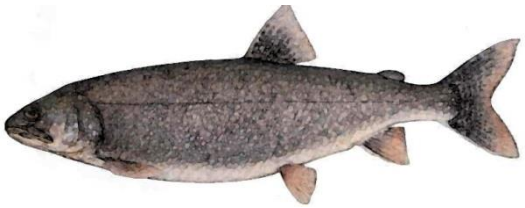
Technical Fisheries Committee Administrative Report 2015: Status of Lake Trout and Lake Whitefish Populations in the 1836 Treaty-Ceded Waters of Lakes Superior, Huron, and Michigan, with Recommended Yield and Effort Levels for 2015



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

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Editors

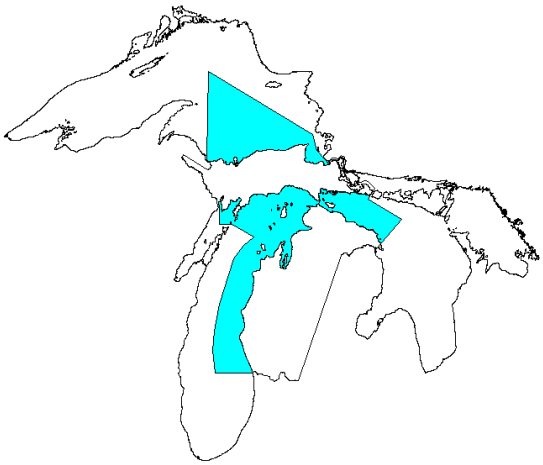

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Table of Contents

EXECUTIVE SUMMARY

Prepared by Stephen J. Lenart and David C. Caroffino

This document outlines 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. We retain here the revised report format first instituted in 2013. The objective of the revised format is to provide a more succinct, consistent summary while maintaining focus on the primary purposes of the report, which are 1) to describe the status of each stock in the context of establishing harvest limits according to the terms of the Decree; and 2) to document important technical changes in the stock assessment process.

Model-generated yield limits and actual yield and effort limits for 2015 are provided in Table 1. In instances where actual yield limits for lake trout units or shared-allocation whitefish units (WFS-04, WFS-05, WFM-01, WFM-06 and WFM-08) differ from model-generated yield limits, a brief explanation is provided below. For non-shared 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 yield limits - these may differ from the model-generated limits. Population models for Lake Whitefish are on a one-year lag, so estimates reported here are derived from data through 2013.

Table 1. 2015 yield and effort limits

Species	Lake	Management unit	Model-generated yield limit (lb)	Actual yield limit (lb)	Gill net limit (ft)
Lake trout	Superior	MI-5	142,937	142,937	NA
		MI-6	167,428	167,428	3,159,000
		MI-7	111,236	97,851	4,597,000
	Huron	MH-1	No model estimate	420,931	11,259,000
		MH-2	No model estimate	125,000	NA
	Michigan	MM-123	44,793	TBD	TBD
		MM-4	189,756	201,827	872,000
		MM-5	80,397	98,000	161,000
		MM-67	231,480	374,869	NA
Lake whitefish	Superior	WFS-04	107,000	107,000	NA
		WFS-05	410,000	410,000	NA
		WFS-06	No model estimate	210,000	NA
		WFS-07	427,300	427,300	NA
		WFS-08	161,100	161,100	NA
	Huron	Northern Huron	379,900	379,900	NA
		WFH-05	431,000	431,000	NA
	Michigan	WFM-01	1,445,800	1,445,800	NA
		WFM-02	465,500	465,500	NA
		WFM-03	622,700	780,800	NA
		WFM-04	920,000	548,000	NA
		WFM-05	427,000	365,000	NA
		WFM-06	199,500	250,000	NA
		WFM-07	No model estimate	500,000	NA
		WFM-08	801,400	1,400,000	NA

Lake Trout

In Lake Superior, lean Lake Trout are self-sustaining, and the statistical catch-at-age (SCAA) models and target mortality rates apply to these wild fish in three management areas (MI-5, MI-6, and MI-7). Declines in population abundance and biomass have occurred since the late 1990s, a product of a long-term decline in recruitment. Recent estimates, however, suggest that this downward trend has been somewhat ameliorated. Estimated total biomass has now been stable (MI-5) to increasing (MI-6) in the western units for the past five years. In MI-7, where biomass declines were not as pronounced, total biomass has increased modestly since the middle 2000s. Aside from natural mortality, sea lamprey-induced mortality (SLIM) represents the greatest individual source of mortality in all modeled Superior units. SLIM rates remain higher in units MI-6/7, where estimated peak rates exceed 0.2 y^{-1} for the older age classes, roughly twice the peak rate estimated for MI-5. Average SLIM rates (ages 6-11) range between 0.06 and 0.13 y^{-1} in Lake Superior.

Commercial fishing mortality remains low (<0.05 y^{-1}) throughout the Treaty waters of Lake Superior. Commercial harvest of Lake Trout from unit MI-5 occurs exclusively in 1842 Treaty waters, though data from the most recent year (2014) were unavailable for this fishery - yield and effort were thus assumed to be equivalent to 2013 levels for stock assessment purposes. Commercial yield once again declined in MI-6 and is now below the long-term average for the unit, while commercial yield in MI-7 increased modestly over that observed in 2013. Recreational harvests in the western units (MI-5 and MI-6) have remained fairly stable since the early 2000s, while recreational harvest has been more variable, and lower, in unit MI-7. Recreational fishery mortality rates are below 0.03 y^{-1} throughout the Treaty waters of Lake Superior.

Mortality of lean Lake Trout remains below the maximum target rate throughout Lake Superior Treaty waters, thus projections suggest yield could be increased in all modeled management units. Following prescriptions in the Decree, the 2015 harvest limit for unit MI-7 was restricted to a 15% increase over the prior year's limit. 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.

Wild fish comprise an increasing proportion of the Lake Trout population in Lake Huron and recruitment of wild Lake Trout to the adult population continues to be evident. In 2014, unclipped fish represented 53% of the commercial, 57% of the recreational, and 42% of the survey samples collected from Lake Huron Treaty waters. Spawning biomass, however, is still dominated by hatchery fish, though the wild spawning biomass proportion exceeds 0.4 in MH-2. Estimating recruitment of wild fish remains a challenge, a condition that has resulted in high levels of uncertainty in the scaling of the Huron populations. To address this as well as other technical issues in the Huron assessments, the MSC will undertake a comprehensive review of the Lake Huron model structure during 2015-2016. To provide adequate time for the review, the MSC has requested that the TFC recommend two-year (2015-2016) constant harvest limits for the Huron units. The MSC derived its harvest limit recommendations from recent model-derived values. Due to divergent model results for MH-1, and the absence of timely commercial fishery reporting for MH-2, population model estimates for Lake Huron are not described below.

After remaining below 0.1 y^{-1} during 2004-2008, average SLIM in MH-1 has remained at or above this level (range 0.10 to 0.15 y^{-1}) since 2009. Average SLIM in MH-2 is typically lower and has only exceeded 0.1 y^{-1} during two years since 2001. Commercial fishing is the largest source of mortality in MH-1, although total commercial yield in 2014 decreased by more than 100,000 lb from the 2013 peak (355,532 lb). Commercial yield from the Ontario waters of north-central Lake Huron (included in unit MH-2) increased modestly in 2014 yet was below the recent average (57,578 during 2000-2013) for the area. Sport fishery yields increased slightly in 2014 over the lower values observed in 2013 (<15,000 lb in each unit), though, overall, recreation harvest has been fairly consistent since 2008.

While absolute values of spawning biomass for Lake Huron are unavailable from this assessment cycle, trends continue to point to a decline from the peak value observed in 2009 in

MH-1. Based on estimates from 2014, spawning biomass in MH-1 has declined approximately 35% since 2009. Spawning biomass in MH-2, where mortality rates from fishing and sea lamprey are lower and wild fish contribute at a proportionally higher level to the overall spawning biomass, has remained more stable. Lake wide declines in adult biomass are primarily being driven by reduced survival of stocked fish, a pattern that began in the early 2000s. The biomass of adult wild fish appears to be stable to increasing.

In Lake Michigan Treaty waters, where wild adult Lake Trout are scarce, the assessment models and target mortality rates apply only to stocked fish. In unit MM-123 total mortality is well above target, a product of excessive commercial fishing and sea lamprey-induced mortality. SLIM has slowly declined in MM-123 since the early 2000s, when the average (ages 6-11) rate peaked at nearly 0.4 y^{-1}. The average has since declined to 0.145 y^{-1}, an encouraging trend, yet SLIM remains higher in MM-123 than in any other Lake Michigan unit. Commercial fishing mortality remains high (0.38 y^{-1} average for fish ages 6-11) and yield exceeded 525,000 lb for the second consecutive year. Recreational fishery yield increased for the third consecutive year to the highest level observed since 1999, though mortality rates are below 0.04 y^{-1}. Biomass of young fish continues to increase due to increased stocking, yet few fish survive beyond age 7 and adult stocks remain depressed. A Decree Amendment dated 4 April 2007 set the harvest limit in MM-123 at 453,000 lb for CORA and 50,000 lb for the State. These limits were imposed because the elevated sea lamprey mortality would have prevented any harvest under the original terms of the Consent Decree. The stipulated limits will remain in place until conditions of the stipulation are met. Due to unresolved issues relating to the application of penalties for CORA overharvest in 2013 and 2014, the 2015 Lake Trout harvest limit has yet to be established for unit MM-123.

Estimated spawning biomass has declined slightly in unit MM-4 following the marked increase observed in the middle 2000s, although the 2014 estimate remains well above levels observed in the late 1990s and early 2000s. While natural mortality is currently the largest individual source of mortality in MM-4, mortality from sea lamprey (0.09 y^{-1}), commercial fishing (0.17 y^{-1}), and recreational fishing (0.09 y^{-1}) are factors in this unit. Average total mortality has been quite stable since 2009 (range 0.50 – 0.55 y^{-1}). Total yield of Lake Trout from MM-4 declined slightly from the Decree-period peak of 173,706 lb in 2013. Recruitment is enhanced by the substantial increase in stocking in adjacent MM-123, a mitigating factor for the relatively intense harvest that occurs in the unit. This year marks the first time model-generated yield limits exceeded the floor limits established for MM-4 in the 2009 Decree stipulation. The transfer provision remains in place, thus the CORA limit for 2015 will exceed the model-derived value.

Mortality rates in units MM-5 and MM-67 remain below target and natural mortality is the largest individual source of mortality in these units. Recreational fishery yield from MM-5 in 2014 (51,613 lb) was only slightly lower than the Decree-period peak observed in 2013. MM-5 is the only Treaty unit where recreational fishing mortality (0.13 y^{-1}) exceeds both commercial fishing mortality (0.09 y^{-1}) and SLIM (0.02 y^{-1}). SLIM is quite variable in MM-5 and this most recent estimate is historically low. In contrast, SLIM in unit MM-67 exceeded 0.1 y^{-1} for the first time since 2007. Commercial fishery yield is nearly non-existent in unit MM-67 and recreational fishery harvest is modest (average mortality <0.05 y^{-1}) relative to the size of the population. Although spawning biomass in MM-5 has declined slightly since 2009, current biomass levels remain well above the long-term average for the unit. Low mortality and consistent growth have allowed adult biomass to build in unit MM-67 to levels not observed since the early 1990s. The Decree's 15% rule was applied in deriving the 2015 harvest limit for MM-67. There is a Decree stipulation for MM-5 that establishes the 2015 harvest limit at 98,000 lb.

Full assessments were conducted for all Lake Trout units during the 2015 assessment cycle, though as noted above, not all were strictly utilized to generate a model-based harvest limit recommendation.

Lake Whitefish

In the western 1836 Treaty waters of Lake Superior (WFS-04 and WFS-05), commercial yields of Lake Whitefish declined during the late 2000s in response to declining effort. The vast majority of harvest from WFS-04 occurs outside 1836 waters and recent increases observed during 2012-2013 are attributed to increased trap-net fishery effort in 1842 waters. In unit WFS-05 an increase in gill-net effort was responsible for the increased yields observed since 2012. Estimated maximum mortality rates during 2013 were 0.58 y^{-1} in WFS-04 and 0.38 y^{-1} in WFS-05 and fishing mortality exceeded natural mortality in both units. Stable recruitment and growth, combined with low mortality rates, have resulted in remarkably stable estimated biomass levels in unit WFS-04. In unit WFS-05, recruitment appears to be more variable, although total biomass during 2000-2013 has only deviated by a maximum of 18% from the 2000-2013 average.

