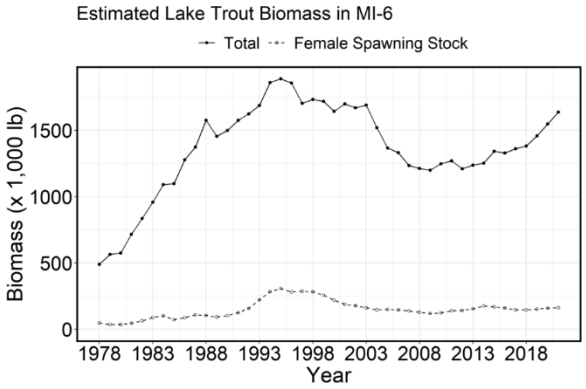
Notable stock dynamics and model revisions for MI-5:

Lake trout abundance in this unit peaked in the late 1990s, underwent a systematic decline until 2014, but has since increased due to increased recruitment. Sea lamprey-induced mortality has declined since 2007 and has been consistently low in recent years. Recreational harvest averaged 7,800 fish during 2019-2021. Commercial yield averaged 12,900 lb during 2018-2020 (2021 not available) and has declined by more than two-thirds since 2006. The 2022 model does not have actual 2021 commercial yield, effort, and age composition data. The assessment was based on assuming that 2021 commercial fishery data were equal to the 2020. Total annual mortality for age 6-11 lake trout averaged 20% in the last three years. The lake trout model harvest limit in 2022 increased by 13% from 2020 due slight increase in abundance and lower mortality.

MI-6 (Munising) — Shawn Sitar

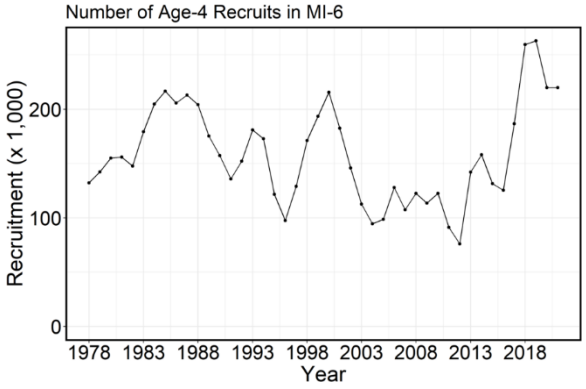






Parameter	Value
Base SSBR	4.40 lb
Current SSBR	1.68 lb
SSBR at target mortality	0.41 lb
Current SPR	0.38
M	0.17 y^{-1}
F, Commercial (2019-2021)	0.02 y^{-1}
F, Recreational (2019-2021)	0.02 y^{-1}
Sea Lamprey Mort (2018-2020)	0.07 y^{-1}
Z (2021)	0.27 y^{-1}
2022 Model-derived Limit	289,714 lb
2022 Actual Harvest Limit	289,714 lb
Model Rating	Medium

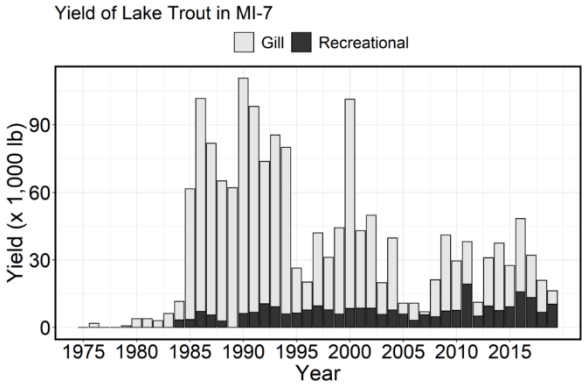
Mortality rates represent averages for Lake Trout ages 6-11. Commercial fishing mortality includes Lake Trout harvested from all commercial fishery gear types.

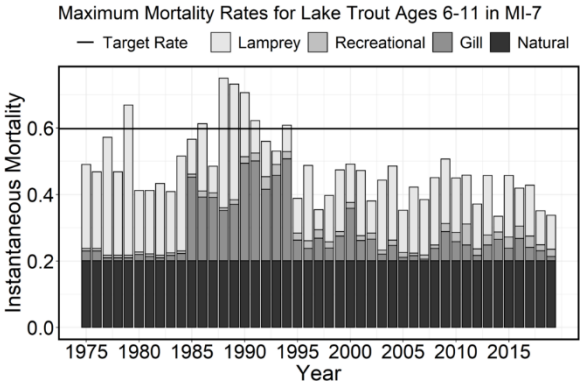


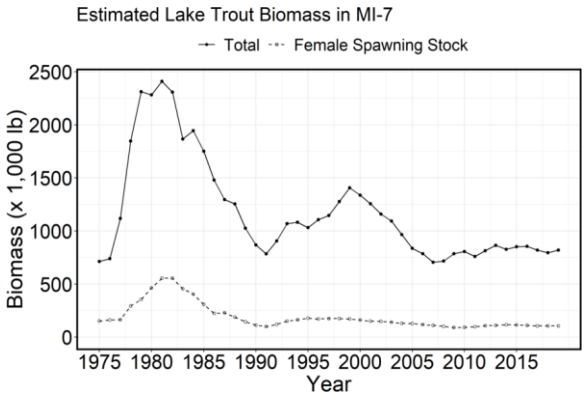
Notable stock dynamics and model revisions for MI-6:

Recent abundance continues to increase due to recent surges in recruitment starting in 2012. Sea lamprey predation persists as the dominant source of mortality and has remained high. Total annual harvest has increased in the last three years with recreation harvest averaging 5,000 fish and the commercial yield averaging 18,700 lb. Total annual mortality for age 6-11 lake trout averaged 24% in the last three years. The 2022 TAC for MI-6 increased only 4% from the last assessment.

MI-7 (Grand Marais) Shawn Sitar

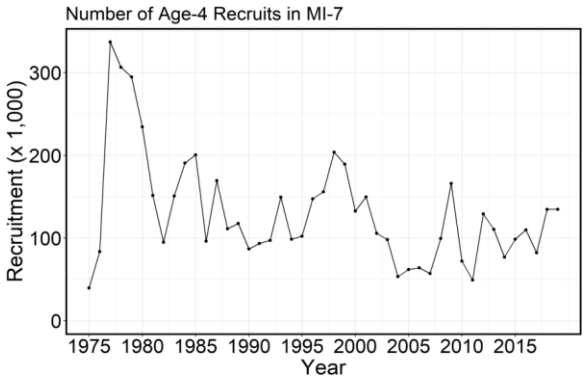






Parameter	Value
Base SSBR	2.81 lb
Current SSBR	1.31 lb
SSBR at target mortality	0.64 lb
Current SPR	0.47
M	0.17 y^{-1}
F, Commercial (2017-2019)	0.01 y^{-1}
F, Recreational (2017-2019)	0.03 y^{-1}
Sea Lamprey Mort (2018-2020)	0.07 y^{-1}
Z (2019)	0.22 y^{-1}
2022 Model-derived Limit	116,074 lb
2022 Actual Harvest Limit	116,074 lb
Model Rating	Low

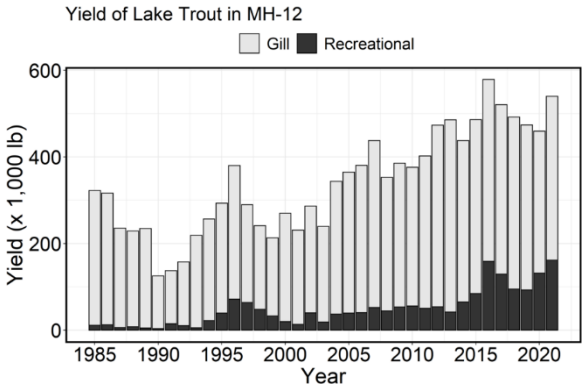
Mortality rates represent averages for Lake Trout ages 6-11. Commercial fishing mortality includes Lake Trout harvested from all commercial fishery gear types.

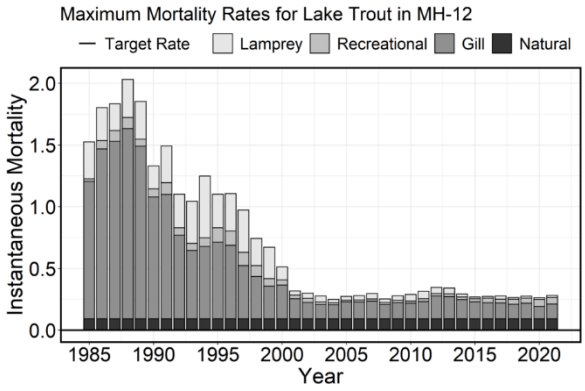


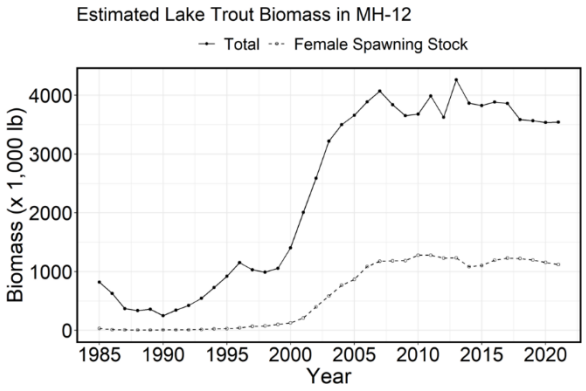
Notable stock dynamics and model revisions for MI-7:

The 2022 harvest limit for MI-7 was based on a two-year projection of the output from the 2020 assessment model and the accompanying figures and model estimates reflect the stock status of 2019, except for sea lamprey mortality, for which updated values are utilized during the projection process. The TAC increased by 23% because of a projected increase in stock size in recent years. Commercial yield averaged 4,900 lb during 2019-2021. Average recreational harvest in the last three years was 2,100 fish. Sea lamprey-induced mortality continues as the highest mortality source since 2001. Total mortality is low and averaged 27.9% between 2017 and 2019.

Lake Huron
MH-1 and MH-2 (Northern and North-central Lake Huron) Ji He

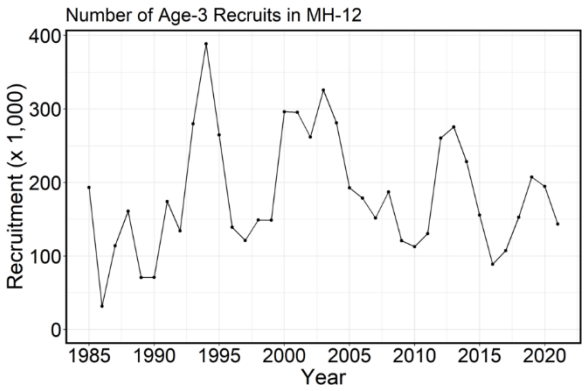






Parameter	Value
Base SSBR	31.12 lb
Current SSBR	6.70 lb
SSBR at target mortality†	n/a
Current SPR	0.22
M	0.09 y^{-1}
F, Commercial (2017-2019)	0.13 y^{-1}
F, Recreational (2017-2019)	0.04 y^{-1}
Sea Lamprey Mort (2018-2020)††	0.01 y^{-1}
Z (2021)	0.27 y^{-1}
2022 Model-derived Limit	642,261 lb
2022 Actual Harvest Limit	775,308 lb
Model Rating	Medium

Mortality rates represent averages for Lake Trout ages 6-11. Commercial fishing mortality includes Lake Trout harvested from all commercial fishery gear types.



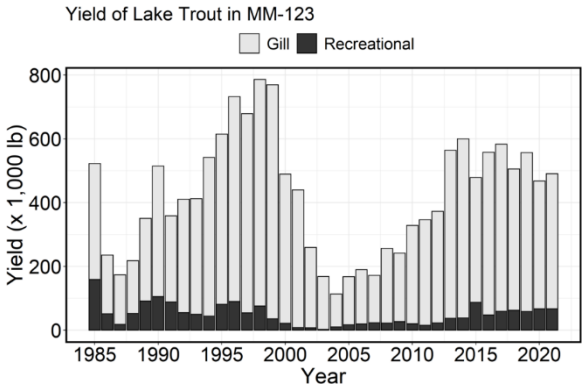
†Target mortality rates differ between MH-1 and MH-2. SSBR at target mortality is 1.51 lb for MH-1 and 2.02 lb for MH-2.

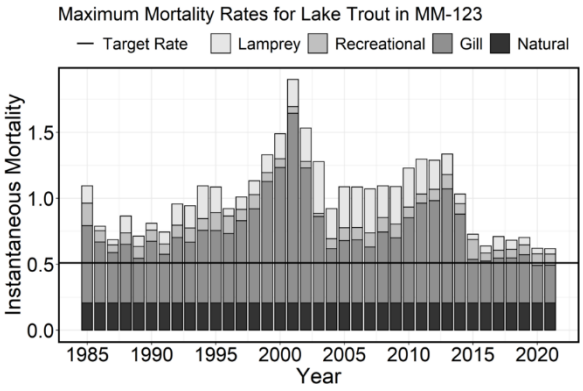
†† After adjustment due to assumed higher survival of Seneca-strain Lake Trout, which is the dominant strain of both hatchery and wild fish in main basin Lake Trout stocks of Lake Huron.

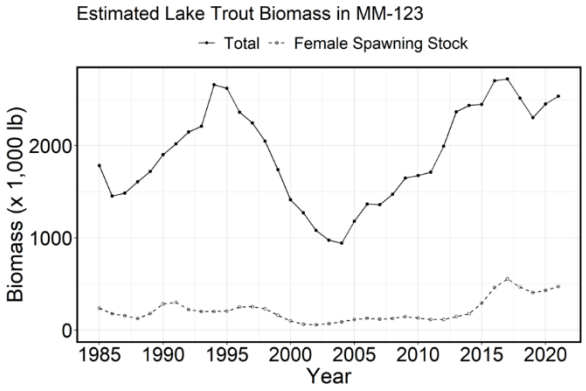
Notable stock dynamics and model revisions for MH-12:

From the base model updated with data up to 2022, the population status did not experience major changes. Female spawning biomass was maintained above 1 million lb, and the total stock biomass was above 3.5 million lb. The total abundance was above 800 thousand fish, and the recent ten-year average recruitment at age-3 was 242,943 fish. Annual mortality at the peak age in 2021 was 24%, near the average since 2000. Based on the current harvest policy, total allowable catch for 2022 was calculated as 382,913 lb for commercial fishery and 52,217 lb for recreational fishery in the area of MH-1, and 17,021 lb for commercial fishery and 323,392 lb for recreational fishery in the area of MH-2. The model adequately fit the survey and fisheries data. Canadian harvest data, including fishing effort, harvests, and age compositions, were carried over from the past years because no data updates were received. The base model continues to display strong retrospective patterns in spawning stock biomass. There was evidence that the reoccurring of strong retrospectively patterns was due to underestimates of recruitment. The scaling of recruitment at age 3 should be evaluated against the stocking of yearling equivalent that was increased since 1990, while post-stocking survival rates may also have at least some improvements since then. Using recruitment indices as data input to the SCAA model is in progress of investigation.

Lake Michigan
MM-123 (Northern Lake MI Treaty Waters) Ted Treska





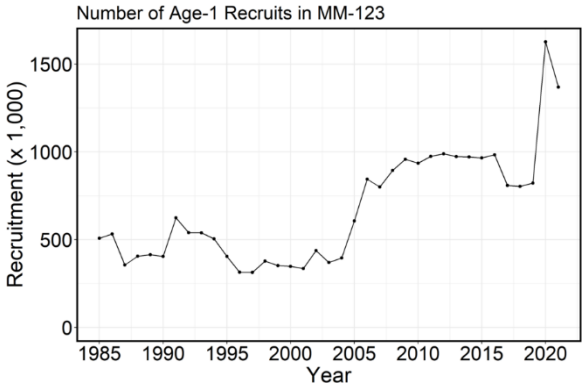


Parameter	Value
Base SSBR	2.60 lb
Current SSBR†	0.73 lb
SSBR at target mortality†	0.76 lb
Current SPR†	0.28
M	0.21 y^{-1}
F, Commercial (2019-2021)	0.23 y^{-1}
F, Recreational (2019-2021)	0.07 y^{-1}
Sea Lamprey Mort (2018-2020)	0.05 y^{-1}
Z (2021)	0.53 y^{-1}
2022 Model-derived Limit	625,029 lb
2022 Actual Harvest Limit††	n/a
Model Rating	Medium

Mortality rates represent averages for Lake Trout ages 6-11. Commercial fishing mortality includes Lake Trout harvested from all commercial fishery gear types.

†Current SSBR and SPR as well as target SSBR values are reported for the blended refuge/non-refuge stock. Current SPR for the non-refuge stock is 0.21. Sea lamprey-induced mortality, female maturity and weight-at-spawning are assumed to be the same for refuge and non-refuge portions of the stock.

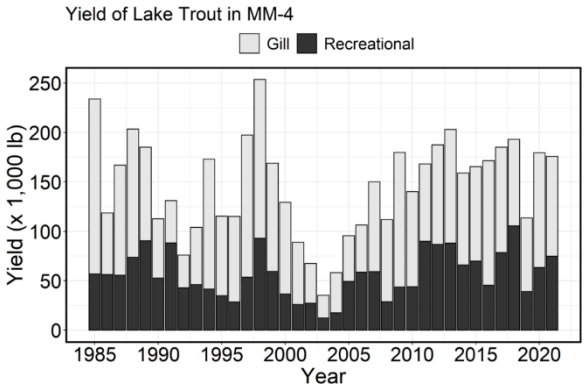
†† The 2022 Lake Trout Harvest Limit for MM-123 had yet to be formally established at time of publication.

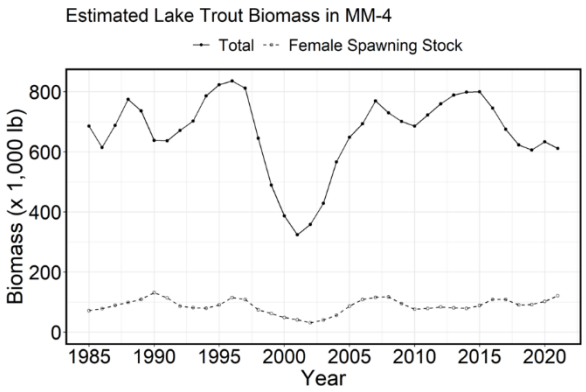


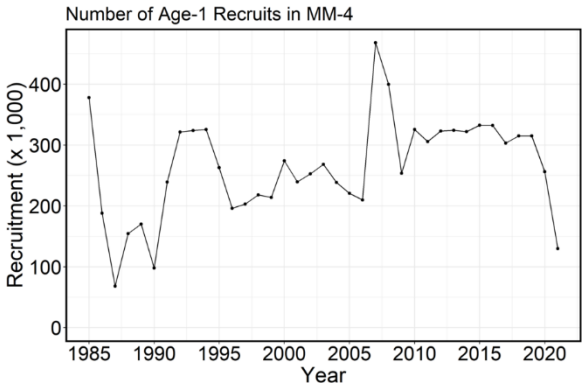
Notable stock dynamics and model revisions for MM-123:

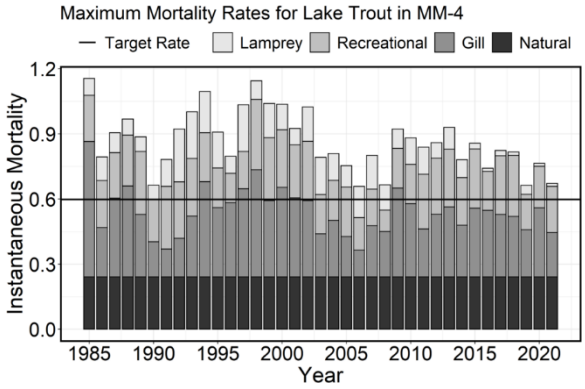
A sustained reduction in estimated sea lamprey mortality over the last few years has resulted in increased lake trout abundance, and all fisheries indicate the continuation of the very strong 2011 cohort, as well as a surge of age-5 fish in 2021. Overall, commercial yield in 2021 was very similar to 2020, and yield has been steady since 2013, while effort in the commercial fishery decreased slightly, continuing a downward trend that began in 2012. Effort in the recreational fishery was stable and recreational harvest was essentially the same in 2021 as during 2017-2020. The CPE for both fisheries continue to increase with commercial being the highest in the time series. As noted in the Executive Summary, in reviewing the procedures historically used to project harvest limits for Lake Michigan management units that include a refuge portion of the stock (ie MM-67 and MM-123), the MSC noted that the procedure used to weight the proportion of refuge and non-refuge SSBR during the projection phase relied on a short-term (3-yr) recruitment average. The MSC concluded that a longer-term average (10-yr) weighting factor was more appropriate for implementing such a procedure and the final recommended limit is based on the revised weighting factor.

MM-4 (Grand Traverse Bay) Stephen Lenart









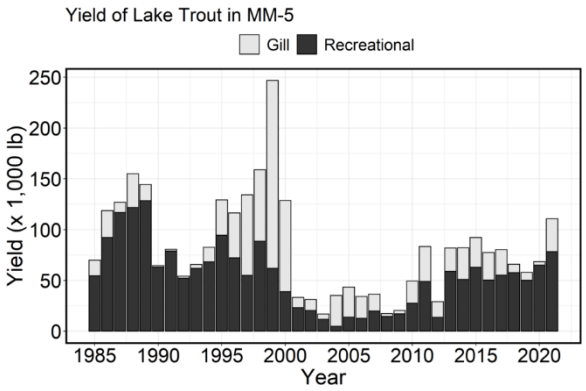
Parameter	Value
Base SSBR	1.71 lb
Current SSBR	0.38 lb
SSBR at target mortality	0.38 lb
Current SPR	0.22
M	0.24 y^{-1}
F, Commercial (2019-2021)	0.20 y^{-1}
F, Recreational (2019-2021)	0.17 y^{-1}
Sea Lamprey Mort (2018-2020)	0.02 y^{-1}
Z (2021)	0.61 y^{-1}
2022 Model-derived Limit	207,340 lb
2022 Actual Harvest Limit	207,340 lb
Model Rating	Medium

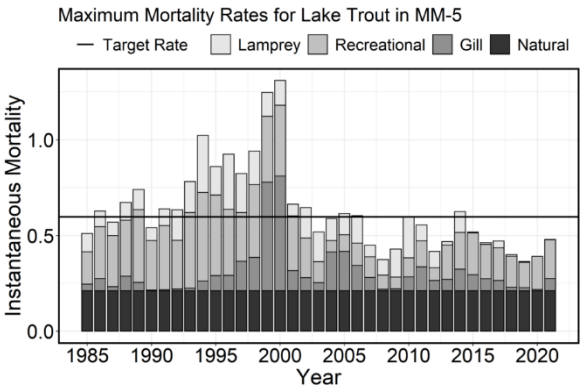
Mortality rates represent averages for Lake Trout ages 6-11. Commercial fishing mortality includes Lake Trout harvested from all commercial fishery gear types.

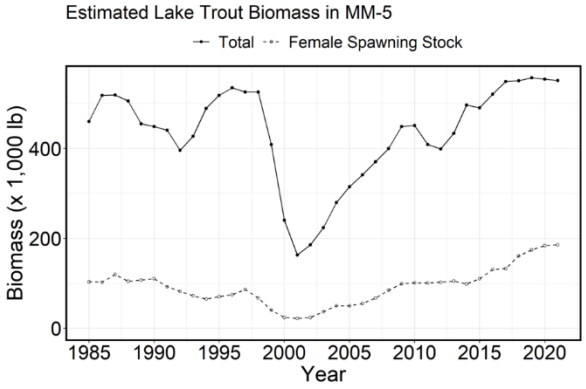
Notable stock dynamics and model revisions for MM-4:

Increased stocking of age-1 Lake Trout that began in the mid-2000s, combined with a reduction in Sea Lamprey-induced mortality after 2010, contributed to stable population size through most of the 2010s despite mortality rates that remained above the target rate. The population, however, remained composed of mostly immature fish, with little expansion of the age structure during this period. Fishery yields have been quite stable, ranging between 150K and 200K annually for all but one year during 2011-2021. Recent data suggest a modest expansion of the age structure, primarily due to the 2011 year-class, which contributed to the increase in spawning biomass at the end of the time series. The average annual mortality rate for fish ages 6-11 (46%) was above the 45% target in 2021, despite that sea lamprey-induced mortality that was at a time-series low (<2%). Recruitment of wild fish, nearly non-existent for much of the time series, increased during the last two years, with the 2016 year-class figuring prominently. The hatchery–fish model produced a harvest limit of 176K lb for 2022, primarily due to an increased number of age-4 and age-5 hatchery fish being projected into the fishable stock and low Sea Lamprey-induced mortality. The final recommended harvest limit of 207,340 lb, which includes an expansion for wild fish, represents a 29% increase in the recommended limit from the last assessment, with most of the increase associated with the 2016 year-class, which represented 33% of the projected TAC. The model-generated harvest limit for MM-4 has increased by 60% since 2019. It is worth noting that decreased stocking levels in 2020-2021 due to Covid-related changes in fish distribution practices are likely to result in reduced recruitment in the coming years.

MM-5 (Leelanau Peninsula to Arcadia) Stephen Lenart

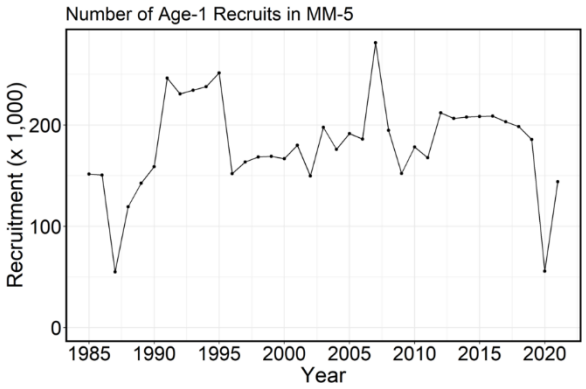






Parameter	Value
Base SSBR	1.75 lb
Current SSBR	0.82 lb
SSBR at target mortality	0.39 lb
Current SPR	0.47
M	0.21 y^{-1}
F, Commercial (2019-2021)	0.02 y^{-1}
F, Recreational (2019-2021)	0.13 y^{-1}
Sea Lamprey Mort (2018-2020)	<0.01 y^{-1}
Z (2021)	0.41 y^{-1}
2022 Model-derived Limit	153,683 lb
2022 Actual Harvest Limit	153,683 lb
Model Rating	Low

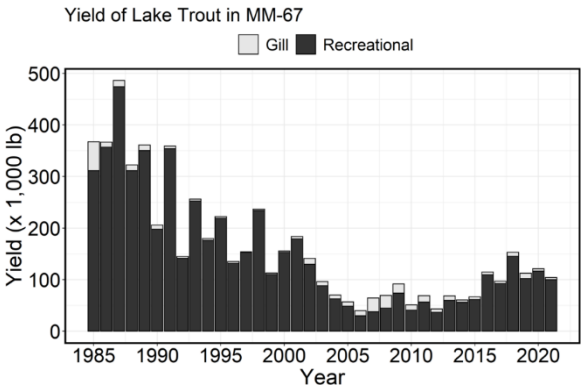
Mortality rates represent averages for Lake Trout ages 6-11. Commercial fishing mortality includes Lake Trout harvested from all commercial fishery gear types.

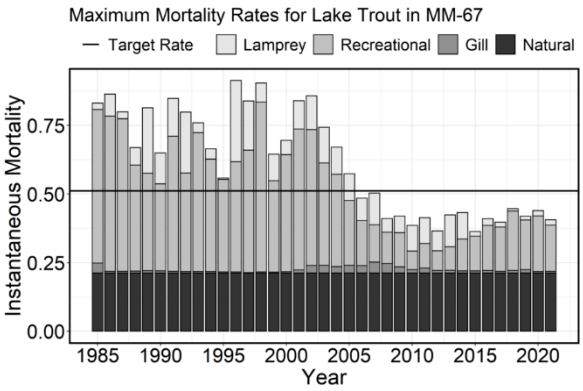


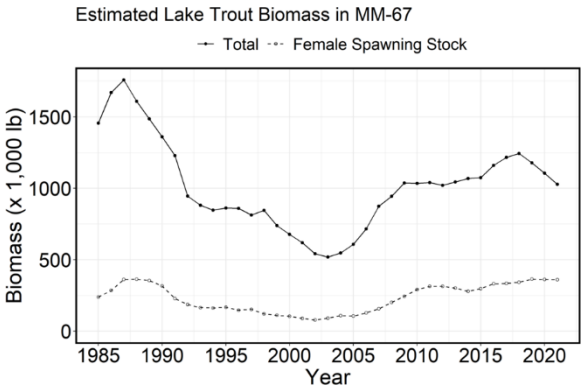
Notable stock dynamics and model revisions for MM-5:

The most recent assessment for unit MM-5 suggests spawning biomass increased nearly 50% since 2014, mainly due to increased maturity of younger fish, but a modest expansion of the age structure in the population and growth of older fish were also contributing factors. As has been the case in the past, the addition of new data to the MM-5 assessment resulted in rescaling of the population near the end of the time series. Numerous factors contribute to the uncertainty of the scale in MM-5, including the sporadic nature of the commercial gill-net fishery, a recent shift in targeted recreational fishery effort toward Lake Trout, and population dynamics that appear to be different in the southern and northern portions of this statistical district. Fishery catches, coupled with a modest increase in stocking since 2012 and lower Sea Lamprey-induced mortality, support the notion of an increased population size here, but changes in catchability due to fishing being more targeted toward lake trout clouds the picture somewhat and trends in survey catches are less clear. Recreational fishery yields were quite stable (50-65K lb) during 2013-2020, but landed yield increased to nearly 80K lb in 2021. After two years of inactivity, commercial gill-net yield increased to nearly 30K lb in 2021, resulting in a total yield of more than 100K lb for both fisheries combined, the highest level observed since 1999. Mortality rates, which had declined annually during 2014 to 2019, increased somewhat the last two years in response to increased fishing while Sea Lamprey mortality continued to decline during this period, dropping to essentially zero in 2020. Average annual mortality for Lake Trout ages 6-11 was 34% in 2021. As in MM-4, recruitment of wild fish has increased recently, beginning here with the 2015 year-class. The hatchery–fish model produced a harvest limit of 139K lb for 2022, primarily due to an increased number of age-5 being projected into the fishable stock and very low (<1%) Sea Lamprey-induced mortality. The final recommended harvest limit of 153,683 lb, which includes an expansion for wild fish, represents a 26% increase in the recommended limit from the last assessment. This assessment retains its low rating due to uncertain scaling and model assumptions (M and selectivity) required to achieve a stable solution. It is worth noting that decreased stocking levels in 2020-2021 due to Covid-related changes to fish distribution practices are likely to result in reduced recruitment in the coming years.