In unit WFS-06, where there has been no attempt to fit a stock assessment model since 2006, fishery effort is quite sporadic and annual yield has not exceeded 50,000 lb since the inception of the Decree. Recent yields, although still highly variable, have been somewhat higher, perhaps offering a future opportunity for model development. In the eastern units (WFS-07 and WFS-08) fisheries are more stable. Both gill-net and trap-net fisheries are active in WFS-07 and yields have been roughly equivalent for the two gears during the past four years. The trap-net fishery has dominated in WFS-08 since 1999, and, although trap-net effort remains quite variable from year to year, total yield has been fairly consistent since 2009 (range 98-130K lb). Estimated mortality rates on the most vulnerable age classes in WFS-07 exceeded the target maximum (1.05 y^{-1}) in 2013, but these rates may be an artifact of unusually high estimated selectivity values. Nonetheless mortality is likely higher here than in any other Superior Treaty unit. Maximum mortality rates have declined slightly in WFS-08, though the most recent estimate (0.64 y^{-1}) is still higher than those in the west. Although estimated recruitment is roughly twofold higher in unit WFS-07 than unit WFS-08, recruitment patterns have been largely similar in these two units over the past decade or more, with the 2005-2006 year classes marginally stronger than cohorts from the early 2000s. Biomass patterns have mirrored recruitment during this time frame, but the long-term declining trend which began during the early 1990s in WFS-07 remains evident.

In northern Lake Huron Treaty waters (WFH-01-WFH-04), dramatic declines in recruitment that began in the early 2000s and substantial increases sea lamprey mortality have combined to drive Lake Whitefish stocks down to their lowest levels since the late 1970s. Fishery yields have predictably declined and 2013 yield was the second lowest in a time series that begins in 1976 (catch rates in both the trap- and gill-net fisheries were the lowest). Lake Huron is the only lake where independent estimates of SLIM are calculated for Lake Whitefish (see *Technical Changes* section for description of methodology). Average SLIM on whitefish in northern Lake Huron (0.3 y^{-1} for ages 6-11) exceeded rates for Lake Trout across all Treaty waters. Total mortality exceeds the target rate (1.05 y^{-1}) for fish greater than age 9 and spawning biomass, which declined for the ninth consecutive year, is near the time-series low in northern Lake Huron. Similar patterns in recruitment and SLIM are evident in unit WFH-05, though the impacts are somewhat muted when compared to the north. Average SLIM in WFH-05 was 0.2 y^{-1} in 2013 and maximum total mortality was 0.88 y^{-1}. Yield (trap-net only) continues to decline, and catch rates are near the time-series low. However, they remain higher (>600 lb) than in most other treaty units. Nonetheless, fisheries in Lake Huron continue to be supported by strong year classes from the 1990s. Spawning biomass has declined annually since 2005 in WFH-05 though the decrease, while substantial, is not as pronounced as in the northern unit. Recent observations from surveys suggest some increase in abundance of pre-recruits, though additional observations will be necessary for confirmation. The near-term outlook for Lake Huron whitefish stocks remains negative.

Lake Whitefish recruitment patterns in northern Lake Michigan (WFM01-04) are synchronous and now appear similar to those in Lake Huron. With the exception of WFM-01,

the relative decline from peak recruitment in the late 1990s appears less severe than in Lake Huron. Mortality from sea lamprey is substantially lower on whitefish here than in adjacent northern Lake Huron. Commercial effort and yield increased in most northern Lake Michigan units during the latter 2000s but declining catch rates have since contributed to decreased yields in recent years - some have speculated that the decline in catch rates is not entirely explained by decreases in abundance. Commercial fishing mortality rates have increased and estimated maximum mortality rates range between 0.4 y^{-1} (WFM-04) and 1.1 y^{-1} (WFM-01). Spawning biomass has declined to varying degrees in all northern Lake Michigan units since the middle 2000s. As in Lake Huron, there are early signs that recruitment may have rebounded, but this has yet to be substantiated.

In central Lake Michigan Treaty units (WFM05 and WFM06), fisheries are less intense and/or more sporadic than in the north. Commercial yield has not exceeded 50,000 lb in WFM-05 since 2009, a product of a nearly non-existent trap-net fishery. Conversely, during 2010-2013, annual trap-net yields in WFM-06 have been among the highest in the time series. Estimated maximum mortality rates (0.37- 0.48 y^{-1}) remain below target in these units. Recruitment patterns in WFM-05 mirror those in the north, but due to low mortality and increased growth, spawning biomass has increased modestly since 2010. The sporadic nature of the fishery in WFM-06 results in somewhat ambiguous estimates and temporal trends have a higher level of uncertainty than in other areas. Although model performance has improved in recent years, the TFC has continued to recommend a harvest limit of 250,000 lb for this unit until such time that model performance is satisfactory.

In unit WFM-07 trap-net fishery effort and yield continue to decline since reaching a peak in 2007. Yield has not exceeded 10,000 lb since 2010. The lack of long-term monitoring data has precluded development of a SCAA model and the HRG for this unit has remained at a constant level since 2007. In WFM-08, the southernmost Lake Michigan Treaty unit, trap-net fishery yield had been quite stable, ranging from 205,000 to 341,000 lb during 2003-2011. Yield declined for the second consecutive year to less than 100,000 in 2013, at least partially due unusual weather conditions that impacted fisheries throughout Treaty waters. Natural mortality is the largest source of mortality in this unit and model estimates continue to suggest that fishery yield is small relative to stock size. Fishing mortality was estimated to be less than 0.07 yr^{-1} and total mortality for the most vulnerable year class was 0.40 y^{-1} in 2013. Recruitment patterns suggest that a relatively strong year class was produced in 2006, something not observed in northern units (but does appears evident in WFM-06). Although biomass has declined somewhat from the 2008 peak, estimates suggest stock size is still much higher than it was during the 1980s and 1990s. The assessment for unit WFM-08 has generated highly variable estimates of stock size over the years, a situation that has lead the TFC to recommend a constant harvest limit of 1.4 million lb. The MSC will continue to conduct the stock assessment and evaluate a suite of stock parameters when making a recommendation to the TFC for continuance of the constant catch policy.

Technical Changes

The estimation of sea lamprey-induced mortality as a separable component of the overall mortality on Lake Whitefish is currently restricted to the Lake Huron management areas. Historically these estimates were calculated for an individual management unit by adjusting the year- and age-specific marking rates (A1-A3, fall data) by the year-specific deviations from the long-term marking rates for that unit. This methodology was employed primarily to deal with small sample sizes for individual age classes within a year. These adjusted marking rates were then translated to age-and year-specific mortality rates, assuming a probability of survival of 0.25 across all ages.

To address concerns over the application of these methods, the MSC evaluated the use of raw (unadjusted) age-specific marking rates to directly estimate mortality, relying on marking data within an the entire calendar year to develop the age-specific values. This revised method was implemented for the 2014 Lake Huron Lake Whitefish assessments. While the revised method seemed preferable to the

previous method, we noted that it did result in highly suspect values for age classes that were not well represented in the samples in a given year. After further review, for 2015, the MSC decided to mirror the methodology utilized to estimate sea lamprey-induced mortality for Lake Trout, where size-based wounding rates are fit to a logistic curve and these are translated to mortality rates based on growth parameters of the stock and the probability of survival. For each management area (North Huron and WFH-05), separate shape parameters (α and β) for the logistic curve were estimated and only the inflection point varied through time in a given unit. We note that the average year-specific mortality rates estimated from this approach were substantially similar to those estimated using the raw data approach (i.e. the 2014 method), yet the current method produced estimates which were far less variable for fish above a certain size. This approach will continue to be employed in future assessments.

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.

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) covering 374,000 ha. 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, and with 117,000 ha shallower than 80 m.

MI-6: Lake trout management unit MI-6 extends from Laughing Fish Point (east of Marquette) to Au Sable Point (east of Munising), encompassing 728,000 ha. 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, and only 105,000 ha of the total area is shallower than 80 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), encompassing 457,000 ha. This management unit has complex bathymetry with many lacustrine ridges, trenches, and slopes. There is approximately158,000 ha of lean Lake Trout habitat (depth less than 80 m).

MH-1: Lake trout management unit MH-1 is located in northern Lake Huron and extends from the Mackinac Bridge south to the border between grids 607 and 608. For stock assessment purposes, biological data from waters in adjacent Ontario management area 4-1 are included. The management unit has a wide bathymetric range with areas in grids 407 and 408 as deep as 130 m. The Michigan portion of this unit lies completely within 1836 Treaty waters, covering 437,000 ha, of which approximately 308,000 ha are less than 80 m in depth. The Ontario portion, which lies outside 1836 Treaty waters, covers approximately 124,000 ha, of which approximately 69,000 ha is less than 80 m in depth. On the Michigan shore this unit 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.

MH-2: Lake trout management unit MH-2 is located in north-central Lake Huron. It includes statistical district MH-2 (approximately 640,000 ha) as well as adjacent Canadian waters (areas 4-2, 4-3, and 4-7 for a total of approximately 546,000 ha). Michigan waters of the MH-2 unit include both 1836 Treaty waters (304,000 ha) and non-treaty waters (336,000 ha), divided by a line running north-east from the tip of North Point to the international border. The Michigan ports of Presque Isle and Alpena are contained in this unit. The management unit has a wide bathymetric range with areas in grids 714 and 814 deeper than 210 m, and a total of approximately 255,000 ha of the Michigan portion has bottom depths less than 80 m. A similar area (257,000 ha) in the Ontario portion contains waters less than 80 m. This management unit contains a limited number of historically important Lake Trout spawning reefs and shoals. These reefs are located near Middle Island, North Point, and Six Fathom Bank, a large offshore reef complex that 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, covering 1.29 million ha. Water depths in the northern portion of the unit are generally less than 45 m, and approximately 911,000 ha are less than 80 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). The total area of the unit is 66,000 ha of which 50,000 ha are less than 80 m in depth. 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 covers 546,000 ha and encompasses 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. Only 125,000 ha (23%) of the unit are at depths less than 80 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 management unit covers 1,157,000 ha, of which 241,000 ha are less than 80 m in depth. 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 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 treaty territories 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 (486,000 ha) 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. Surface area of the unit is 747,000 ha. 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 and contains 150,000 ha of water less than 80-m deep. There is a substantial commercial fishery in adjacent Canadian management unit 33. 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, and it contains 65,000 ha of water less than 80-m deep. A substantial commercial fishery targeting whitefish also exists in adjacent Canadian management units 33 and 34. 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 34, as well as contributions from spawning fish in WFS-07 directly west of WFS-08.

Northern Huron: The catch-at-age model for Lake Whitefish in Northern Lake Huron was created in 2009 after mark-recapture data showed fluid movement of adult fish between management units WFH-01, WFH-02, WFH-03, and WFH-04. The consolidated stock assessment model was an attempt by the Modeling Subcommittee to estimate population parameters for a mixed-stock fishery exploited by only one agency (CORA). Management unit WFH-01 is located in the northwest portion of the main basin of Lake Huron. It is relatively shallow and contains 94,000 ha of water less than 80 m. 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 and contains 50,000 ha of

water less than 80-m deep. 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 and less than 40,000 ha of water less than 80-m deep. WFH-04 is the largest whitefish management unit in the 1836 Treaty waters of Lake Huron. The unit contains 153,000 ha of water less than 80-m deep. 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. There are an estimated 85,000 ha of water less than 80-m deep in WFH-05. 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, and its surface area is 16,000 ha. 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 of 38,000 ha 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. There are 157,000 ha of water less than 80-m deep in the unit. 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. There are 195,000 ha of water less than 80-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-04 contains 234,000 ha of water less than 80-m deep.

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, but only 197,000 ha, or 46% of the water in these grids, is less than 80-m deep. 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. Surface area for this unit is 382,000 ha (including part or all of grids 709-714, 808-814, 908-912, and 1008-1011). 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. The surface area for this unit is 521,000 ha, of which 111,000 ha have bottom depths of 80 m or less, with maximum depths up to 275 m. 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. WFM-08 has a surface area of 610,000 ha in Michigan grids 1706-1710, 1806-1810, 1906-1911, and 2006-2011; 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.