MM-67 (Southern Treaty Waters) Stephen Lenart

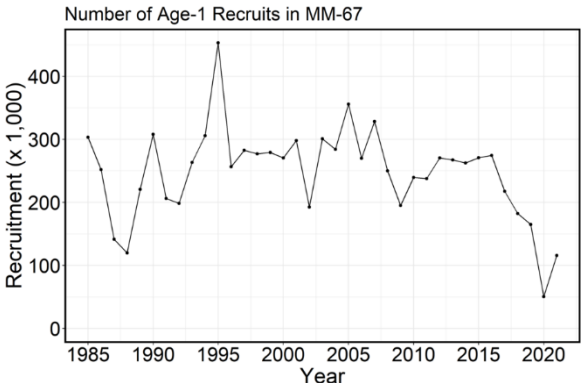






Parameter	Value
Base SSBR	2.81 lb
Current SSBR†	1.47 lb
SSBR at target mortality†	0.76 lb
Current SPR†	0.52
M	0.21 y^{-1}
F, Commercial (2019-2021)	<0.01 y^{-1}
F, Recreational (2019-2021)	0.15 y^{-1}
Sea Lamprey Mort (2018-2020)	0.01 y^{-1}
Z (2021)	0.37 y^{-1}
2022 Model-derived Limit	513,481 lb
2022 Actual Harvest Limit	513,481 lb
Model Rating	Medium

Mortality rates represent averages for Lake Trout ages 6-11. Commercial fishing mortality includes Lake Trout harvested from all commercial fishery gear types.



†Current SSBR and SPR as well as target SSBR values are reported for the blended refuge/non-refuge stock. Current SPR for the non-refuge stock is 0.47. Sea lamprey-induced mortality, female maturity and weight-at-spawning are assumed to be the same for refuge and non-refuge portions of the stock.

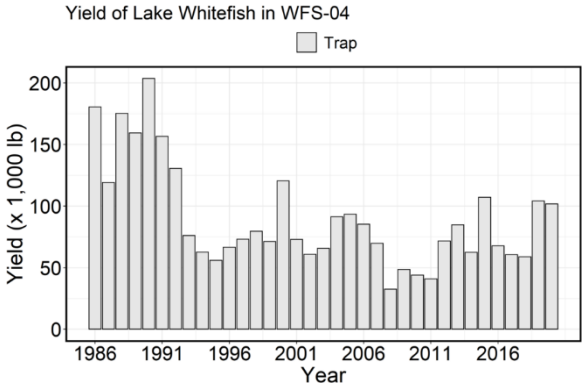
Notable stock dynamics and model revisions for MM-67:

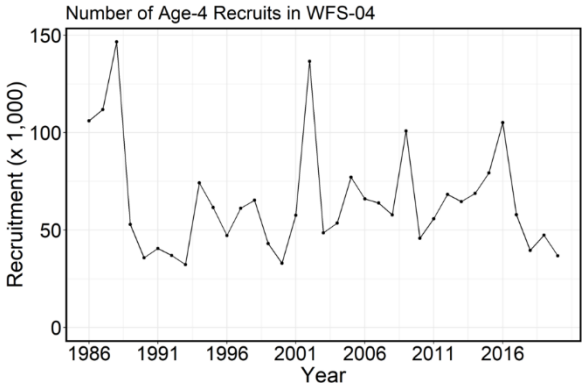
Most trends described for unit MM-5 apply similarly to MM-67 (declining recreational fishing effort but increased catch rates, recent low mortality, and spawning biomass at a time-series high), but ports in this management area are more intensely sampled and model estimates are more stable. The incidence of unclipped fish is higher here than in units to the north and recruitment of wild fish to the fishable stock began somewhat earlier. The age structure is also broader here than in northern areas of the lake, a consequence of average (ages 6-11) annual mortality rates that have remained below 35% since 2005. Average mortality on fish ages 6-11 was 31% in 2021. There is no targeted commercial fishery in this area and nearly all the yield is associated with the recreational fishery (range of 100-150K lb during 2016-2021). As noted for unit MM-5, the spatial scale of the assessment(s) in south-central Treaty waters should be revisited, as population and fishery dynamics in southern MM-5 appear to be more similar to statistical district MM-6 than northern MM-5. The hatchery–fish model produced a harvest limit of 372K lb for 2022, which was largely the same as the last assessment. However, the final recommended harvest limit of 513,481 lb, which includes an expansion for wild fish, represents a 15% increase in the recommended limit from the last assessment due to the increasing contribution of wild fish. As noted in the Executive Summary, in reviewing the procedures historically used to project harvest limits for Lake Michigan management units that include a refuge portion of the stock (ie MM-67 and MM-123), the MSC noted that the procedure used to weight the proportion of refuge and non-refuge SSBR during the projection phase relied on a short-term (3-yr) recruitment average. The MSC concluded that a longer-term average (10-yr) weighting factor was more appropriate for implementing such a procedure and the final recommended limit is based on the revised weighting factor. As noted for other Lake Michigan units, reduced stocking of age-1 fish during 2020-2021 due to changes in stocking operations seems likely to impact future recruitment levels, particularly so in MM-67 because such reductions were layered on top of planned stocking reductions for southern Lake Michigan that began in 2017. Whether increased wild recruitment will offset these reductions remains to be seen.

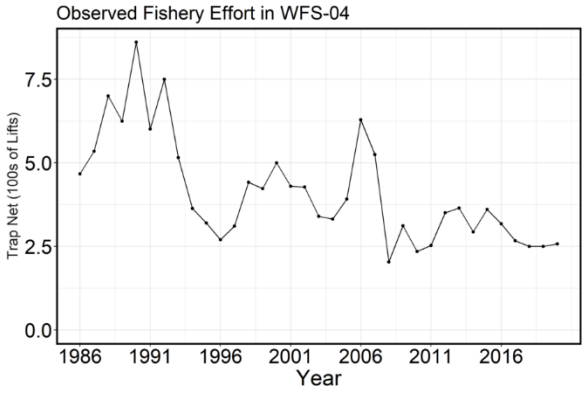
STATUS OF LAKE WHITEFISH POPULATIONS

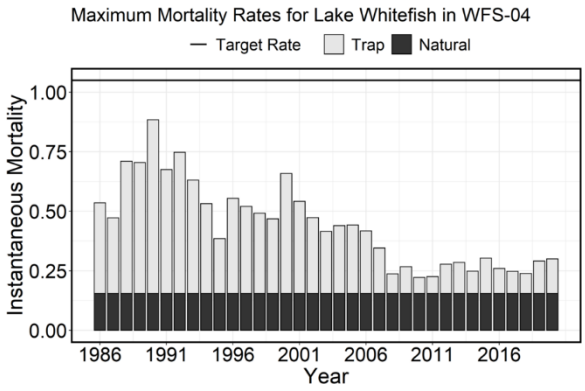
Lake Superior

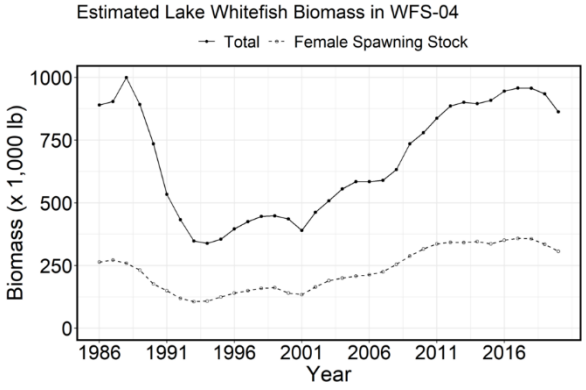
WFS-04 (Marquette-Big Bay) **Mike Seider**











Parameter†	Value
Base SSBR	8.86 lb
Current SSBR	4.58 lb
SSBR at target mortality	0.82 lb
Current SPR	0.52
M	0.16 y^{-1}
F, trap net (2018-2020)†	0.12 y^{-1}
Z (2020)	0.30 y^{-1}
2022 Model-derived Limit	177,000 lb
2022 Actual Harvest Limit	177,000 lb
Model Rating	Medium

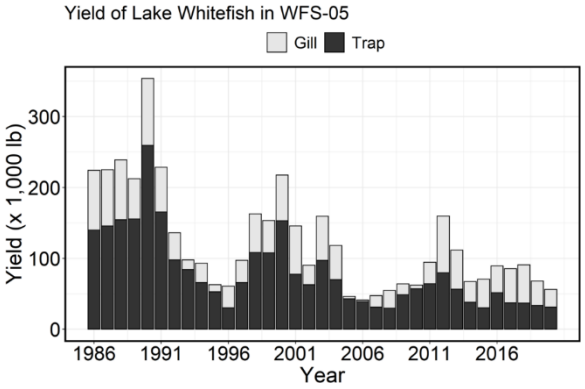
Mortality rates represent averages for Lake Whitefish ages 6-11.

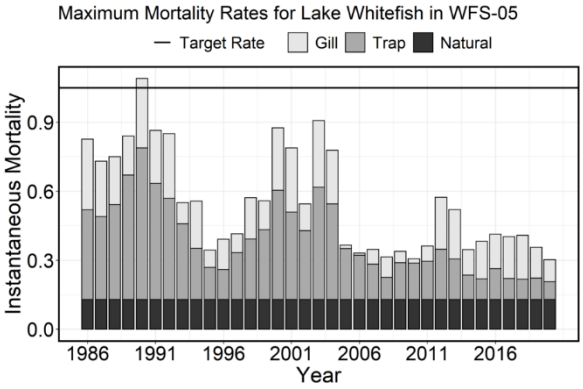
† Harvest from gill-net fishery in 1842 Treaty waters included in trap net mortality

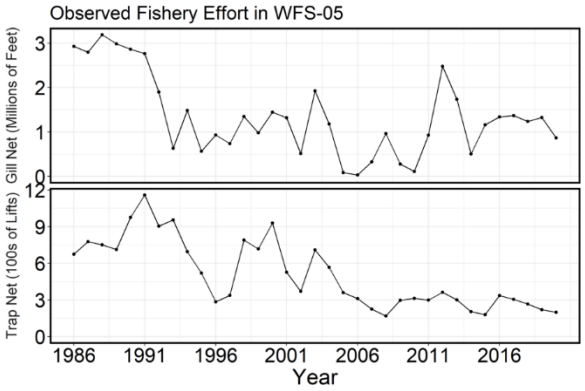
Notable stock dynamics and model revisions for WFS-04:

Lake whitefish biomass in WFS-04 increased steadily from the early 1990s to the late-2000s and has remained generally stable since about 2012. Fishing mortality has increased in the last two years, but maximum total mortality rates have remained lower than in previous decades and well below the target value. Annual mortality rate (A) for the most vulnerable age class was 29% in 2020. The 2012-year class (as measured by age-4 fish in 2016) appears to be larger than average and is contributing more substantially to the trap net fishery. This assessment relies on the signal of the trap net only, thus there continues to be uncertainty regarding recruitment at the end of the time series. The assessment for 2022 included the use of a white-noise function to estimate the number of age-4 fish rather than a stock-recruitment function. These structural changes, along with trends in the 2020 age composition, suggested generally similar recruitment patterns, however the estimated size of most cohorts since 2010 increased which (along with similar estimated annual mortality rates) resulted in greater estimated abundance and biomass when compared to previous assessments. Model diagnostics did not indicate any concerning problems, thus the assessment received a medium rating. The yield limit calculated for the entire WFS-04 management unit is 251,000 lb. After applying the prescribed reduction to reflect the proportion of this management unit that is outside 1836 Treaty waters, the 2022 yield limit for lake whitefish in 1836 Treaty waters is 177,000 lb. The SPR 0.2 rule was triggered during projection and the model limit was based on a projected maximum mortality rate of 45%.

WFS-05 (Munising) Shawn Sitar

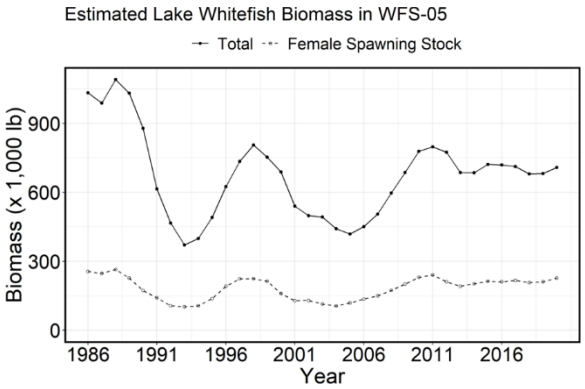


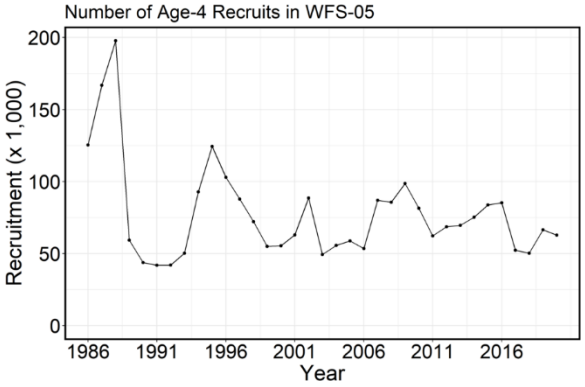




Parameter	Value
Base SSBR	5.04 lb
Current SSBR	3.65 lb
SSBR at target mortality	1.34 lb
Current SPR	0.72
M	0.13 y^{-1}
F, trap net (2018-2020)	0.07 y^{-1}
F, gill net (2018-2020)	0.10 y^{-1}
Z (2020)	0.26 y^{-1}
2022 Model-derived Limit	237,000 lb
2022 Actual Harvest Limit	237,000 lb
Model Rating	Medium

Mortality rates represent averages for Lake Whitefish ages 6-11.

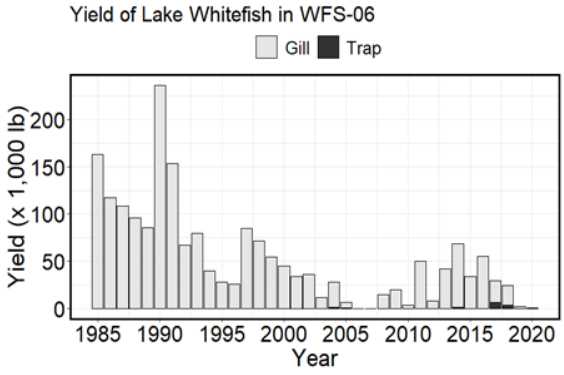


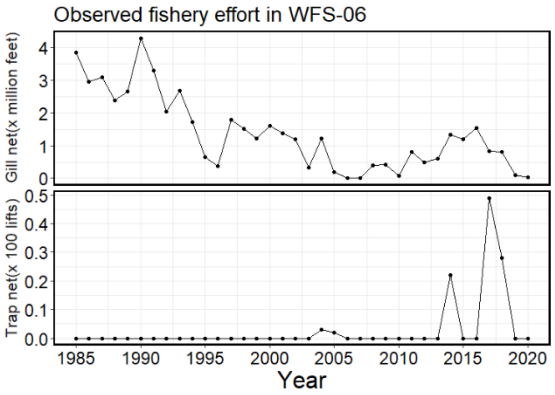


Notable stock dynamics and model revisions for WFS-05:

The 2022 Lake Whitefish TAC is 237,704 lb which is a 17% increase from the 2021 TAC due to recent declines in total mortality. The average total annual mortality rate (A) experienced by ages 4-12 in the stock during 2020 was 26%. In 2020, trap net yield was 31,150 lb and gill net yield was 25,000 lb. The model rating for WFS-05 remains at medium because the model has been consistent with prior models, which have had good diagnostics.

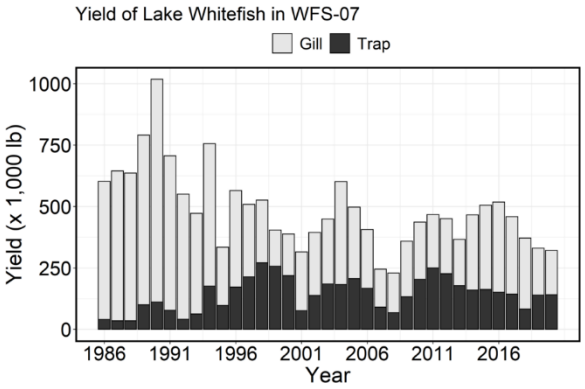
WFS-06 (Grand Marais)

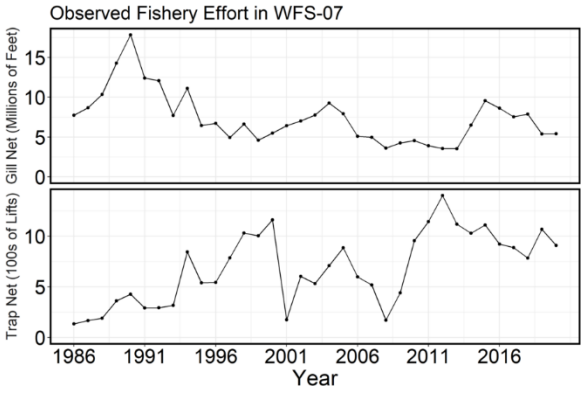


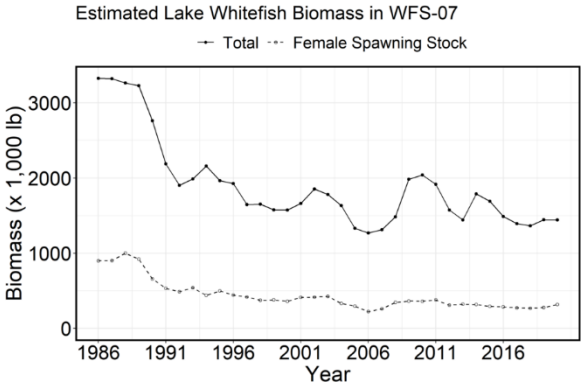


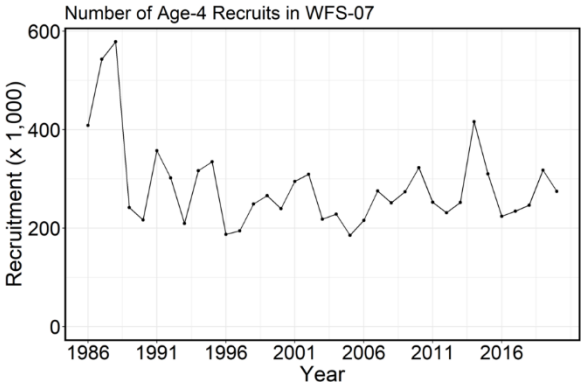
There is no current stock assessment model for WFS-06. Low levels of effort and harvest and a lack of fishery monitoring data since the early 2000s limit the ability to produce an assessment model for this unit. The HRG for this unit was 137,700 lb for 2022.

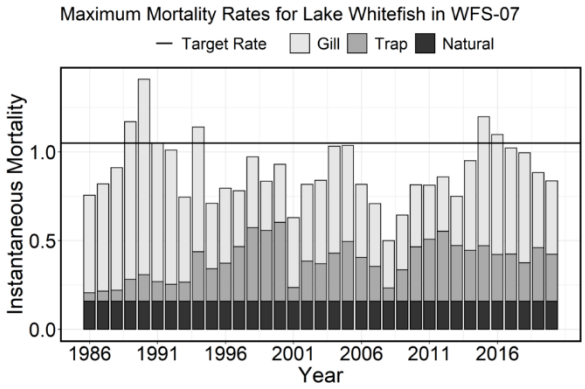
WFS-07 (Tahquamenon Bay) Jack Tuomikoski











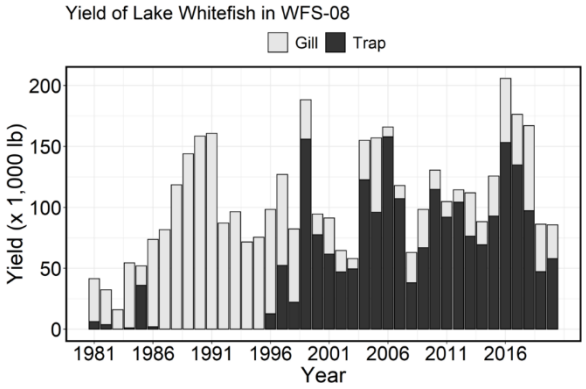
Parameter	Value
Base SSBR	4.54 lb
Current SSBR	1.19 lb
SSBR at target mortality	1.03 lb
Current SPR	0.26
M	0.16 y^{-1}
F, trap net (2018-2020)	0.24 y^{-1}
F, gill net (2018-2020)	0.37 y^{-1}
Z (2020)	0.72 y^{-1}
2022 Model-derived Limit	515,600 lb
2022 Actual Harvest Limit	485,700 lb
Model Rating	Medium

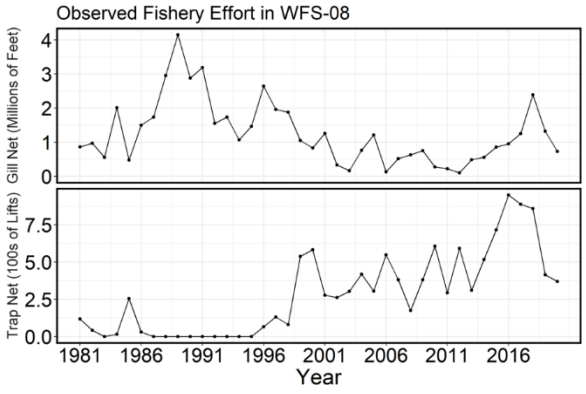
Mortality rates represent averages for Lake Whitefish ages 6-11.

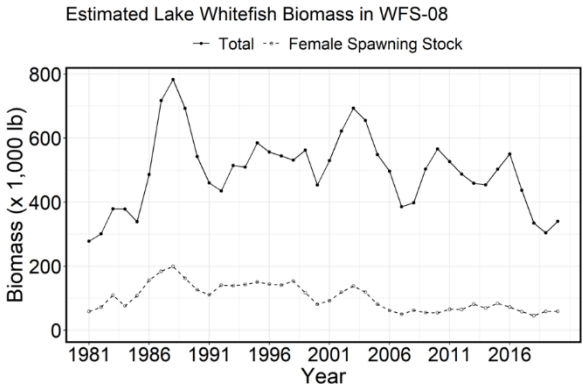
Notable stock dynamics and model revisions for WFS-07:

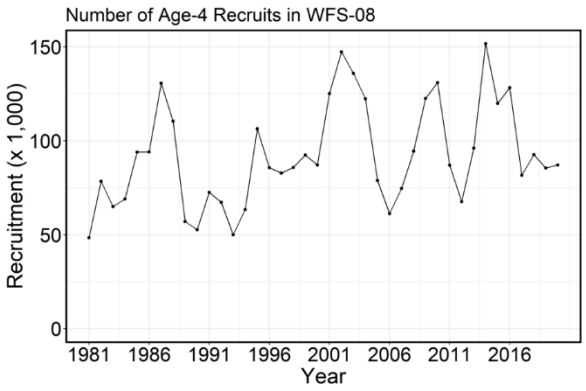
The harvest limit projection from the model for 2022 is 515,600 lb which is an increase of 6% from last year's model projection. Catch, effort, and CPE have generally decreased in recent years within WFS-07. Since 2016, there has been a continual decrease of gill-net effort. Trap-net effort decreased from all-time high in 2012 until 2018 followed by a slight increase in 2019-2020. Yield has decreased since 2016 and in 2019-2020 was at levels in the lower third of the time series. Generally, CPUE has decreased from a peak in 2008 for the trap-net fishery and since a peak in 2012 for the gill-net fishery. The model estimates of total biomass decreased after 2010 but have remained relatively stable since 2016. Spawning biomass estimates are also stable. Since 2015, mortality estimates have continually decreased, though the most recent mortality estimate for 2020 is still within the top half of estimates in the time series. The model estimates that calendar years 2014, 2015, and 2019 had relatively large cohorts of age-4 fish. The recruitment portion of the model was modified this year. The Ricker model was replaced with a white noise model following the results from a MSC sub-committee workgroup. Various metrics showed an improved fit to the data when using the white noise recruitment sub-model. The change in the recruitment sub-model did not result in a markedly large change in model outputs. Retrospective patterns and MCMC's were improved from last year's model.

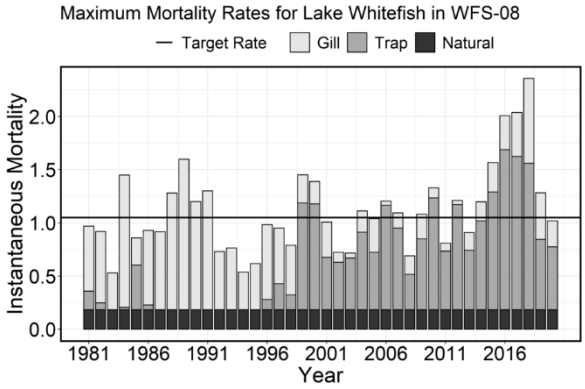
WFS-08 (Brimley) Jack Tuomikoski











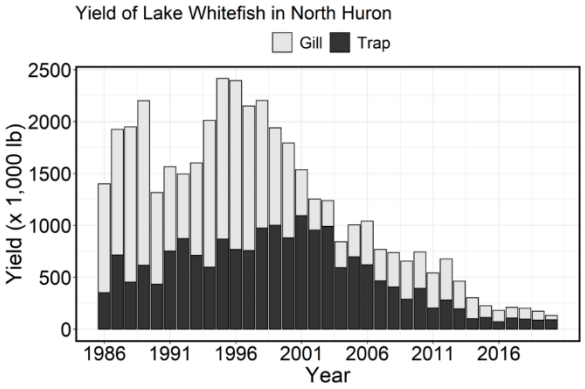
Parameter	Value
Base SSBR	3.27 lb
Current SSBR	0.54 lb
SSBR at target mortality	0.77 lb
Current SPR	0.17
M	0.18 y^{-1}
F, trap net (2018-2020)	0.78 y^{-1}
F, gill net (2018-2020)	0.37 y^{-1}
Z (2020)	0.89 y^{-1}
2022 Model-derived Limit	85,500 lb
2022 Actual Harvest Limit	85,500 lb
Model Rating	Medium

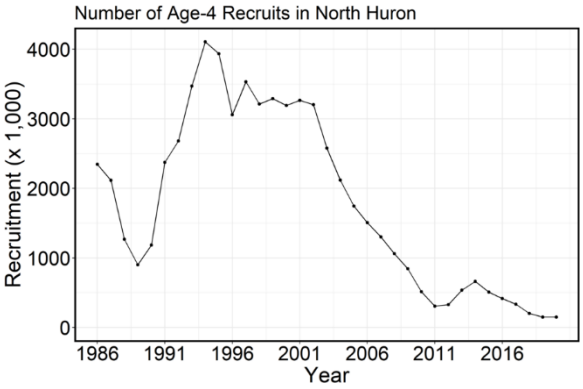
Mortality rates represent averages for Lake Whitefish ages 6-11.