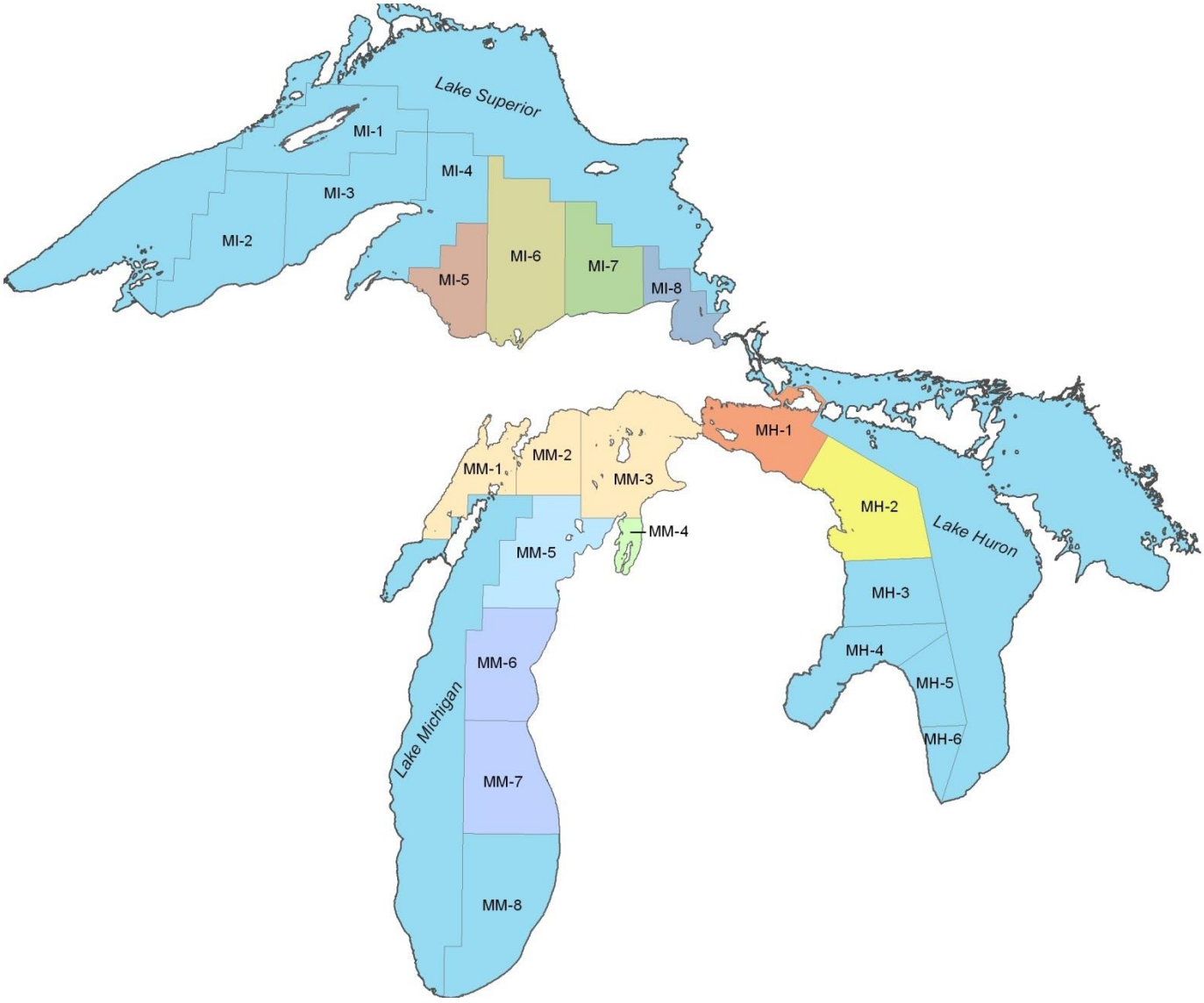


Figure 1. Lake Trout Management Units. Shaded areas denote units subject to provisions of the 2000 Consent Decree. Like shading indicates where statistical districts have been combined into a single management unit for stock assessment purposes. No stock assessment has been developed for Lake Superior unit MI-8.

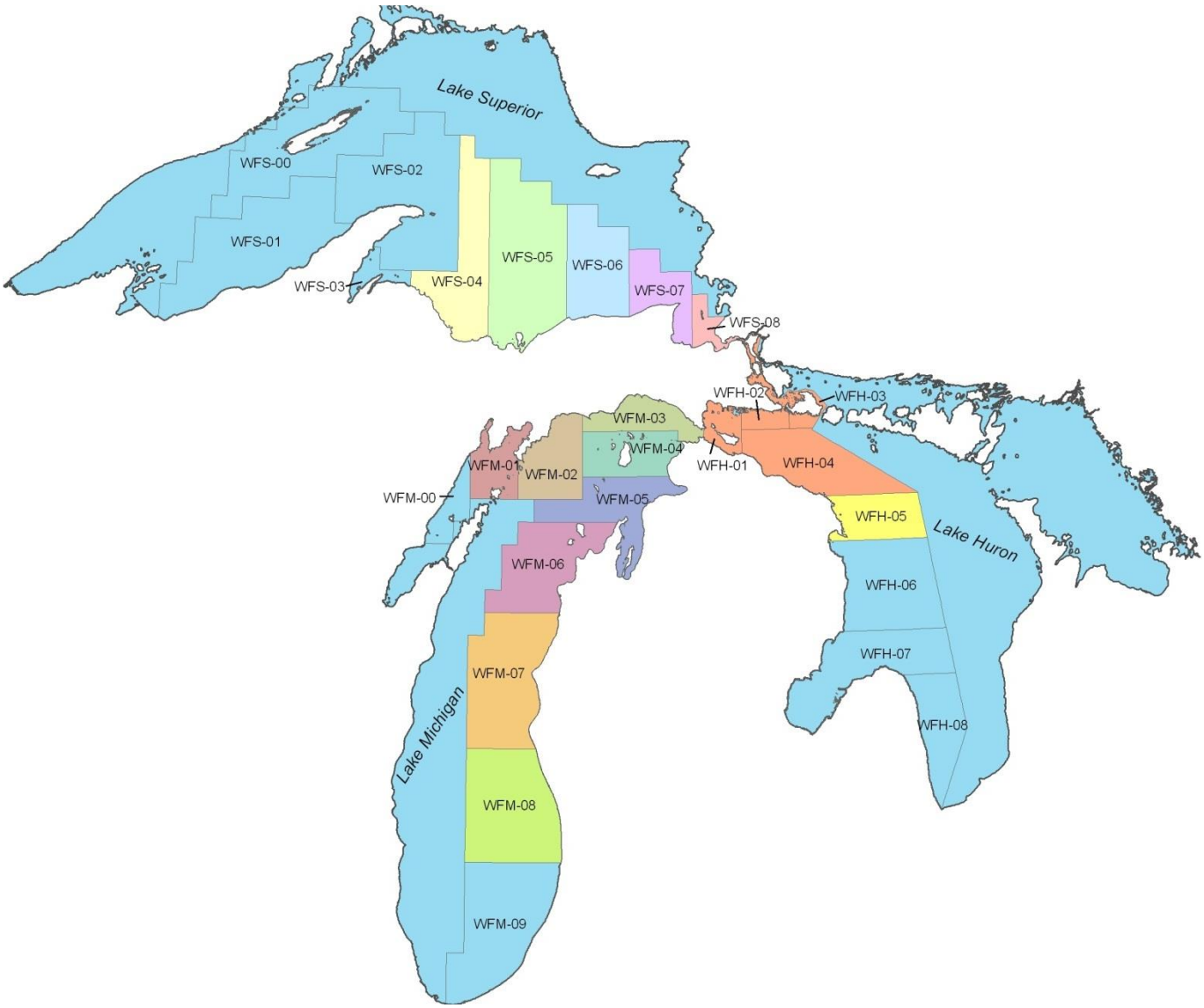
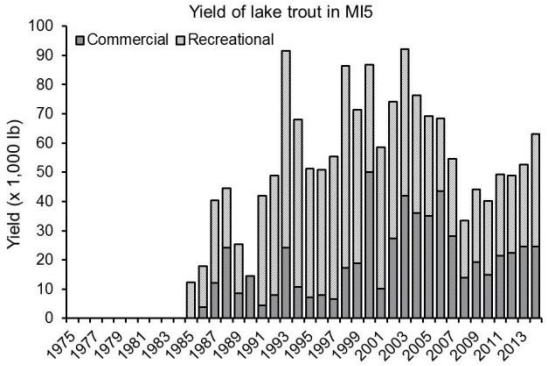


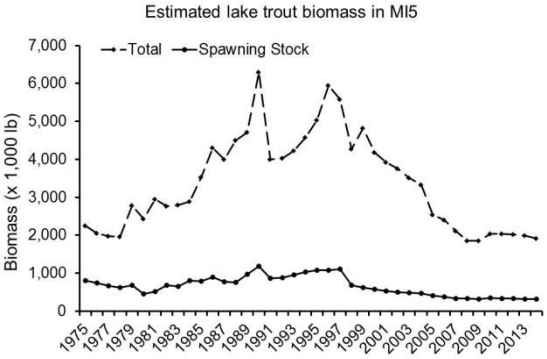
Figure 2. Lake Whitefish Management Units. Shaded areas denote units subject to provisions of the 2000 Consent Decree. Like shading indicates where units have been combined into a single management area for stock assessment purposes. No stock assessment model has been developed for Lake Michigan unit WFM-07 and the stock assessment model for Lake Superior unit WFS-06 has not been populated since 2006 due to a paucity of available data.

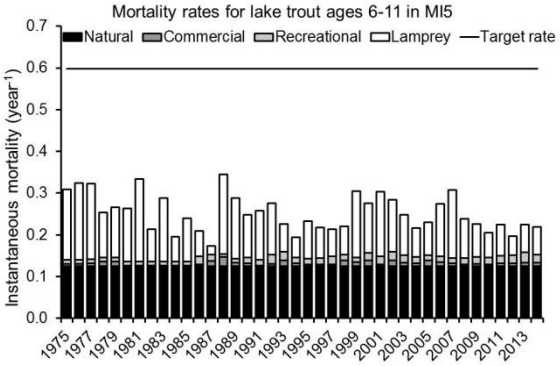
STATUS OF LAKE TROUT POPULATIONS

Lake Superior

MI-5 (Marquette) **Shawn Sitar**







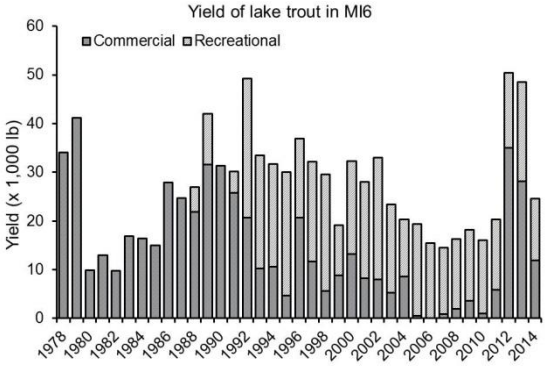
Parameter[(1)]	Value
Base SSBR	8.31 lb
Current SSBR	2.49 lb
Target SSBR	0.41 lb
Current SPR	0.30
M	0.13 y^{-1}
F, Commercial (2012-2014)	0.01 y^{-1}
F, Recreational (2012-2014)	0.02 y^{-1}
Sea Lamprey Mort (2011-2013)	0.06 y^{-1}
Z (2014)	0.22 y^{-1}
Recommended TAC	142,937 lb
Actual TAC	142,937 lb
Model Rating	Medium

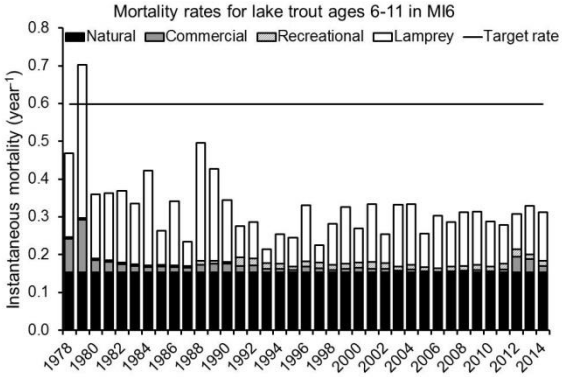
(1) For this and all subsequent tables in this section, mortality rates represent averages for Lake Trout ages 6-11.