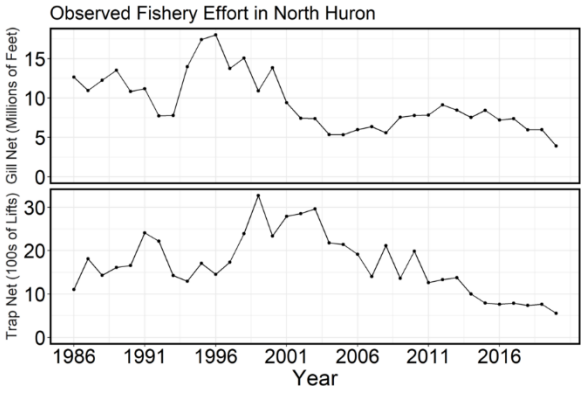
Notable stock dynamics and model revisions for WFS-08:

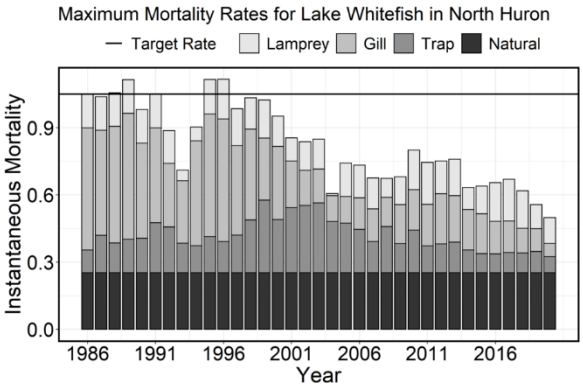
The harvest limit projection from the model for 2022 is 85,500 lb which is an increase of 3% from last year's model projection. WFS-08 saw large changes in fishing effort from 2018 to 2020. Although CPUE was consistent over 2018-2020, effort and therefore harvest decreased by about 50%. Gill-net effort had steadily increased since 2012 but dropped markedly after 2018. Trap-net effort in 2019 and 2020 was about half of 2016 (the peak in the time series). Subsequently, yield in 2019-2020 was approximately half of 2016-2018 levels (some of the highest yields in the time-series). For the trap net, CPUE in 2020 increased slightly from 2019 levels but has decreased since 2011. The gill net CPUE also increased a small amount from 2019 to 2020 but has generally decreased since 2016. The model estimates relatively stable recruitment of age-4 fish from 2017-2020 and a slow decline in biomass since 2016. Estimates of mortality dropped greatly in 2019 and 2020 due to the decreased harvest (mostly in the trap net) and the 2020 mortality estimate was below 65%. As in WFS-07, a white noise model replaced the Ricker recruitment function. Model estimates were similar across differing recruitment model structures and retrospective patterns remained similar to last year's model.

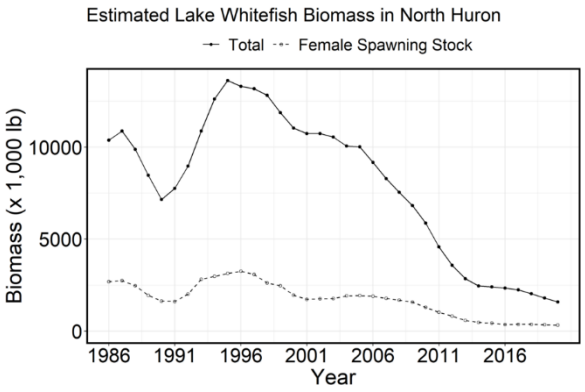
Lake Huron
WFH-01-WFH-04 (North Huron) Kevin McDonnell











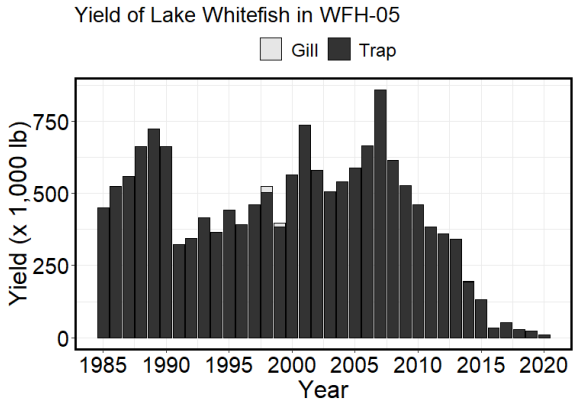
Parameter	Value
Base SSBR	2.22 lb
Current SSBR	0.84 lb
SSBR at target mortality	0.36 lb
Current SPR	0.38
M	0.25 y^{-1}
F, trap net (2018-2020)	0.07 y^{-1}
F, gill net (2018-2020)	0.06 y^{-1}
Z (2020)	0.43 y^{-1}
Sea Lamprey Mort (2018-2020)	0.08 y^{-1}
2022 Actual Harvest Limit	303,900
Model Rating	Medium

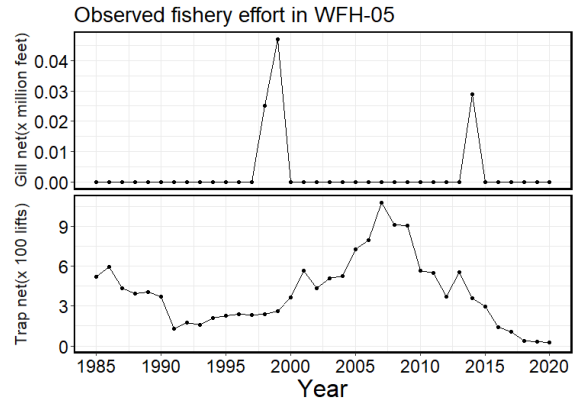
Mortality rates represent averages for Lake Whitefish ages 6-11.

Notable fishery dynamics and model revisions for North Huron:

The Lake Whitefish population that occupies the 1836 Treaty Waters in units WFH-01-WFH-05 has continued to decline and the adult abundance estimate for 2020 is the lowest (~800k fish) in the data series (1986-2020). However, the estimated number of age-4 recruits has somewhat stabilized from 2019, albeit at low rate (150K/year). Overall fishery yield was only slightly lower than the last 5 years, despite changes in fisher operations due to the COVID-19 pandemic. Gillnet CPE declined to below 12.5 lb/1000ft, whereas trap net CPE increased to its highest level since 2012. Maximum mortality rates remained well below the target rate of 65% and since 2017 average mortality rates have continued to decline. The model now incorporates the auto-regressive based recruitment model. This recruitment model was better able to track the trends in recruitment through the time series relative to the previous white noise model. The SPR rule was triggered again in 2020 and the model generated harvest recommendation for 2022 was 304,900 lb (based on a maximum rate of 59% at SPR 0.2), which is substantially lower than the previous year's recommendation of 512,100 lbs. Although there is a large difference between the 2021 and 2022 model generated harvest recommendations, this year's assessment provides a more accurate reflection of the current stock size and structure and improves our ability to describe the recruitment dynamics of Lake Whitefish in Northern Lake Huron.

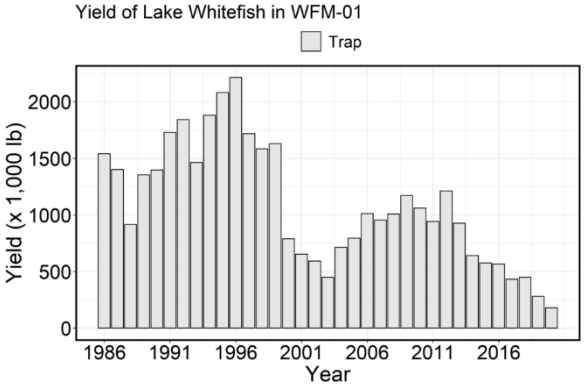
WFH-05 (Alpena)

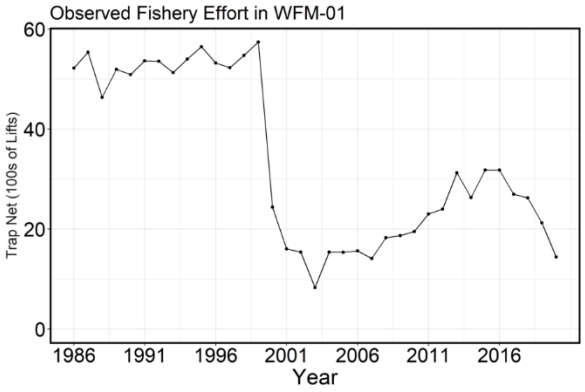


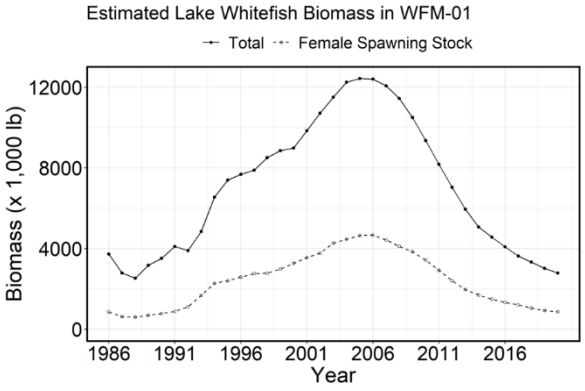


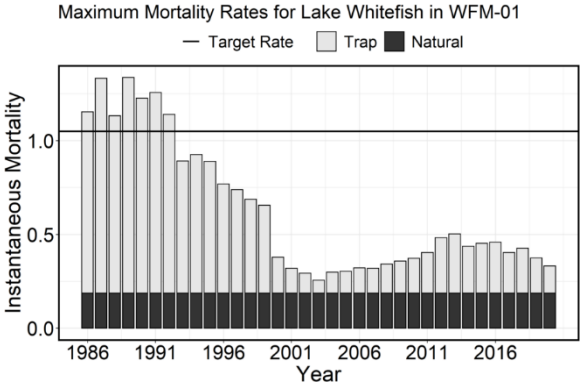
The SCAA model for the Alpena stock has not been updated since 2018 (2016 fishery data). As recently as 2007, over 700K lb of Lake Whitefish were harvested by the trap net fishery in this unit. Fishery catch, effort, and catch rates declines substantially thereafter, dropping to a very low threshold after 2014. Until recently, no monitoring data were available for this recent fishery, which is now exclusively seasonal, restricted to a few weeks in the fall. Effort will be made to repopulate the WFH-05 model, given that some limited sampling has occurred during the past few years. The HRG for this unit was 236,400 lb for 2022.

Lake Michigan
WFM-01 (Bays De Noc) Stephen Lenart









Parameter	Value
Base SSBR	3.24 lb
Current SSBR	1.62 lb
SSBR at target mortality	0.60 lb
Current SPR	0.50
M	0.19 y^{-1}
F, trap net (2018-2020)†	0.15 y^{-1}
Z (2020)	0.30 y^{-1}
2022 Model-derived Limit	717,000 lb
2022 Actual Harvest Limit	717,000 lb
Model Rating	Medium

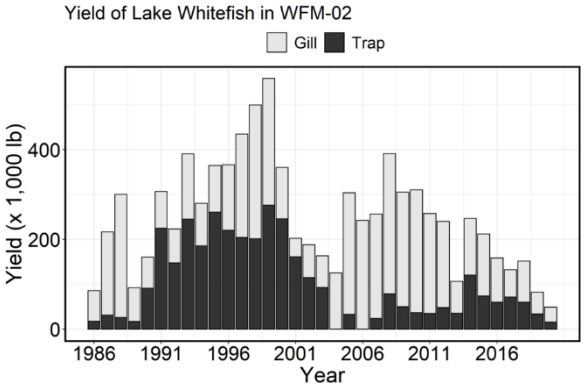
Mortality rates represent averages for Lake Whitefish ages 6-11.

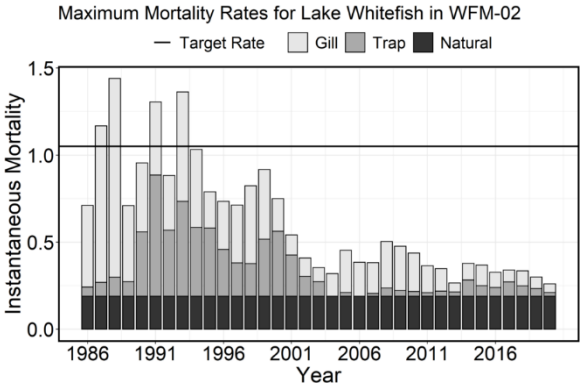
† *Harvest from purse-seine and gill-net fisheries included in trap-net mortality*

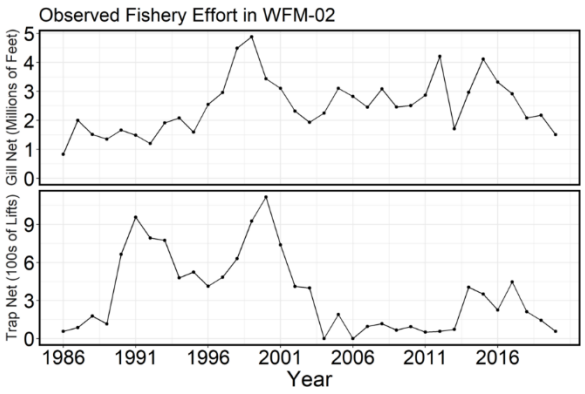
Notable stock dynamics and model revisions for WFM-01:

Fishery yield and catch rates in 2020 were the lowest in the modeled time series and effort in 2020 was similar to the levels last observed in the early to mid-2000s, suggesting that negative consequences of the pandemic and/or declining catches impacted fishery operations in this unit. The use of the alternative autoregressive recruitment (AR) model resulted in downward scaling of recruitment after 2006 compared to the base white noise (WN) model, and a more pronounced negative trajectory in estimated spawning biomass, which has declined 80% since the 2006 peak. Recent mortality rates (max 28% in 2020) remain well below the target maximum but declining recruitment continues to erode the fishable stock. Although retrospective patterns persist, bias is lessened with each successive year for which age compositions are otolith-based, an indication that the retrospective patterns are linked to the data. Continued improvement is expected as additional years are added to the modeled time series. The model-generated harvest limit of 717,000 lb represents a 44% decrease from the prior year's model limit. The SPR 0.2 rule was triggered during projection and the model limit was based on a projected maximum mortality rate of 62%. The substantial reduction in the harvest limit is entirely related to the use of the AR recruitment model versus the base WN version. Retrospective bias in measures associated with the fishable stock was slightly improved in the AR version.