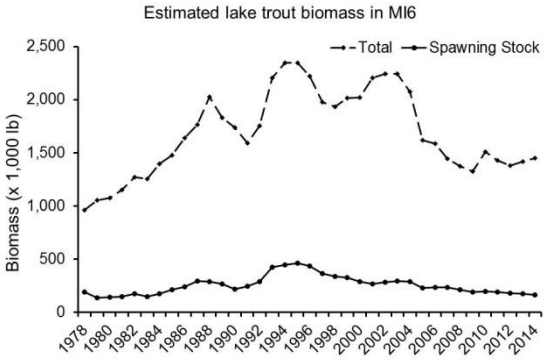
Notable Stock Dynamics and Model Changes:

Lake trout biomass has progressively declined since the 1990s, driven by reduced recruitment and growth. Sea lamprey-induced mortality has declined since 2007 and is at a low rate compared to the mid-1990s. Sport harvest decreased 29% from 2013 to 2014 and is about equal to commercial landings. Commercial yield has increased annually since 2010. Commercial yield, effort, and age composition data were unavailable, so the assessment was based on assuming that 2014 commercial fishery data were equal to 2013. Total annual mortality for age 6-11 Lake Trout averaged 19.2% in the last three years and was 19.6% in 2014. The Lake Trout TAC in 2015 decreased by 2% from 2014 due to continued declining trends in abundance and recruitment.

MI-6 (Munising) Shawn Sitar





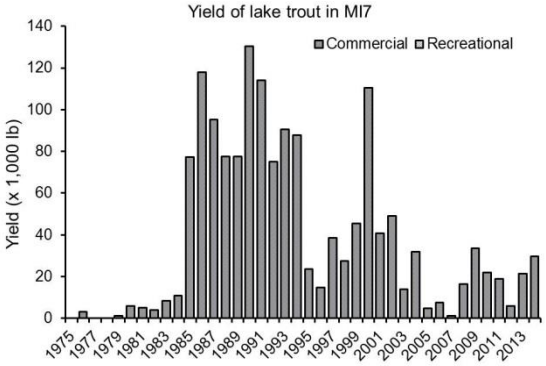


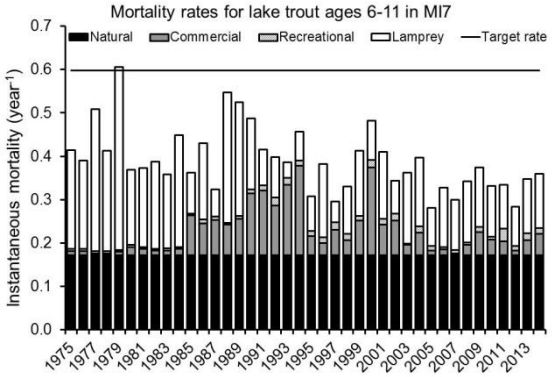
Parameter	Value
Base SSBR	5.39 lb
Current SSBR	1.33 lb
Target SSBR	0.59 lb
Current SPR	0.25
M	0.15 y^{-1}
F, Commercial (2012-2014)	0.03 y^{-1}
F, Recreational (2012-2014)	0.01 y^{-1}
Sea Lamprey Mort (2011-2013)	0.12 y^{-1}
Z (2014)	0.31 y^{-1}
Recommended TAC	167,428 lb
Actual TAC	167,428 lb
Model Rating	Low

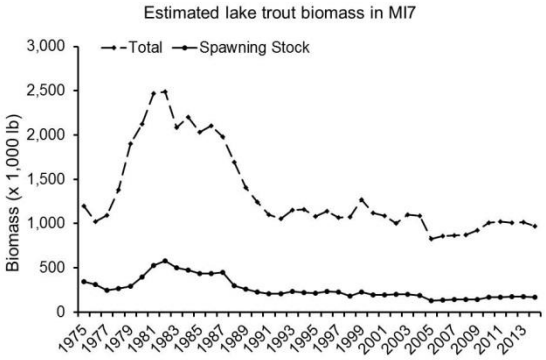
<u>Notable Stock Dynamics and Model Changes:</u>

Abundance of Lake Trout continues to decline due to major declines in recruitment since 2001. However, recruitment has slightly resurged since 2011. Total mortality has not varied substantially in the last 10 years and is mostly driven by sea lamprey predation. Recent commercial landings had been low, however in 2012 and 2013 they increased five-fold to the highest levels since 1980. Total annual mortality for age 6-11 Lake Trout averaged 27% in the last three years and was 26.7% in 2014. The 2015 TAC for MI-6 decreased by 3% from last year due to slightly higher projected mortality and a minor decrease in projected adult abundance. This model retains a low rating due to the assumption regarding survey catchability (MI-5 survey catchability is used as a prior).

MI-7 (Grand Marais) Shawn Sitar



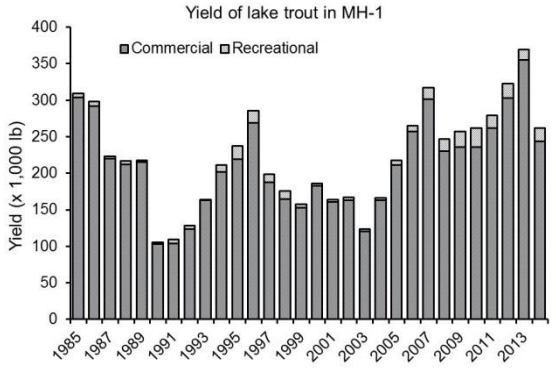


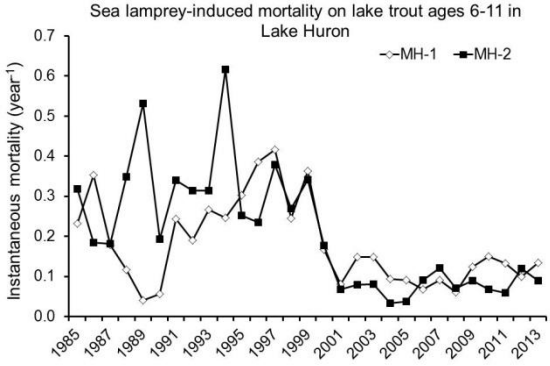


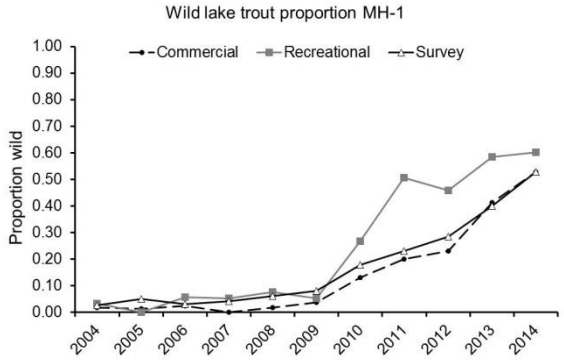
Parameter	Value
Base SSBR	5.92 lb
Current SSBR	1.91 lb
Target SSBR	1.15 lb
Current SPR	0.32
M	0.17 y^{-1}
F, Commercial (2012-2014)	0.03 y^{-1}
F, Recreational (2012-2014)	0.01 y^{-1}
Sea Lamprey Mort (2011-2013)	0.11 y^{-1}
Z (2014)	0.36 y^{-1}
Recommended TAC	91,065 lb
Actual TAC	85,088 lb
Model Rating	Medium

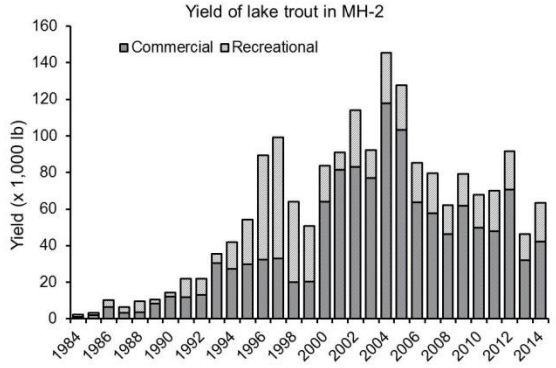
<u>Notable Stock Dynamics and Model Changes:</u>
Based on the model rotation schedule, this model underwent the full assessment process this year. Total Lake Trout abundance has been steady since 2004 and recruitment has been variable but not in decline as in the other management units. Total mortality is low and averaged 28.1% in the last three years (30.2% in 2014). Sea lampreys continue to be the highest mortality source since 2001. Commercial yield has been consistently higher than recreational harvest since 2003. The 2015 TAC for MI-7 increased 22% from 2014 because updated data in the model indicated slightly higher abundance levels.

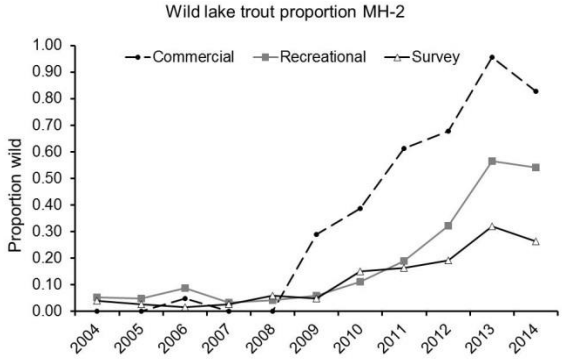
Lake Huron
MH-1 and MH-2 (Northern and North-central Lake Huron) Ji He







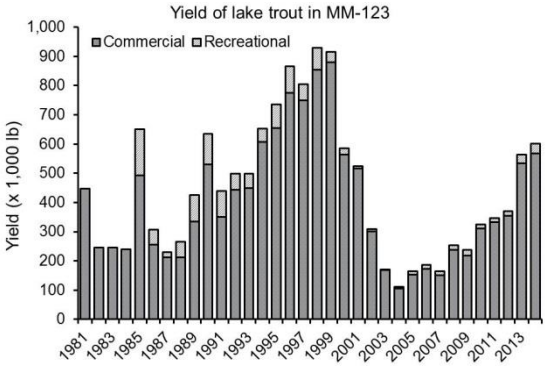


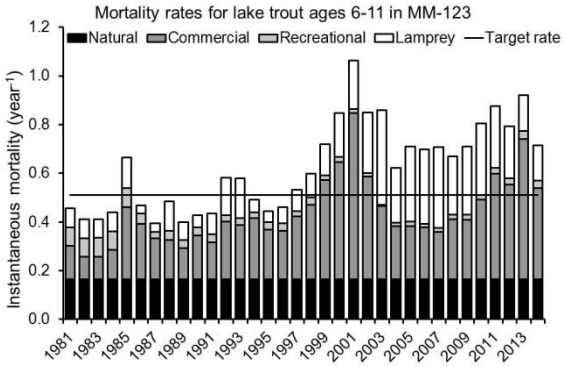


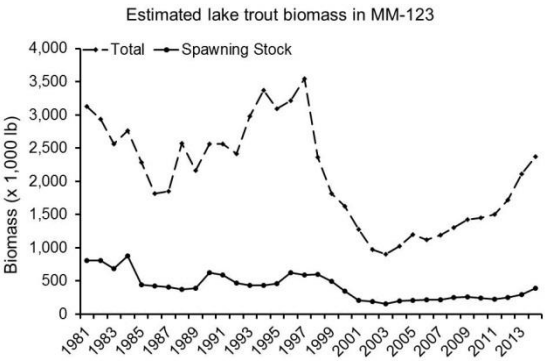
<u>Notable Stock Dynamics and Model Changes:</u>
Continued evidence for strong retrospective patterns in the MH-1 assessment, coupled with widely varying population scaling, led the MSC to assemble a sub-group to review and reconstruct the Lake Huron assessments with the hope of overcoming their most persistent problems. During this review period, the MSC recommended that the TFC and the Parties adopt a 2-year (2015-2016) constant harvest limit for the Lake Huron units based upon a rough average of model-based limits over the most recent five-year period.

Despite the persistent performance issues in the assessments for Lake Huron, the overall status of the population remains positive. Wild fish continue to recruit to fisheries and surveys and now compose more than 50% of the biological samples collected in US waters. Nearly 90% of the fish sampled in the Ontario waters of north-central Lake Huron, where no stocking occurs, were of wild origin. Commercial yield in the north declined in 2014 closer to levels observed during 2008-2011, while recreational yields increased slightly over those observed in 2013. Average sea lamprey mortality rates range between 0.09 and 0.13 yr^{-1}. Recent wild cohorts (2009-2010) appear to be more abundant than those produced during the early 2000s, though our ability to estimate the actual abundance of these cohorts remains limited. This uncertainty will likely continue until sufficient observations are available on recent wild year classes since 2010.

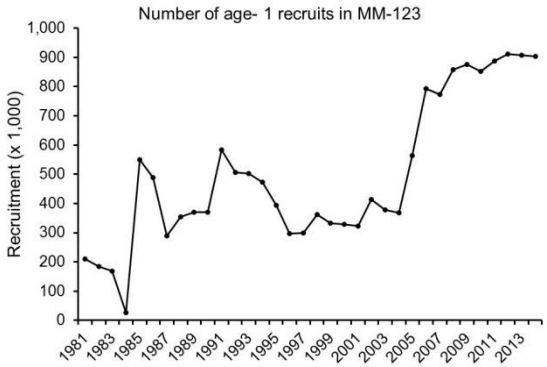
Lake Michigan
MM-123 (Northern Treaty Waters) Jory Jonas







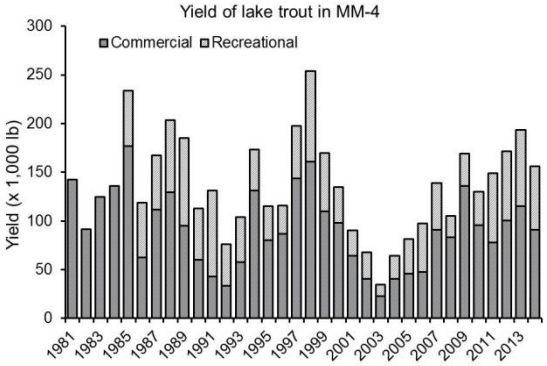
Parameter	Value
Base SSBR	8.45 lb
Current SSBR	0.52 lb
Target SSBR	2.08 lb
Current SPR	0.06
M	0.16 y^{-1}
F, Commercial (2012-2014)	0.45 y^{-1}
F, Recreational (2012-2014)	0.03 y^{-1}
Sea Lamprey Mort (2011-2013)	0.21 y^{-1}
Z (2014)	0.72 y^{-1}
Recommended TAC	44,793 lb
Actual TAC	503,000 lb
Model Rating	Medium

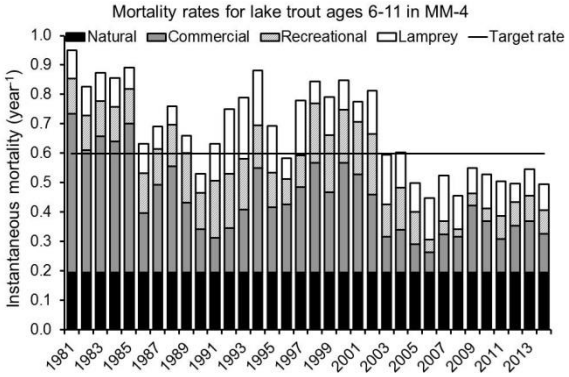


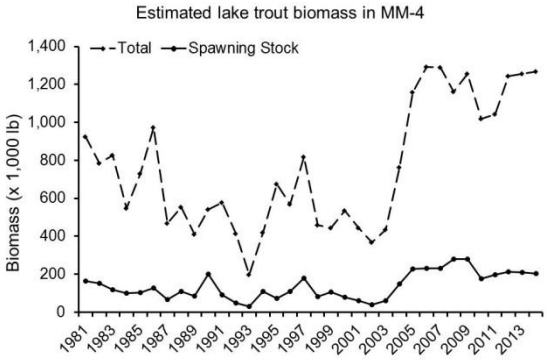
<u>Notable Stock Dynamics and Model Changes:</u>

Sea lamprey mortality has declined from 0.21 y^{-1} to 0.14 y^{-1}, yet commercial fishing mortality remained high at 0.38 y^{-1} in 2014. The most recent two years saw the highest number of Lake Trout killed by lamprey, commercial and recreational fishing combined – an estimated 240,400 and 233,200 fish were killed in 2013 and 2014 respectively. Total annual mortality for Lake Trout ages 6-11 averaged 51% in 2014. The harvest limit in MM-123 is set by stipulation, which allocates 453,000 lb to CORA and 50,000 lb to the State. State fishers are harvesting at levels within their stipulated allocations. Tribal fishery harvest has been above the allowable limit in recent years. The number of stocked fish recruited to this unit has more than doubled since 2004, from 369,000 to 903,000 in 2014.

MM-4 (Grand Traverse Bay) Jory Jonas



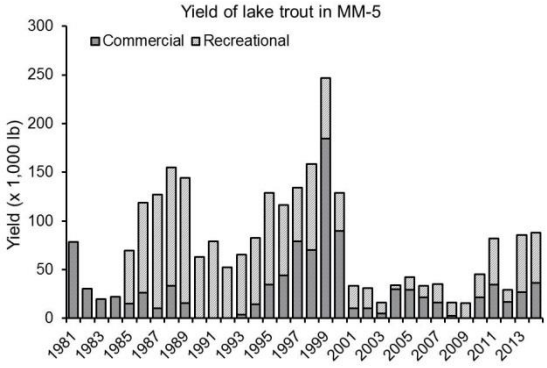


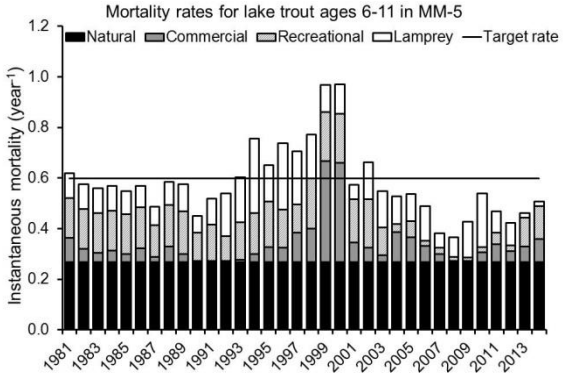


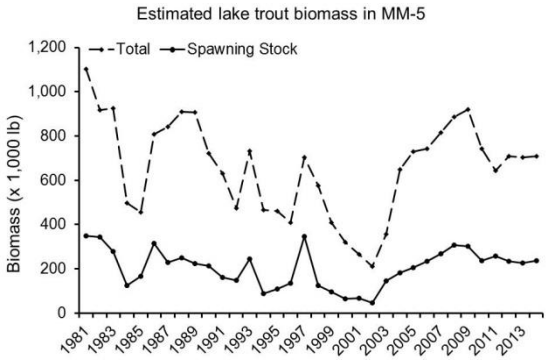
Parameter	Value
Base SSBR	4.32 lb
Current SSBR	0.73 lb
Target SSBR	0.70 lb
Current SPR	0.17
M	0.19 y^{-1}
F, Commercial (2012-2014)	0.15 y^{-1}
F, Recreational (2012-2014)	0.08 y^{-1}
Sea Lamprey Mort (2011-2013)	0.09 y^{-1}
Z (2014)	0.49 y^{-1}
Recommended TAC	189,756 lb
Actual TAC	201,827 lb
Model Rating	Medium

<u>Notable Fishery Dynamics and Model Changes:</u>
The model-based harvest limits for 2015 (85,390 lb State and 104,366 lb CORA) were higher than those estimated for 2014 and were above the minimum limits established by the stipulation. Lamprey mortality rates were up slightly from 2013 (0.06 y^{-1}) at 0.09 y^{-1}. Harvests by recreational and commercial fisheries remained relatively high but were somewhat lower than those observed in 2012 or 2013. Both commercial and recreational fisheries harvested within their allowable limit. The number of stocked fish recruited to the unit was similar to levels observed in 2012 and 2013 at approximately 394,000 fish. Total annual mortality for Lake Trout ages 6-11 averaged 39% in 2014. The stipulation states that any unused portion of the previous year's state allocation is transferred to the tribal fishery for inclusion in the next year's harvest limit. This unused portion was 12,071 lb in 2014.

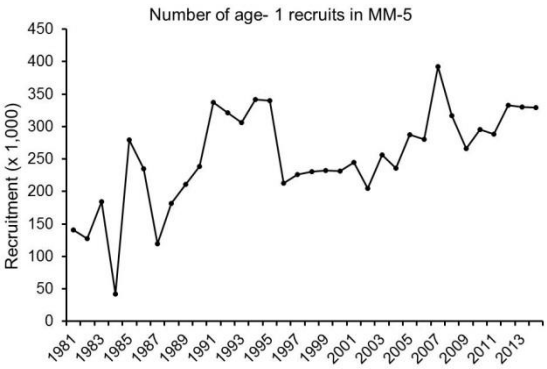
MM-5 (Leelanau Peninsula to Arcadia) Jory Jonas





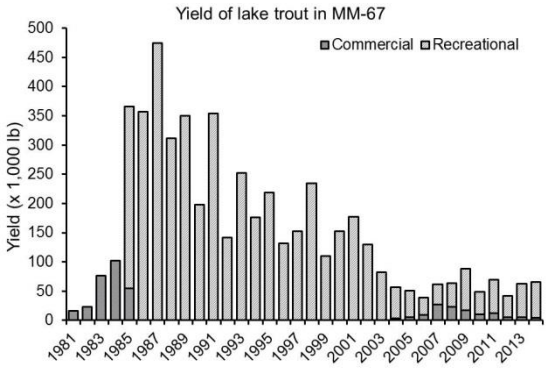


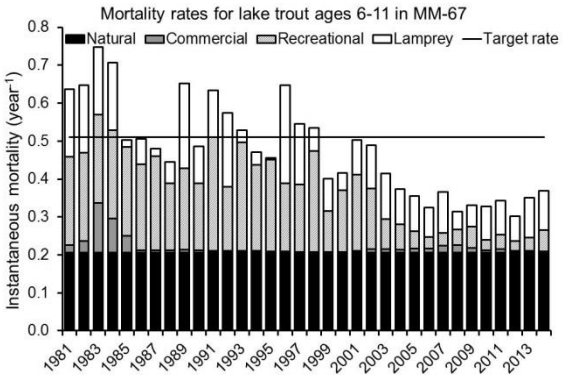
Parameter	Value
Base SSBR	2.18 lb
Current SSBR	0.98 lb
Target SSBR	0.94 lb
Current SPR	0.45
M	0.27 y^{-1}
F, Commercial (2012-2014)	0.06 y^{-1}
F, Recreational (2012-2014)	0.09 y^{-1}
Sea Lamprey Mort (2011-2013)	0.06 y^{-1}
Z (2014)	0.51 y^{-1}
Recommended TAC	80,397 lb
Actual TAC	98,000 lb
Model Rating	Low

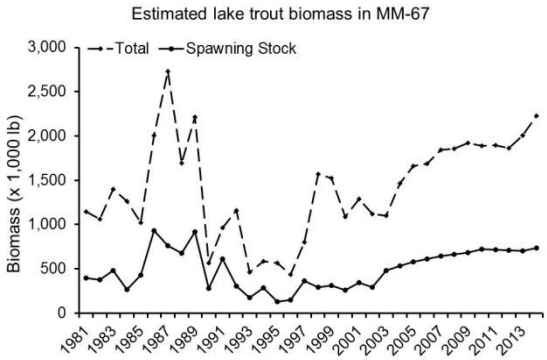


<u>Notable Fishery Dynamics and Model Changes:</u>
The projected harvest limits for 2015 (48,238 lb State and 32,159 lb CORA) were substantially higher than those projected for 2014 yet remained below the stipulated limits (58,800 lb State and 39,200 lb CORA). The average lamprey mortality rate was down substantially from the previous year (0.09 vs. 0.02 y^{-1}). Mortality rates for recreational fisheries in 2013 (0.11 y^{-1}) and 2014 (0.13 y^{-1}) were substantially higher than in 2012 (0.02 y^{-1}). Mortality rates for commercial fisheries were higher than in 2013 (0.09 y^{-1} vs. 0.06 y^{-1}). Total annual mortality for Lake Trout ages 6-11 averaged 40% in 2014. The number of stocked fish recruited to this unit has remained consistent for the past three years at approximately 329,000 fish.