WFM-02 (Manistique) Ted Treska

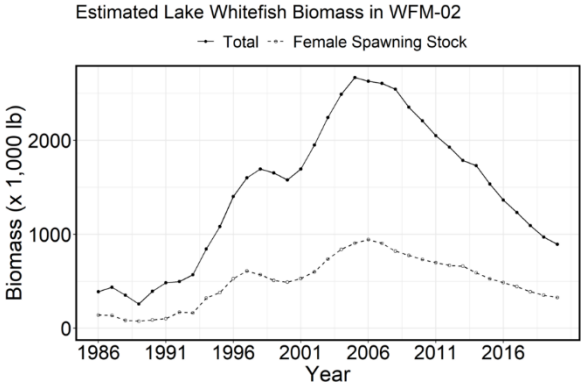


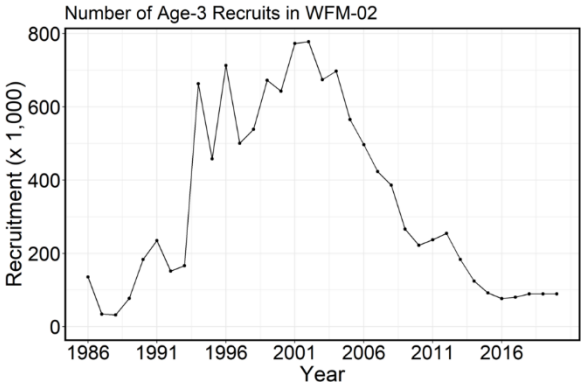




Parameter	Value
Base SSBR	3.32 lb
Current SSBR	2.21 lb
SSBR at target mortality	0.61 lb
Current SPR	0.66
M	0.19 y^{-1}
F, trap net (2018-2020)	0.04 y^{-1}
F, gill net (2018-2020)	0.05 y^{-1}
Z (2020)	0.25 y^{-1}
2022 Model-derived Limit	292,000 lb
2022 Actual Harvest Limit	204,000 lb
Model Rating	Medium

Mortality rates represent averages for Lake Whitefish ages 6-11.

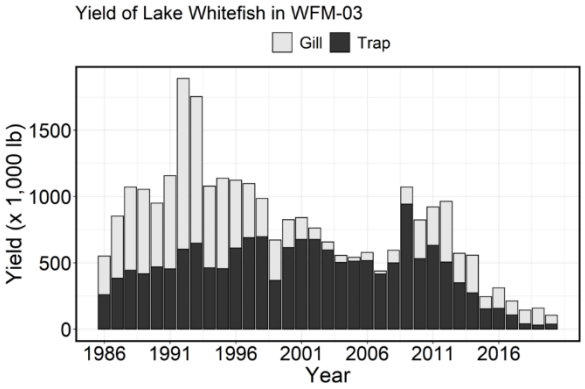


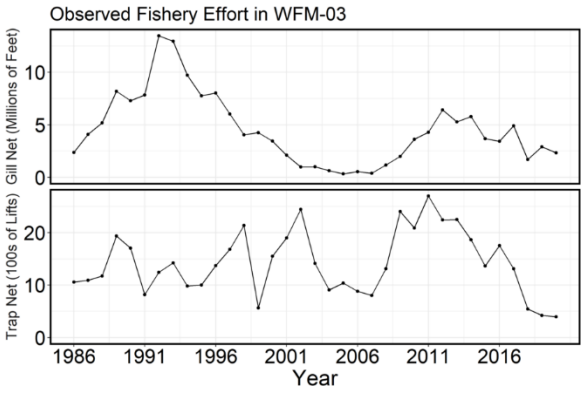


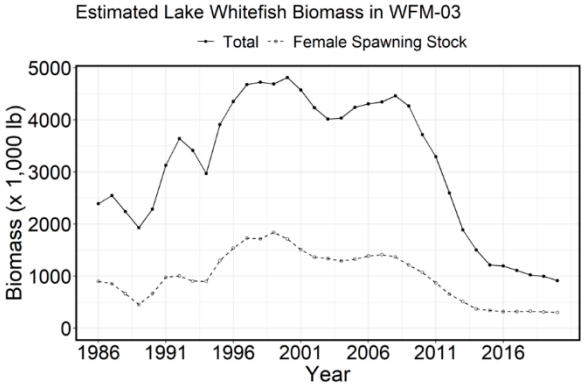
Notable stock dynamics and model revisions for WFM-02:

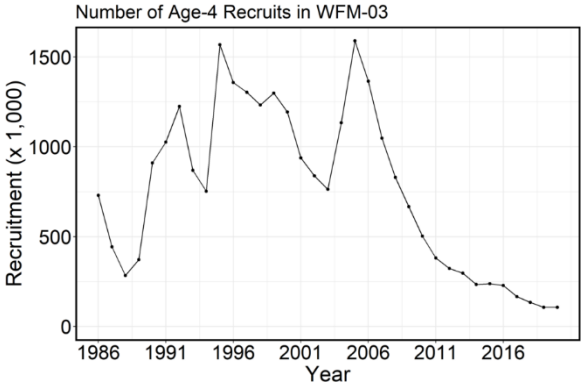
WFM-02 now utilizes the AR recruitment method, and along with a more stable, yet lower, recruitment pattern in recent years comes a continued decline in biomass since 2005. Recruitment in recent years is now estimated to be similar to levels last observed in the early 1990s. Catch rates have remained relatively constant over the last 5 years, though effort declined in both fisheries to the lowest values in approximately 10 years. Mortality rates in the unit are well below the target level and have been for several years. A slight increase in growth has been observed in the past few years. As expected, 2020 saw depressed sample numbers due to Covid pandemic, with 0 fish sampled from the Trap-net and 97 from the Gill-net fishery. The recommended 2022 harvest limit for WFM-02 is 292,000 pounds. Harvest in 2019 (pre-pandemic) was 82,844 pounds and the average for the last 5 years (pre-pandemic 2015-19) has been 147,690 pounds.

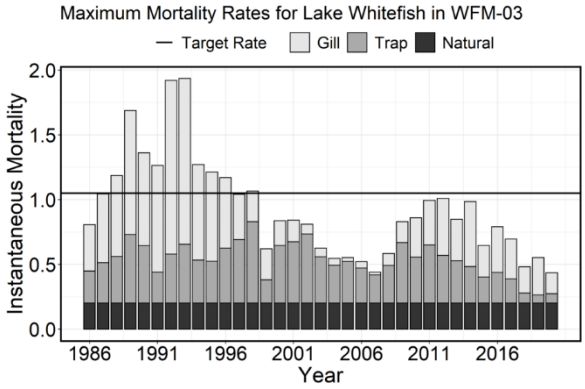
WFM-03 (Naubinway) Ted Treska











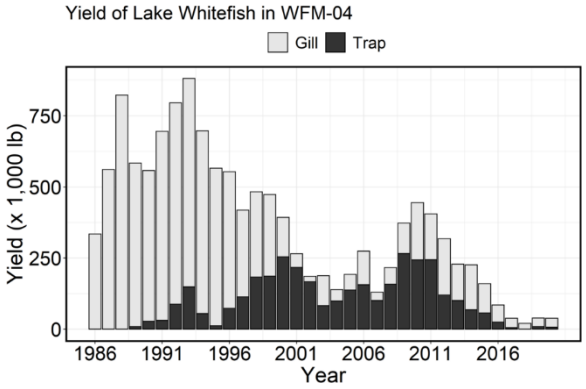
Parameter	Value
Base SSBR	3.29 lb
Current SSBR	1.86 lb
SSBR at target mortality	1.06 lb
Current SPR	0.57
M	0.20 y^{-1}
F, trap net (2018-2020)	0.06 y^{-1}
F, gill net (2018-2020)	0.14 y^{-1}
Z (2020)	0.36 y^{-1}
2022 Model-derived Limit	288,000 lb
2022 Actual Harvest Limit	450,225 lb
Model Rating	Medium

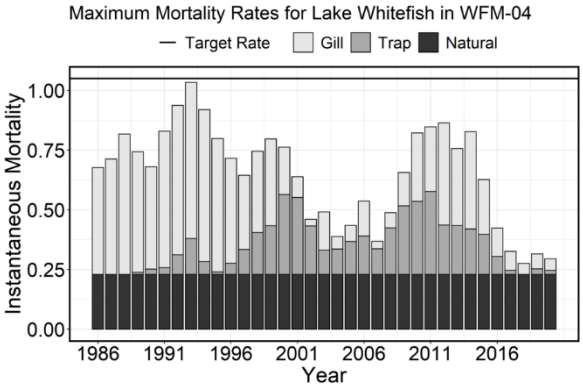
Mortality rates represent averages for Lake Whitefish ages 6-11.

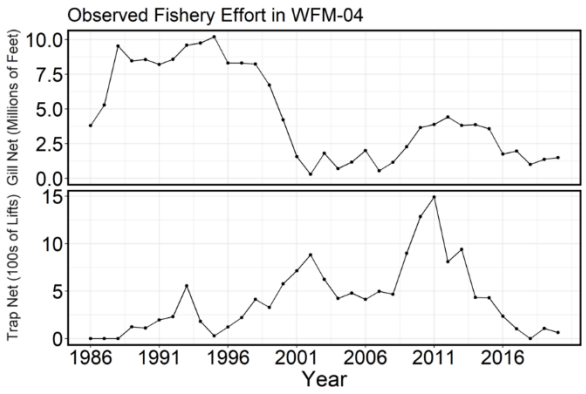
Notable stock dynamics and model revisions for WFM-03:

WFM-03 now utilizes the AR recruitment method, and along with a more stable, yet lower, recruitment pattern in recent years comes a continued decline in biomass since the late 2000s. Recruitment in recent years is now estimated to be similar to levels last seen in the late 1980s. Trap-net effort declined to the lowest value in the time series and a continued decline was evident in the gill-net fishery. After approaching the target during the early 2010s, recent mortality rates in the unit are well below the target level. Similar to WFM-02, a slight increase in growth has been observed recently. Gill-net fishery samples have been quite limited in recent years. Harvest in 2019 (pre-pandemic) was 159,595 pounds and the average for the last 5 years (pre-pandemic 2015-19) has been 215,565 pounds. The recommended 2022 harvest limit for WFM-03 is 288,000 pounds.

WFM-04 (Beaver Island) Kevin Donner

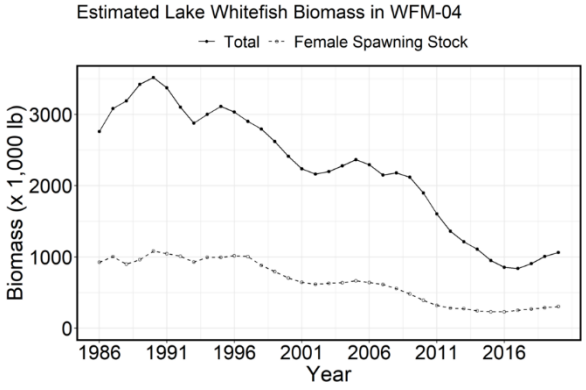


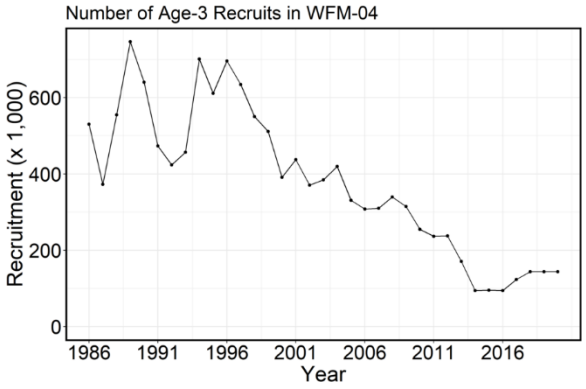




Parameter	Value
Base SSBR	3.44 lb
Current SSBR	2.88 lb
SSBR at target mortality	0.62 lb
Current SPR	0.84
M	0.23 y^{-1}
F, trap net (2018-2020)	0.01 y^{-1}
F, gill net (2018-2020)	0.05 y^{-1}
Z (2020)	0.29 y^{-1}
2022 Model-derived Limit	397,300 lb
2022 Actual Harvest Limit	240,300 lb
Model Rating	Medium

Mortality rates represent averages for Lake Whitefish ages 6-11.

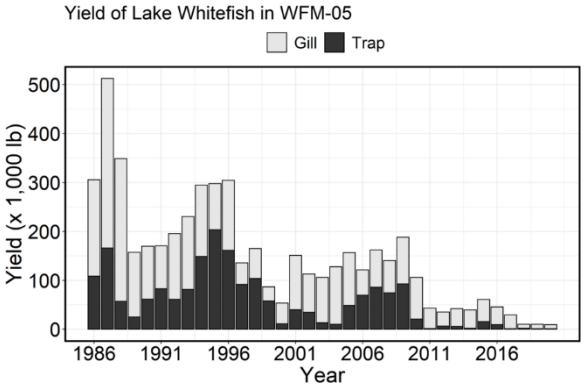


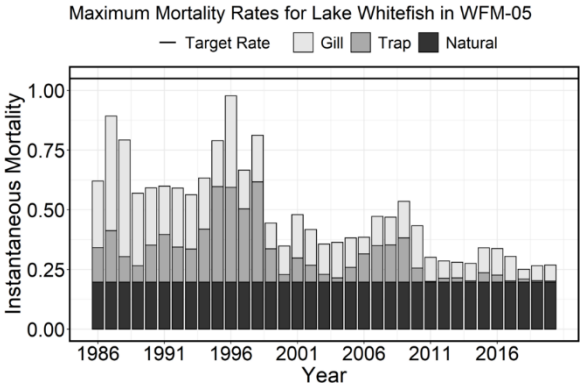


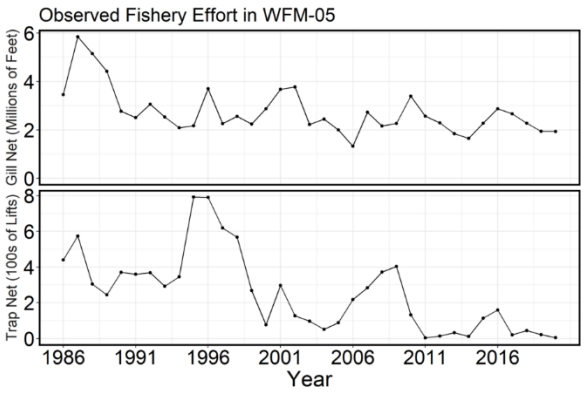
Notable stock dynamics and model revisions for WFM-04:

Trapnet and gillnet harvest, effort, and catch-per-effort observed during 2019 and 2020 were among the lowest on record, including a complete absence of trapnet activity in 2019. The fishery has contracted such that the logistics required for collection of biological data in this unit have been severely challenged. Several seasonal operations have ceased fishing in this unit and one long-time, consistent fishermen walked-on (passed away) in 2020. COVID-19 precautions during 2020 further prevented sampling at times and complicated on the ground logistics. Model structure changed slightly during the 2021 model run with the inclusion of effective sample size function to provide more appropriate weighting for biological data collections. Three recruitment functions were evaluated during the 2022 modeling process, as described earlier. The SR model performed well but consistently resulted in bounded variable. The WN version produced unrealistic trends in biomass and abundance. Finally, the AR version produced believable model results with no bounded variables. The AR model was ultimately selected having the best overall output and diagnostics. Recent information regarding the genetic make-up of whitefish in northern Lake Michigan suggests that the WFM04 stock is genetically similar to the stocks in WFM03 and in portions of WFM05 (Larson unpublished). In addition, the majority of whitefish harvested in WFM04 are taken near the unit's border with WFM03. Given this information, it seems that future stock assessments may benefit from a re-evaluation of the geographic boundaries of the stock, specifically, combining the WFM03 and WFM04 models with, possibly, portions of WFM05.