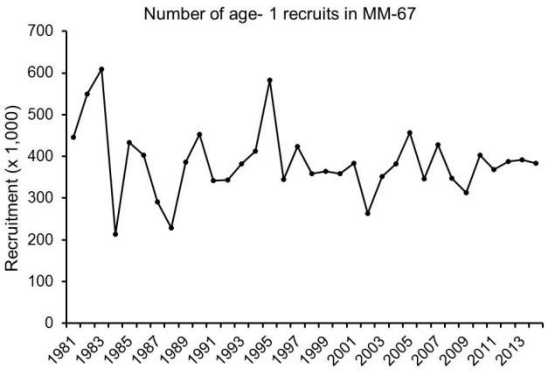
MM-67 (Southern Treaty Waters) Jory Jonas







Parameter	Value
Base SSBR	6.01 lb
Current SSBR	3.00 lb
Target SSBR	1.87 lb
Current SPR	0.49
M	0.21 y^{-1}
F, Commercial (2012-2014)	<0.01 y^{-1}
F, Recreational (2012-2014)	0.04 y^{-1}
Sea Lamprey Mort (2011-2013)	0.09 y^{-1}
Z (2014)	0.34 y^{-1}
Recommended TAC	231,480 lb
Actual TAC	374,869 lb
Model Rating	Low



Notable Fishery Dynamics and Model Changes:

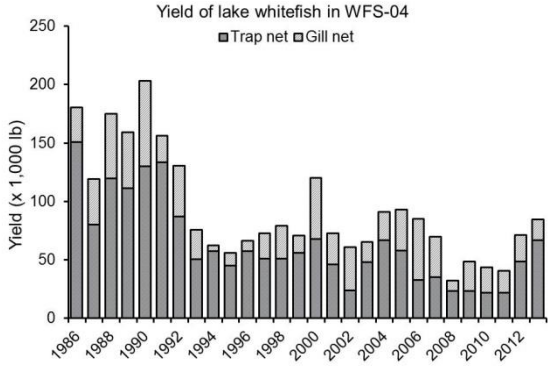
The projected harvest limits for 2015 (208,332 lb State and 23,148 lb CORA) were substantially lower than those established for 2014, the last year of the previous rotation cycle. Lamprey mortality estimates were up slightly from previous years at 0.10 y^{-1} compared to 0.06 y^{-1}. Recreational harvest in 2014 (10,711 fish) increased relative to 2013 (7,196 fish). Commercial harvest was very low at 821 fish. The average annual mortality rate for Lake Trout ages 6-11 in this unit was estimated to be 31% in 2014. The 2015 model, the first full assessment since 2012, continues to receive a low rating due to poor MCMCs and unstable population scaling.

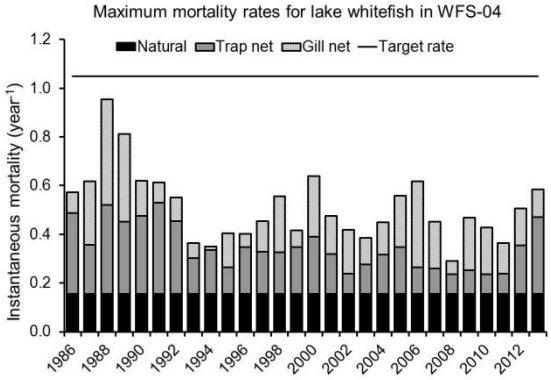
STATUS OF LAKE WHITEFISH POPULATIONS

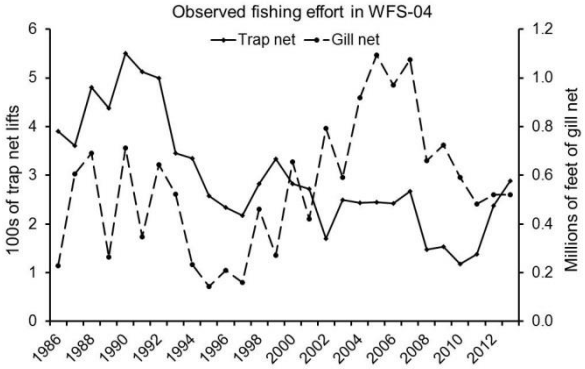
Lake Superior

WFS-04 (Marquette-Big Bay)

Mike Seider

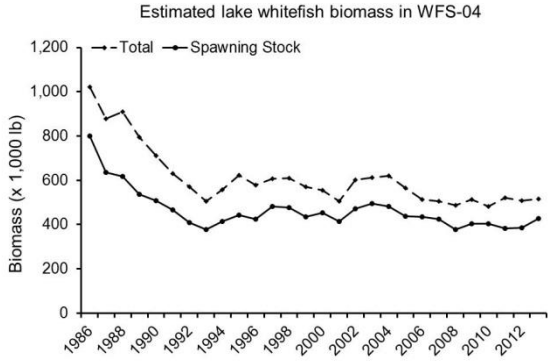


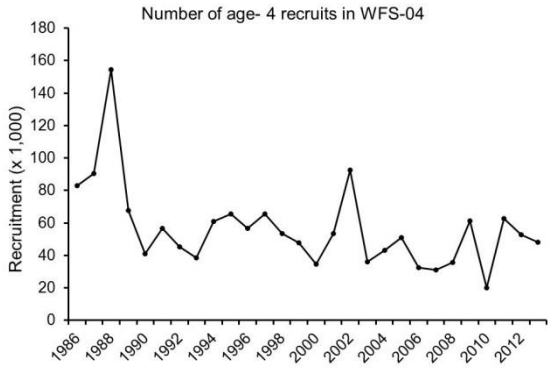




Parameter[(2)]	Value
Base SSBR	9.87 lb
Current SSBR	3.16 lb
Target SSBR	0.26 lb
Current SPR	0.32
M	0.16 y^{-1}
F, trap net (2011-2013)	0.17 y^{-1}
F, gill net (2011-2013)	0.08 y^{-1}
Z (2013)	0.49 y^{-1}
Recommended TAC	107,000 lb
Actual TAC	107,000 lb
Model Rating	Medium

(2) For this and all subsequent tables in this section, mortality rates represent averages for whitefish ages 6-11.

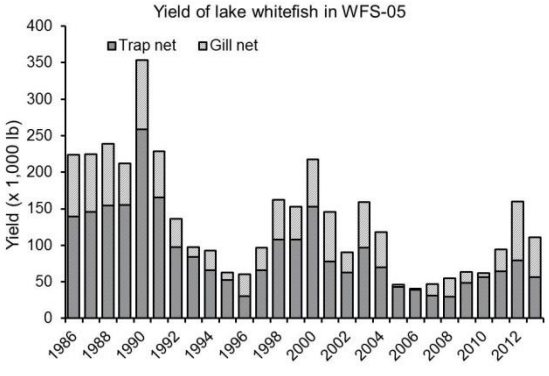


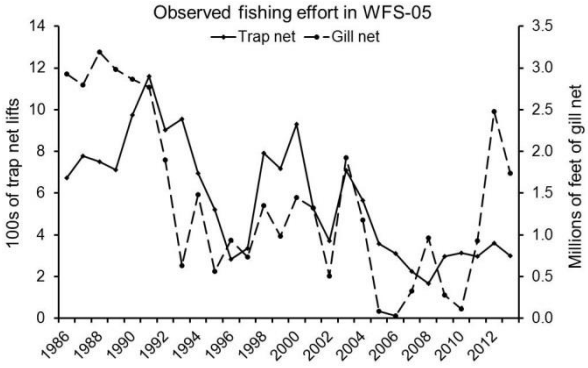


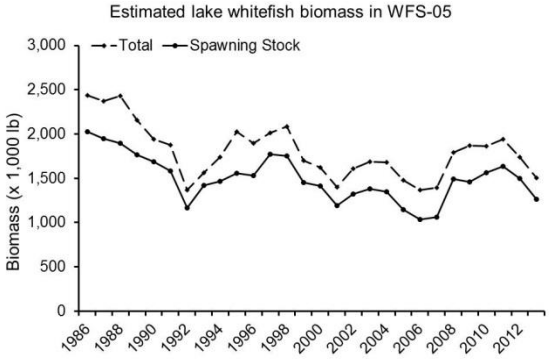
Notable Fishery Dynamics and Model Changes:

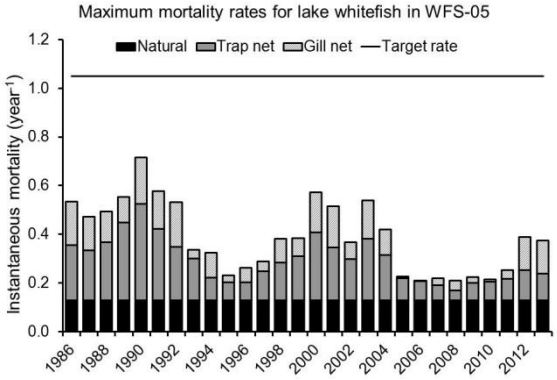
Lake whitefish population dynamics remain generally stable in WFS-04. Biomass has not changed substantially since the mid-2000s, due to relatively consistent recruitment and little change in weight-at-age for most age classes. Total mortality rates were well below the target maximum value throughout the time series. Annual mortality rate for the most vulnerable age class was 44% in 2013. The 2015 yield limit calculated for the entire WFS-04 management unit is 152,000, which is 5% higher than for 2014. After applying the prescribed reduction to reflect the proportion of this management unit that is outside 1836 Waters, the 2015 yield limit for Lake Whitefish in 1836 Treaty Waters is 107,000 lb.

WFS-05 (Munising) Shawn Sitar





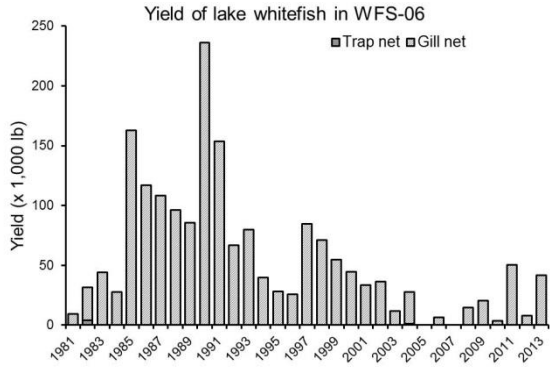


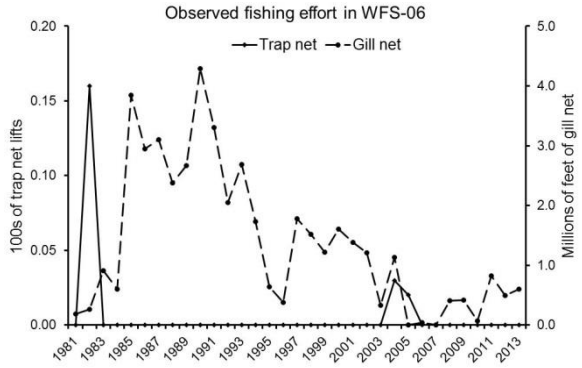


Parameter	Value
Base SSBR	8.80 lb
Current SSBR	4.33 lb
Target SSBR	0.20 lb
Current SPR	0.49
M	0.13 y^{-1}
F, trap net (2011-2013)	0.07 y^{-1}
F, gill net (2011-2013)	0.06 y^{-1}
Z (2013)	0.29 y^{-1}
Recommended TAC	410,000 lb
Actual TAC	410,000 lb
Model Rating	Medium

Notable Fishery Dynamics and Model Changes:
The 2015 Lake Whitefish TAC was 410,000 lb, an increase of 10% from 2014. The increase in TAC was due to higher estimates of recruitment in recent years. There were no key changes to the model from the 2014 assessment. The average total annual mortality rate experienced by ages 4-12 in the stock during 2011-2013 was 29% and the maximum annual rate was 31% in 2013. Trap-net yield has increased since 2008 and gill-net yield increased from 30,100 lb in 2011 to 80,200 lb in 2012. Gill-net yield remained relatively high at 55,000 lb in 2013.

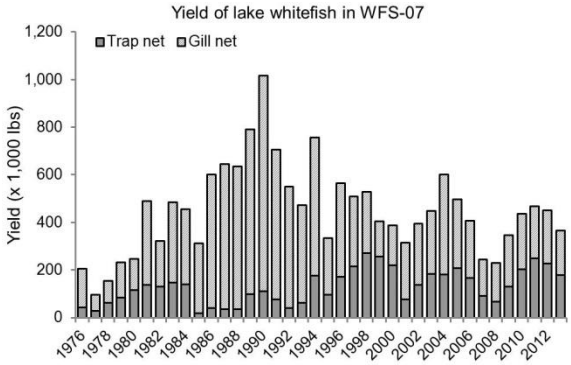
WFS-06 (Grand Marais)

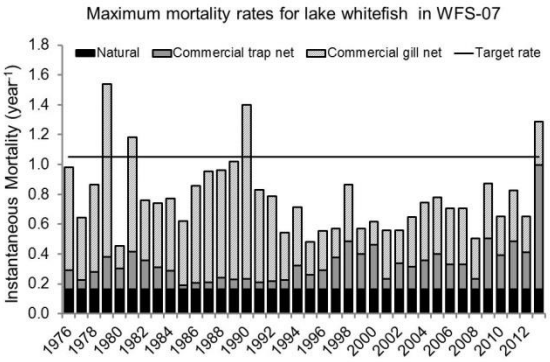


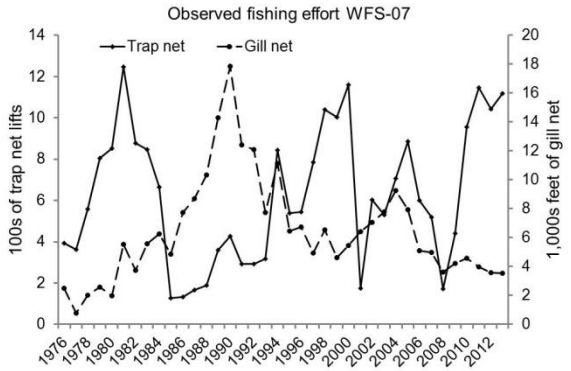


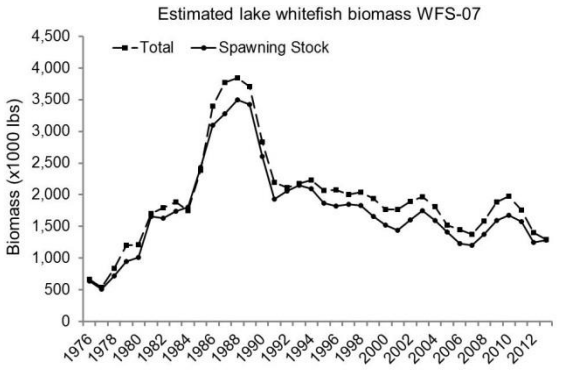
There is no current stock assessment model for WFS-06. Low levels of effort and harvest and a lack of fishery monitoring data since the early 2000s limit the ability to produce an assessment model for this unit.

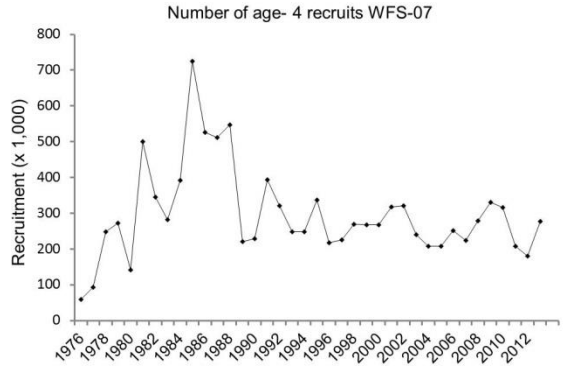
WFS-07 (Tahquamenon Bay) Mark Ebener









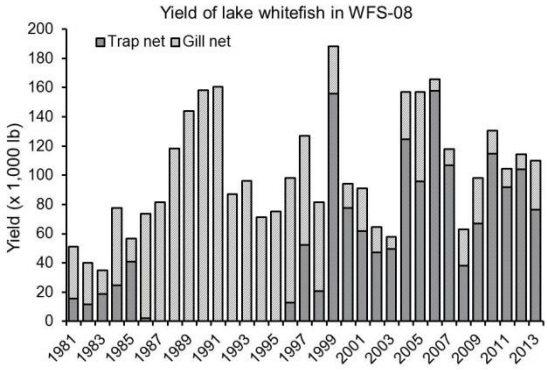


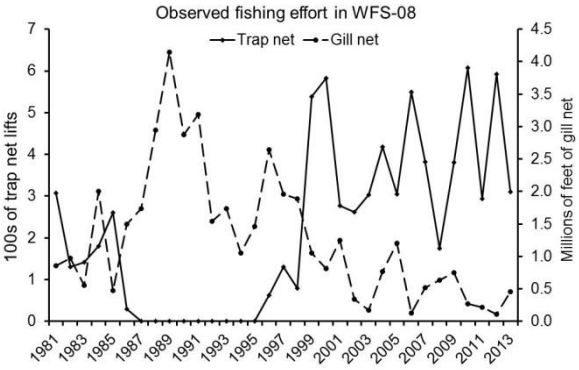
Parameter	Value
Base SSBR	5.72 lb
Current SSBR	1.26 lb
Target SSBR	0.31 lb
Current SPR	0.22
M	0.16 y^{-1}
F, trap net (2011-2013)	0.34 y^{-1}
F, gill net (2011-2013)	0.27 y^{-1}
Z (2013)	0.90 y^{-1}
Recommended TAC	427,300 lb
Actual TAC	427,300 lb
Model Rating	Low

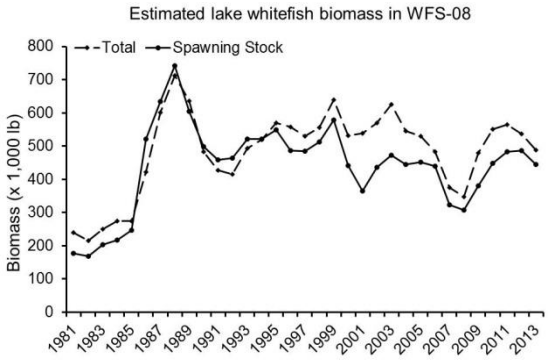
Notable Fishery Dynamics and Model Changes:

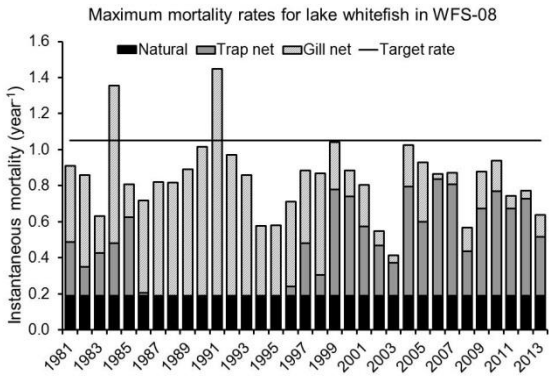
Fishable biomass in WFS-07 continued its two-decade long decline as of 2013. Annual mortality of the most fully vulnerable age class was estimated to be 72% (Z=1.29 y^{-1}) in 2013 and exceeded the target mortality rate primary because trap-net fishing mortality was estimated to be 0.83 y^{-1}, whereas gill-net fishing mortality was estimated to be 0.29 y^{-1}. SSBR in 2013 was estimated to be 0.57 kg, producing a SPR of 0.22. Consequently the projection model estimated that gill-net fishing effort in 2015 could be increased 1.75 times while trap-net effort should be reduced by 18% over that observed during 2011-2013. The resulting TAC was estimated to be 427,300 lb for 2015. The low rating was driven by sensitivity of the estimates to parameter start values, MCMCs that were not quite normal, and retrospective patterns.

WFS-08 (Brimley) Paul Ripple







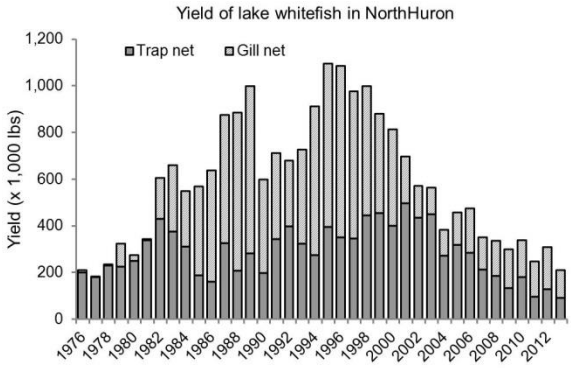


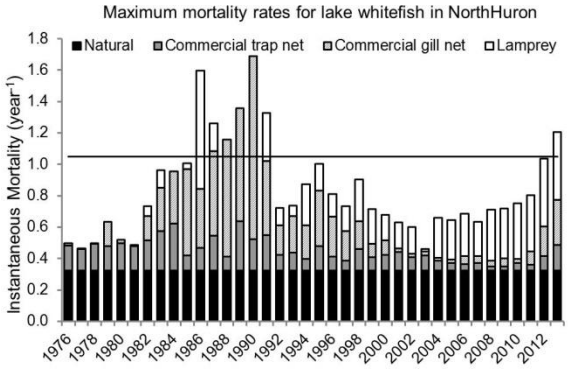
Parameter	Value
Base SSBR	4.03 lb
Current SSBR	1.02 lb
Target SSBR	0.20 lb
Current SPR	0.25
M	0.19 y^{-1}
F, trap net (2011-2013)	0.42 y^{-1}
F, gill net (2011-2013)	0.07 y^{-1}
Z (2013)	0.62 y^{-1}
Recommended TAC	161,100 lb
Actual TAC	161,100 lb
Model Rating	Low

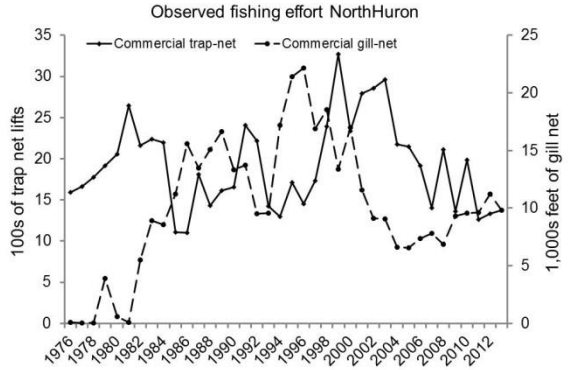
Notable Fishery Dynamics and Model Changes:

The model recommended TAC for 2015 in WFS-08 was 161,100 lb, up from 130,235 lb in 2014. Spawning stock biomass peaked in 1988 (742,721 lb), decreased through 1991, and has varied since then around a 456,000 lb average. Gill-net effort peaked in 1989 and has since steadily decreased. In 2013, 366,000 feet of large-mesh gill-net were fished. Trap-net effort, while variable, has generally increased since 1995. Trap-net effort in 2013 was 310 lifts, about half the peak level of 607 lifts in 2010. While model fit and convergence were satisfactory, poor MCMC results resulted in a low model rating.

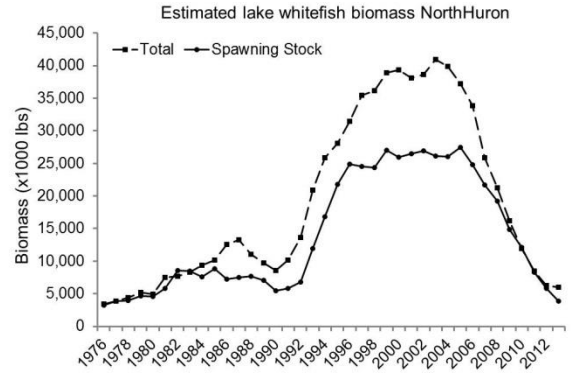
Lake Huron
Northern Huron (WFH-01 to WFH-04) Mark Ebener







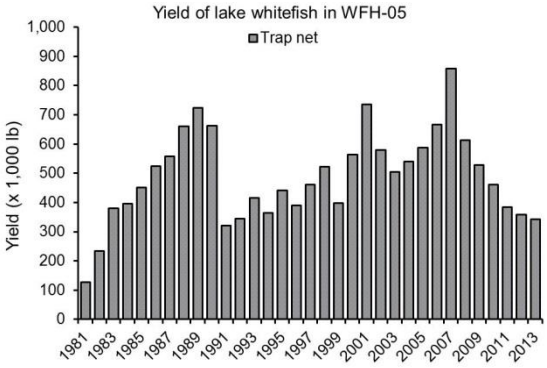
Parameter	Value
Base SSBR	1.55 lb
Current SSBR	0.55 lb
Target SSBR	0.26 lb
Current SPR	0.36
M	0.33 y^{-1}
F, trap net (2011-2013)	0.07 y^{-1}
F, gill net (2011-2013)	0.10 y^{-1}
Z (2013)	0.87 y^{-1}
Recommended TAC	379,900 lb
Actual TAC	379,900 lb
Model Rating	Medium