WFM-05 (Grand Traverse Bay) Chris Hessell

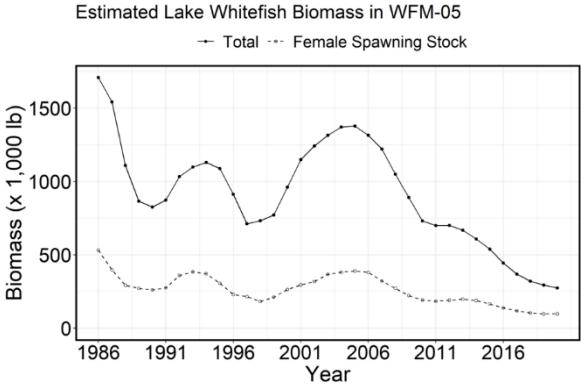


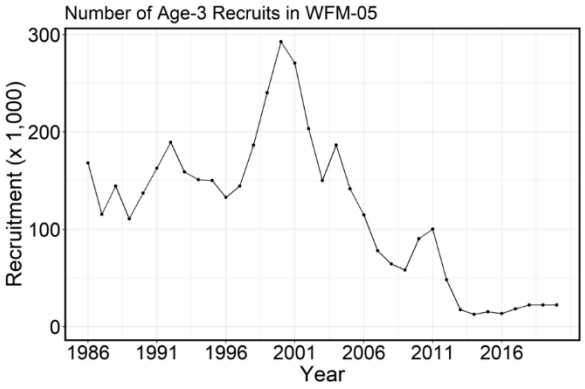




Parameter	Value
Base SSBR	3.86 lb
Current SSBR	2.92 lb
SSBR at target mortality	0.45 lb
Current SPR	0.76
M	0.20 y^{-1}
F, trap net (2018-2020)	0.01 y^{-1}
F, gill net (2018-2020)	0.05 y^{-1}
Z (2020)	0.27 y^{-1}
2022 Model-derived Limit	70,300 lb
2022 Actual Harvest Limit	112,500 lb
Model Rating	Medium

Mortality rates represent averages for Lake Whitefish ages 6-11.

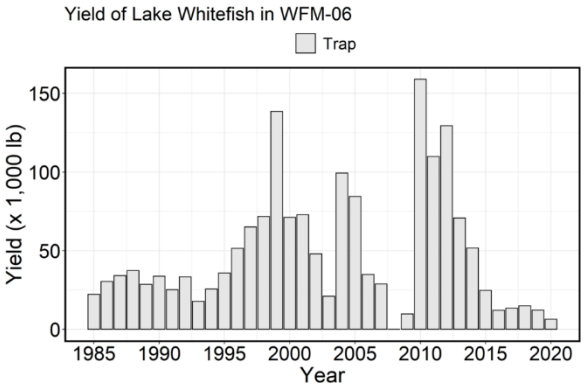


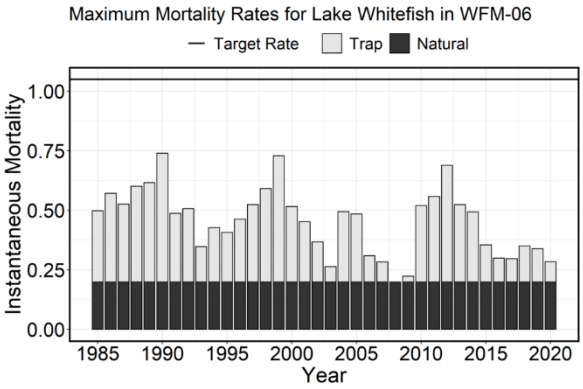


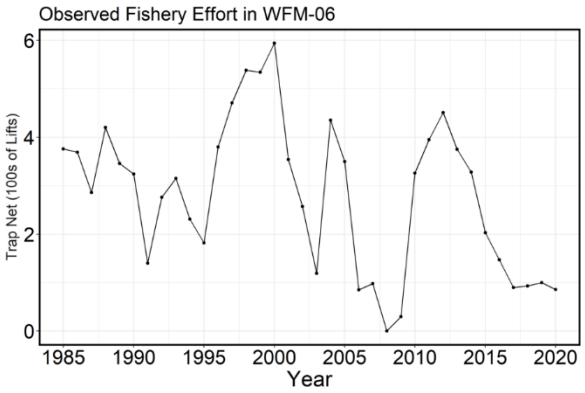
Notable stock dynamics and model revisions for WFM-05:

The WFM-05 assessment model was changed from a stock recruitment (SR) model to an autoregressive (AR) recruitment model. The AR model performed better in terms of retrospective bias. In addition, biomass and recruitment estimates appear to be more realistic with current trends in the fishery. The scaling issues observed in the SR model are less pronounced in the AR model. The change in recruitment models reduced the recommended harvest limit by 61%, although the recommended limit is still high relative to current harvest. The SPR 0.2 rule was triggered during projection and the model limit was based on a projected maximum mortality rate of 49%. Yields have declined 85% since 2015 despite consistent fishing effort.

WFM-06 (Leland) Stephen Lenart



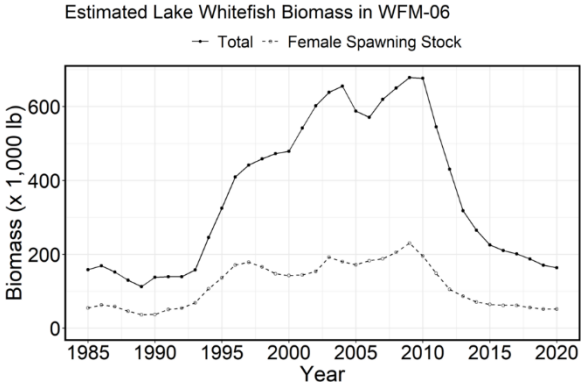


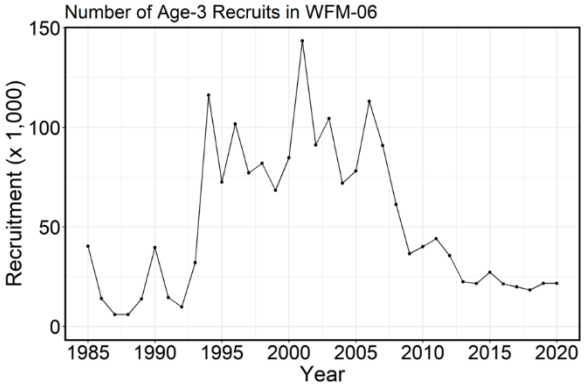


Parameter	Value
Base SSBR	3.68 lb
Current SSBR	2.35 lb
SSBR at target mortality	0.79 lb
Current SPR	0.64
M	0.20 y^{-1}
F, trap net (2018-2020)†	0.06 y^{-1}
Z (2020)	0.26 y^{-1}
2022 Model-derived Limit	57,400 lb
2022 Actual Harvest Limit	57,400 lb
Model Rating	Medium

Mortality rates represent averages for Lake Whitefish ages 6-11.

† Harvest from gill-net fishery included in trap net mortality

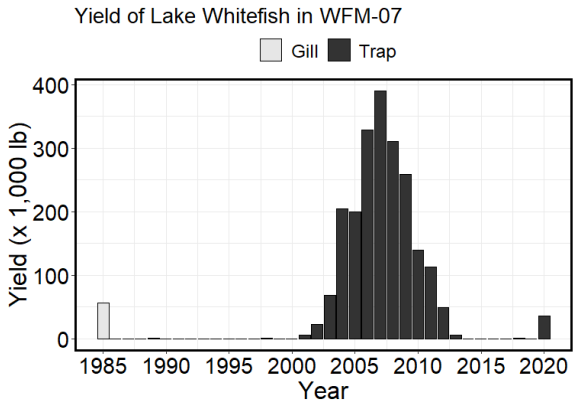


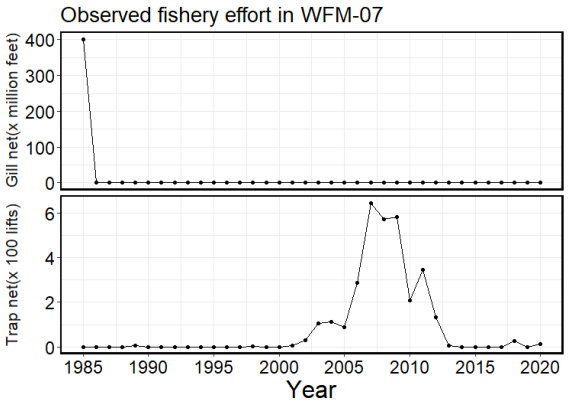


Notable stock dynamics and model revisions for WFM-06:

Trap net fishery effort in WFM-06 has been stable at 70-100 lifts over the past 5 years, but declining catch rates contributed to 2020 yield reaching a time-series low. Gill-net fishery effort and yield are sporadic, with average effort of 54K ft and average yields less than 2,500 lb since 2016. As in the north, declining recruitment has contributed to lower stock size in recent years, though the pattern here is different than in the north, where the decline began somewhat earlier – this is likely due to the absence in the north of a comparatively large 2003 year-class that appears to have been produced in central and southern treaty waters of Lake Michigan. The use of the alternative autoregressive recruitment (AR) model resulted in downward scaling of recruitment after 2009 compared to the base white noise (WN) model, and a more pronounced negative trajectory in estimated spawning biomass since 2012. Recent annual mortality rates (max 25% in 2020) remain well below the target maximum but declining recruitment continues to erode the fishable stock. The model-generated harvest limit of 54,700 lb is 22% lower than the prior year's model limit – a reduction entirely related to the use of the AR recruitment model, which scales recruitment downward relative to the base version. Retrospective bias in measures associated with the fishable stock was substantially improved in the AR version. The model-based harvest limit is less than 50% of the conditional constant catch level that has been applied since 2017 yet is still 5-fold higher than recent (2018-2020) average yield and higher than any annual yield achieved since 2014. Given the continued improved performance of the model, recent fishery dynamics, and the revised outlook on the stock offered by the AR recruitment version, the MSC recommended the use of the model-based limits for 2022.

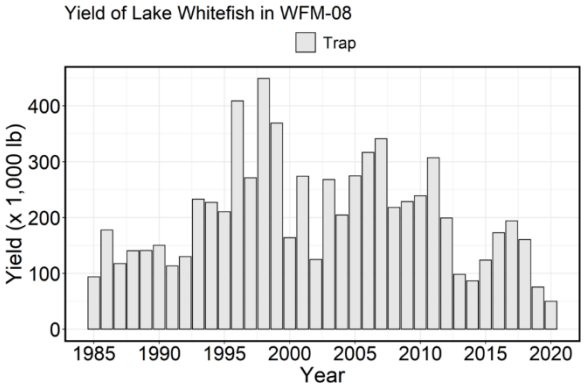
WFM-07 (Manistee to Pentwater)

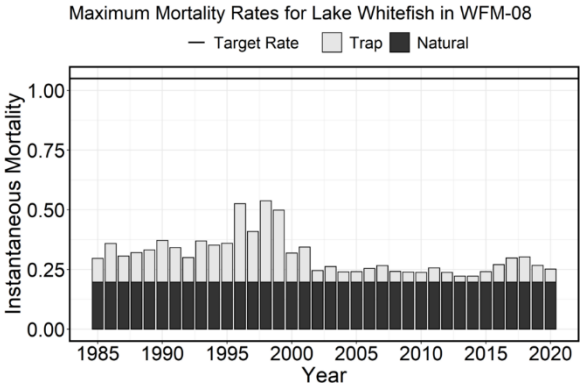


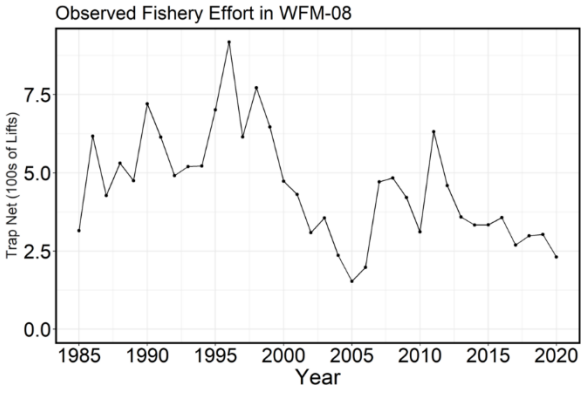


No stock assessment model has been developed for WFM-07. When the Consent Decree was initially signed, this unit lacked the necessary time series of data to populate a model. After the inception of the Decree, fishing effort and yield in this unit peaked in 2007, after which both declined to low levels by the early 2010s. No fishery was active during 2013-2017. Low levels of effort have since been reported, but yield exceeded 30K lb in 2020, and 50K lb in 2021. The HRG was established at 202,500 lb for 2022.

WFM-08 (Muskegon) Stephen Lenart

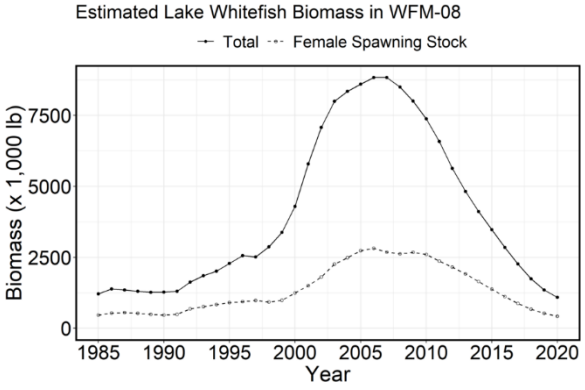






Parameter	Value
Base SSBR	4.26 lb
Current SSBR	2.94 lb
SSBR at target mortality	0.61 lb
Current SPR	0.69
M	0.20 y^{-1}
F, trap net (2018-2020)	0.07 y^{-1}
Z (2020)	0.25 y^{-1}
2022 Model-derived Limit	275,400 lb
2022 Actual Harvest Limit	275,400 lb
Model Rating	Low

Mortality rates represent averages for Lake Whitefish ages 6-11.



Notable stock dynamics and model revisions for WFM-08:

Trap net fishery effort in WFM-08 declined to less than 250 lifts during 2020, the lowest effort level observed since the mid-2000s. Reduced effort, coupled with declining catch rates over the past two years, resulted in yet another time series low for yield in 2020. There is little evidence for meaningful recruitment in this unit since 2006 (2003 year-class at age 3) and 63% of the harvest was composed of fish > age 17 in 2020. The use of the alternative autoregressive recruitment (AR) model resulted in a completely different scale of recruitment compared to the base stock-recruit (SR) model and a more pronounced negative trajectory (-84%) in estimated spawning biomass since 2010. Recent mortality rates (max 22% in 2020) remain well below the target maximum but declining recruitment continues to erode the fishable stock. Population scaling remains suspect and although retrospective bias was improved with the AR model, the persistent concentration of old fish in the population exacerbates bias that results from the switch to otolith-based age compositions in 2015. This also contributes to low weighting of the age composition data and less than satisfactory fit to the age compositions. Despite the low rating, the model is stable at the current solution. The model-generated harvest limit of 275,000 lb (based on the 54% mortality at SPR 0.2) is 55% of the conditional constant catch level that has been applied since 2017 yet is still roughly 3-fold higher than recent average (2018-2020) yield and higher than any annual yield achieved since 2011. Given recent fishery dynamics, and the revised outlook on the stock offered by the AR recruitment version, the MSC recommended the use of the model-based limits for 2022.

ANCILLARY INFORMATION FROM THE MOST RECENT STOCK ASSESSMENTS

The following tables provide detailed output from the most recent Lake Trout and Lake Whitefish stock assessments of the 1836 Treaty waters. In the interest of brevity, estimates are reported for roughly the last twenty years of the time series, although all 1836 treaty water assessment time series begin in either the 1970s or 1980s. We strongly encourage that individuals contact the co-chairs of the Modeling Subcommittee and/or the lead stock assessment analyst prior to any public use of these summary data.

Table 4. Various age-specific quantities from Lake Trout stock assessments in the 1836 Treaty waters of lakes, Superior, Huron and Michigan.

Table 5. Estimated mortality of Lake Trout for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-2021.

Table 6. Estimated female Lake Trout spawning biomass for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-2021.

Table 7. Various age-specific quantities from Lake Whitefish stock assessments in the 1836 treaty waters of lakes Superior, Huron and Michigan.

Table 8. Estimated abundance of age-4 Lake Trout for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-2020.

Table 9. Estimated mortality of Lake Whitefish for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-202.

Table 10. Estimated female Lake Whitefish spawning biomass for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-2020.

Table 11. Estimated abundance of age-4 Lake Whitefish for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-2019.

Table 12. Email contacts for stock assessment information.

Table 4. Various age-specific quantities from Lake Trout stock assessments of the 1836 treaty waters of the Great Lakes. Maturity and selectivity values are reported for terminal model data year (2021 unless noted).

Unit	First modeled age	Last modeled age (plus group)	Target age for SSBR calculations†	Age at 50% maturity (female)	Peak selectivity, commercial gill-net fishery	Peak selectivity, recreational fishery
MI-5	4	15	7	11	15	10
MI-6	4	15	7	10	9	11
MI-7 *(2019)*	4	15	7	10	10	12
MH-12	3	30	5	7	7	8
MM-123	1	15	5	5	7	8
MM-4	1	15	5	6	8	9
MM-5	1	15	5	5	6	7
MM-67	1	15	5	6	NA	8

†See Executive Summary for an explanation of how the target age concept is utilized in the projection of Lake Trout harvest limits.

Table 5. Estimated mortality of Lake Trout for each stock assessment unit of the 1836 Treaty waters of the Great Lakes, 2002-2021. Values denote maximum age-specific annual mortality.

Unit	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
MI-5	36%	45%	43%	33%	52%	53%	39%	37%	33%	36%	34%	37%	24%	29%	29%	33%	31%	31%	25%	25%
MI-6	26%	36%	37%	29%	35%	32%	35%	34%	31%	30%	31%	33%	22%	33%	30%	33%	29%	27%	26%	26%
MI-7	31%	37%	39%	31%	36%	34%	38%	40%	37%	38%	33%	38%	28%	39%	34%	35%	30%	30%		
MH-12	26%	24%	22%	24%	24%	26%	22%	24%	25%	27%	29%	28%	25%	23%	23%	24%	23%	24%	23%	24%
MM-123†	78%	72%	60%	66%	66%	65%	66%	66%	70%	72%	72%	73%	64%	51%	47%	50%	49%	50%	46%	46%
MM-4	64%	52%	53%	51%	47%	54%	48%	59%	57%	56%	57%	60%	53%	57%	52%	56%	56%	48%	53%	49%
MM-5	48%	47%	39%	44%	45%	45%	36%	31%	34%	44%	42%	34%	37%	46%	40%	37%	37%	33%	30%	32%
MM-67†	57%	52%	48%	43%	38%	39%	33%	34%	31%	33%	30%	33%	35%	30%	33%	33%	36%	34%	35%	33%

†Non-refuge stock only

Table 6. Estimated female Lake Trout spawning biomass (x1000 lb) for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-2021.

Unit	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
MI-5	200	171	163	169	148	128	128	145	178	193	216	236	243	241	234	219	202	189	179	165
MI-6	179	162	147	151	146	139	128	120	123	140	142	155	177	169	160	146	147	152	159	164
MI-7	149	141	130	128	119	111	101	91	93	99	108	111	117	115	111	105	105	105		
MH-12	400	584	766	867	1087	1175	1184	1186	1278	1279	1229	1230	1084	1102	1191	1228	1222	1197	1157	1118
MM-123†	57	70	90	115	129	120	129	148	132	115	115	147	180	293	462	556	466	408	430	474
MM-4	31	40	56	87	109	116	117	95	77	79	84	81	79	89	109	109	90	92	103	122
MM-5	24	37	50	50	55	67	85	99	101	101	102	105	99	110	131	133	161	174	184	186
MM-67†	78	91	109	107	128	156	202	245	291	313	314	301	280	298	332	334	343	364	362	360

†Non-refuge stock only

Table 7. Estimated abundance† (x 1000 fish) of age-4 Lake Trout for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-2020.

Lake/Unit	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MI-5	272	189	170	108	201	106	133	136	69	125	145	62	101	285	129	179	78	401	63
MI-6	146	113	94	99	128	107	123	114	122	91	76	142	158	131	125	187	260	263	220
MI-7	106	98	54	62	64	57	100	166	72	49	129	111	77	99	110	82	135		
MH-12	265	235	292	251	174	160	135	168	109	101	118	236	248	205	139	80	95	138	186
MM-123††	105	57	64	137	67	91	135	121	108	128	176	193	317	333	161	100	114	133	202
MM-4	25	50	103	107	84	65	46	79	165	63	74	95	80	93	55	37	69	81	94
MM-5	24	18	26	25	37	27	39	36	21	26	19	22	46	41	32	26	36	24	41
MM-67††	49	34	36	40	83	78	90	72	49	33	39	45	58	70	57	62	63	54	44

†Abundance estimates are for hatchery fish in Lake Michigan, hatchery and wild fish in Lake Huron, and wild fish in Lake Superior.
††Non-refuge stock only

Table 8. Various age-specific quantities from Lake Whitefish stock assessments in the 1836 treaty waters of the Great Lakes. Maturity and selectivity† values are reported for the terminal model data year (2020). There is no current stock assessment for Lake Superior unit WFS-06, Lake Huron unit WFH-05 or Lake Michigan unit WFM-07.

Unit	First modeled age	Last modeled age (plus group)	Age at 50% female maturity	Peak selectivity, commercial gill-net fishery	Peak selectivity, commercial trap-net fishery
WFS-04	4	20	4	NA††	6+
WFS-05	4	12	5	8	9+
WFS-07	4	11	5	7	8+
WFS-08	4	11	5	8	8+
North Huron	4	25	7	11	9+
WFM-01	3	25	6	NA††	10
WFM-02	3	20	6	12	9+
WFM-03	4	15	6	12	10+
WFM-04	3	16	6	8	9+
WFM-05	3	20	6	10	9+
WFM-06	3	20	6	NA††	11+
WFM-08	3	25	6	NA	8+

† Selectivity values with a "+" indicate that all ages at or above the age noted are assumed to be fully vulnerable.
†† Gill-net fishery not modeled separately; harvest combined with trap-net.

Table 9. Estimated mortality of Lake Whitefish for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-2020. Values denote maximum age-specific annual mortality.

Unit	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
WFS-04	38%	34%	36%	36%	34%	29%	21%	23%	20%	20%	24%	25%	22%	26%	23%	22%	21%	25%	26%
WFS-05	41%	59%	53%	30%	28%	29%	27%	28%	26%	30%	43%	40%	29%	32%	34%	33%	33%	30%	26%
WFS-07	47%	56%	57%	64%	64%	56%	51%	39%	47%	56%	55%	57%	53%	61%	70%	67%	64%	63%	59%
WFS-08	51%	50%	66%	64%	70%	66%	50%	65%	73%	55%	70%	59%	69%	78%	86%	87%	90%	72%	63%
North Huron	59%	60%	45%	59%	57%	53%	50%	51%	57%	54%	54%	55%	48%	48%	49%	50%	49%	44%	41%
WFM-01	25%	23%	26%	26%	28%	27%	29%	30%	31%	33%	38%	40%	35%	36%	37%	33%	35%	31%	28%
WFM-02	34%	30%	27%	37%	33%	33%	40%	39%	37%	33%	32%	24%	33%	32%	29%	29%	29%	26%	23%
WFM-03	58%	48%	42%	43%	41%	36%	45%	58%	62%	70%	74%	62%	66%	49%	57%	53%	40%	43%	35%
WFM-04	37%	39%	32%	35%	42%	31%	39%	48%	56%	57%	58%	53%	56%	46%	34%	28%	24%	27%	26%
WFM-05	34%	30%	30%	32%	32%	37%	37%	41%	35%	26%	25%	24%	24%	29%	29%	26%	22%	23%	24%
WFM-06	31%	23%	39%	38%	27%	25%	18%	20%	41%	43%	50%	41%	39%	30%	26%	26%	30%	29%	25%
WFM-08	22%	23%	21%	21%	23%	23%	22%	21%	21%	23%	21%	20%	20%	21%	24%	26%	26%	24%	22%

Table 10. Estimated female Lake Whitefish spawning biomass (x1000 lb) for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-2020.

Unit	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
WFS-04	164	190	200	208	213	225	255	288	316	337	343	342	345	336	351	358	356	335	307
WFS-05	130	114	106	119	135	149	174	201	230	241	211	191	202	213	211	216	207	211	227
WFS-07	416	427	332	296	224	259	345	363	360	380	308	322	316	293	285	273	268	279	317
WFS-08	92	119	138	119	81	62	51	63	55	54	66	65	81	69	84	72	58	46	59
North Huron	1761	1770	1922	1948	1904	1787	1693	1581	1301	1037	815	589	477	439	370	381	375	357	335
WFM-01	3775	4273	4460	4648	4663	4422	4119	3844	3430	2926	2402	1972	1693	1495	1325	1209	1052	936	865
WFM-02	601	735	839	905	944	905	821	774	731	698	669	662	590	526	486	442	389	351	328
WFM-03	1364	1340	1292	1327	1387	1413	1367	1216	1073	869	657	512	372	343	318	322	326	313	304
WFM-04	617	630	639	666	642	615	555	484	393	321	282	274	245	231	231	251	270	288	305
WFM-05	318	368	382	390	381	322	272	222	192	184	190	199	190	165	139	118	105	97	97
WFM-06	154	192	180	172	183	188	205	231	196	149	105	87	71	65	62	62	56	52	52
WFM-08	1801	2258	2484	2730	2818	2685	2623	2678	2600	2371	2155	1914	1645	1377	1118	873	670	528	426

Table 11. Estimated abundance (x 1000 fish) of age-4† Lake Whitefish for each stock assessment unit in the 1836 Treaty waters of the Great Lakes, 2002-2019.

Unit	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
WFS-04	137	49	54	77	66	64	58	101	46	56	68	65	69	79	105	58	40	47
WFS-05	89	49	56	59	54	87	86	99	82	62	69	70	75	84	85	52	50	67
WFS-07	309	218	228	185	216	275	251	274	323	253	231	252	416	310	224	234	247	318
WFS-08	147	136	122	79	61	75	95	123	131	87	68	96	152	120	128	82	93	86
North Huron	3206	2580	2118	1745	1508	1302	1063	846	514	308	330	537	663	508	416	335	203	150
WFM-01	2266	2246	2036	1689	1509	1359	1148	807	503	415	535	714	586	406	346	294	270	285
WFM-02	639	643	557	577	468	411	350	320	220	184	196	211	152	103	76	63	67	74
WFM-03	839	763	1134	1590	1365	1048	830	667	503	381	323	297	234	239	229	166	134	107
WFM-04	347	294	305	333	263	245	246	270	249	202	188	189	135	75	76	75	98	114
WFM-05	222	167	123	153	116	94	64	53	48	74	82	39	14	10	12	11	15	18
WFM-06	117	74	86	59	64	93	74	50	30	33	36	29	18	18	22	18	16	15
WFM-08	1141	1026	793	647	662	1020	751	424	223	133	92	69	51	33	21	16	14	14

†Estimates near the end of the time-series are highly uncertain, particularly in lakes Michigan and Huron.

Table 12. Contact information for 1836 Treaty water stock assessments.

Unit	Stock assessment lead	Agency	Email address
MI-5, MI-6, MI-7	Shawn Sitar	Michigan Department of Natural Resources	sitars@michigan.gov
MH-12	Ji He	Michigan Department of Natural Resources	hej@michigan.gov
MM-123	Ted Treska	US Fish and Wildlife Service	ted_treska@fws.gov
MM-4, MM-5, MM67	Stephen Lenart	Michigan Department of Natural Resources	lenarts1@michigan.gov
WFS-04	Mike Seider	US Fish and Wildlife Service	mike_seider@fws.gov
WFS-05	Shawn Sitar	Michigan Department of Natural Resources	sitars@michigan.gov
WFS-07, WFS-08	Jack Tuomikoski	Bay Mills Indian Community	jtuomikoski@baymills.org
North Huron	Kevin McDonnell	US Fish and Wildlife Service	kevin_mcdonnell@fws.gov
WFM-01, WFM-06, WFM-08	Stephen Lenart	Michigan Department of Natural Resources	lenarts1@michigan.gov
WFM-02, WFM-03	Ted Treska	US Fish and Wildlife Service	ted_treska@fws.gov
WFM-04	Kevin Donner	Little Traverse Bay Bands of Odawa Indians	kdonner@ltbbodawa-nsn.gov
WFM-05	Chris Hessell	Grand Traverse Band of Ottawa and Chippewa Indians	chris.hessell@gtbindians.com