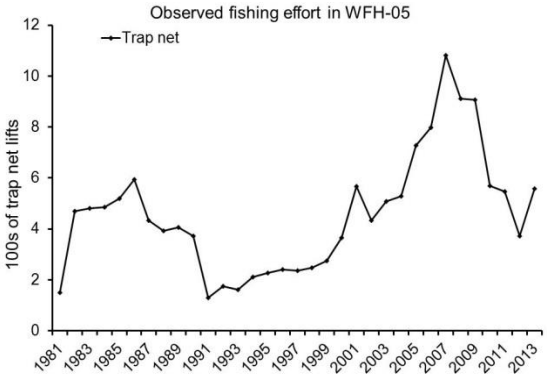


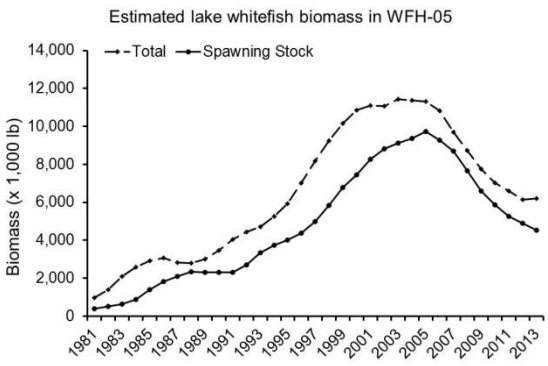
<u>Notable Fishery Dynamics and Model Changes:</u>

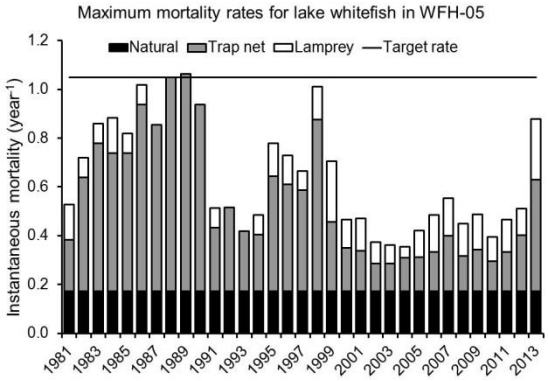
Fishable biomass of age-4 and older whitefish in 2013 was estimated to be only 6 million lb, the lowest value since 1981. Only during 1976-1980 was biomass lower in northern Lake Huron. The decline in biomass was due to huge declines in recruitment and increased sea lamprey predation since 2004. Total mortality on the most fully vulnerable age class was estimated to be 70% (Z=1.20 y^{-1}) in 2013, with slightly over one-third of this mortality being due to sea lampreys (Ml=0.43 y^{-1}). Fishing mortality was estimated to be 0.29 y^{-1} from gill nets and 0.16 y^{-1} from trap nets. SSBR was estimated to be 0.25, producing a SPR value of 0.36 in 2013. Consequently the projection model estimated that fishing effort could be increased 1.04 times in 2015 above average levels estimated during 2011-2013, producing a TAC of 379,900 lb.

WFH-05 (Alpena) Stephen Lenart







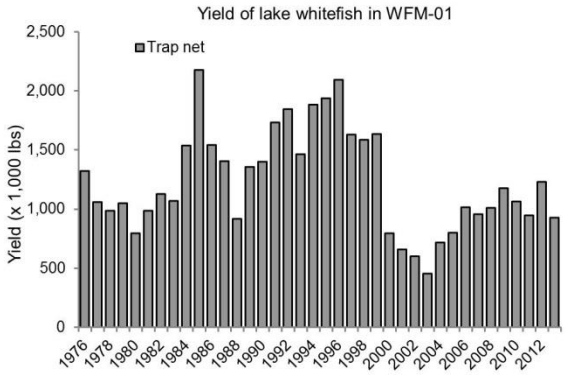


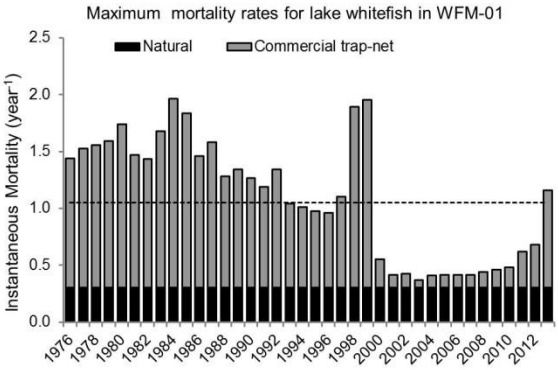
Parameter	Value
Base SSBR	4.62 lb
Current SSBR	1.57 lb
Target SSBR	0.15 lb
Current SPR	0.34
M	0.17 y^{-1}
F, trap net (2011-2013)	0.09 y^{-1}
Z (2013)	0.48 y^{-1}
Recommended TAC	431,000 lb
Actual TAC	431,000 lb
Model Rating	Medium

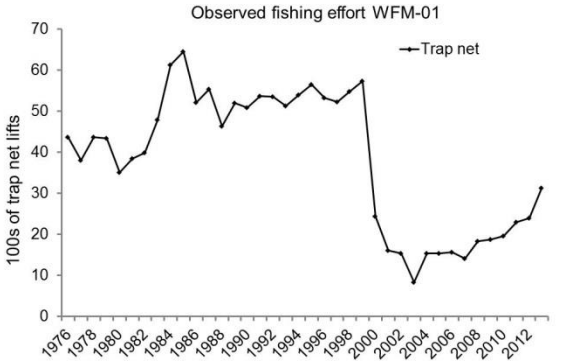
Notable Fishery Dynamics and Model Changes:

Spawning biomass continues to decline in WFH-05 in response to declining recruitment. Average annual mortality was 47% for ages 4+ during 2013, though the maximum annual rate was 58%. Sea-lamprey induced mortality continues to be high on older age classes, with annual rates averaging 14% on fish ages 6-15 during 2011-2013 and a maximum rate of 22% in 2013. The methodology used to estimate sea-lamprey induced mortality on whitefish is now equivalent to that for Lake Trout, a change that was implemented for the 2015 assessment. The 2015 model-generated TAC of 431,000 lb represents a 41% decline from the 2014 limit, primarily due to higher projections of both sea-lamprey and fishing mortality. Continued retrospective patterns are likely linked to major expansion of age classes in TN fishery age composition data-there was no signal for these older fish in prior years.

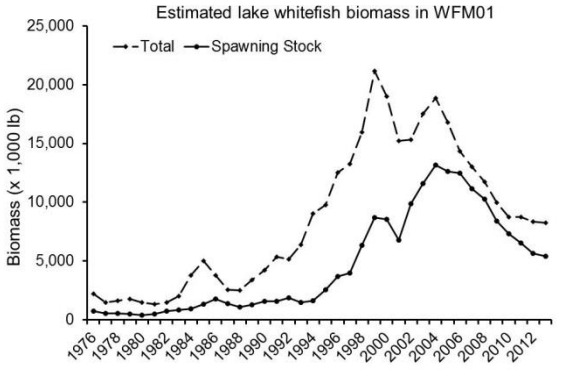
Lake Michigan
WFM-01 (Bays De Noc) Mark Ebener







Parameter	Value
Base SSBR	1.44 lb
Current SSBR	0.85 lb
Target SSBR	0.18 lb
Current SPR	0.59
M	0.31 y^{-1}
F, trap net (2011-2013)	0.26 y^{-1}
Z (2013)	0.48 y^{-1}
Recommended TAC	1,445,800 lb
Actual TAC	1,445,800 lb
Model Rating	Low

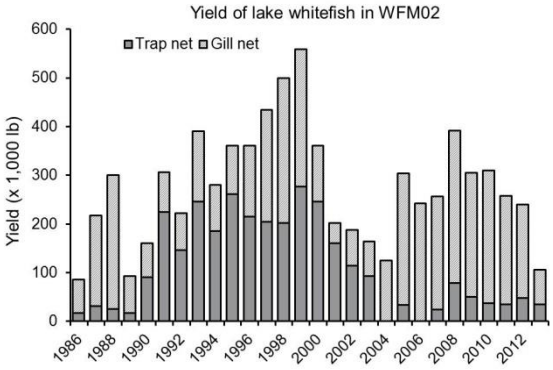


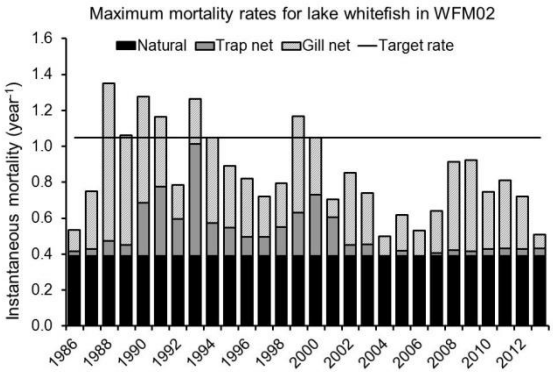
Notable Fishery Dynamics and Model Changes:

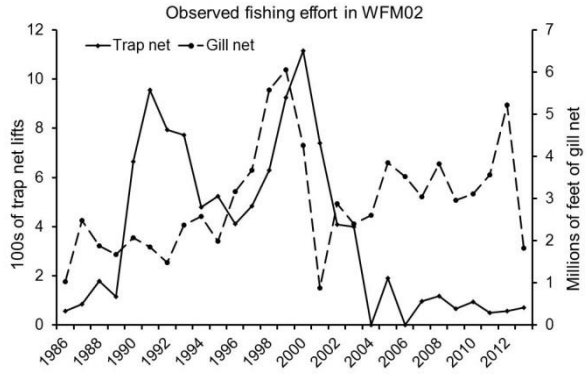
The structure of the WFM-01 stock assessment was modified after providing the preliminary harvest limit in October. The age composition of the assessment was expanded from age 12+ to age 20+ and the plus age group was allowed to change annually by adding a vector that designated the oldest age group in the commercial harvest for each year. Expanding the age structure and creating a flexible plus group helped stabilize the WFM-01 stock assessment. The WFM-01 stock assessment model appeared to have several distinct outcomes depending on the variance ratio structure - two of which were examined for detailed diagnostics. These two versions met minimum convergence criteria, though they differed in which diagnostic criterion was problematic. The first version estimated a maximum instantaneous fishing mortality rate of 0.86 y^{-1} and maximum instantaneous total

mortality of 1.160 y^{-1} in 2013. This version produced a harvest limit of 815,900 lb. The second version estimated a maximum instantaneous fishing mortality rate of 0.41 y^{-1}, with maximum instantaneous total mortality of 0.71 y^{-1}, and a harvest limit of 1,445,800 lb. Estimated biomass for 2013 was actually higher in the first version (8.3 versus 7.7 million lb) but the projection of higher fishing mortality resulted in a lower estimated harvest limit.

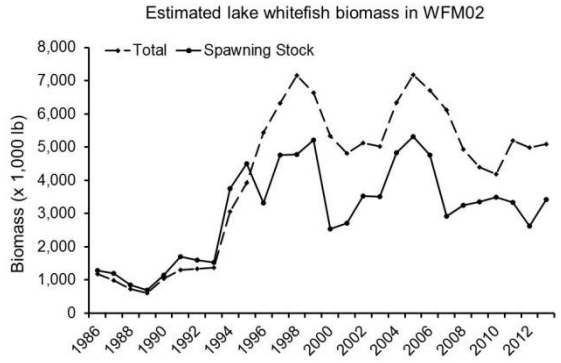
WFM-02 (Manistique) Ted Treska







Parameter	Value
Base SSBR	0.96 lb
Current SSBR	0.79 lb
Target SSBR	0.15 lb
Current SPR	0.82
M	0.39 y^{-1}
F, trap net (2011-2013)	0.03 y^{-1}
F, gill net (2011-2013)	0.12 y^{-1}
Z (2013)	0.46 y^{-1}
Recommended TAC	465,500 lb
Actual TAC	465,500 lb
Model Rating	Low

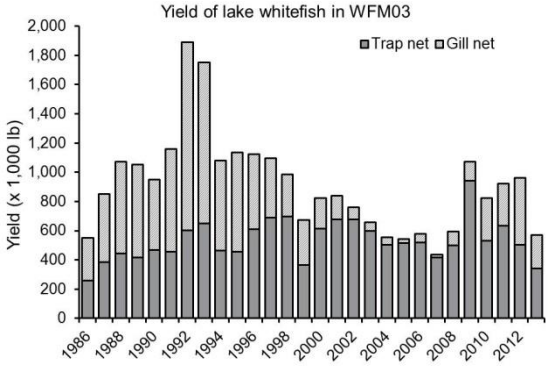


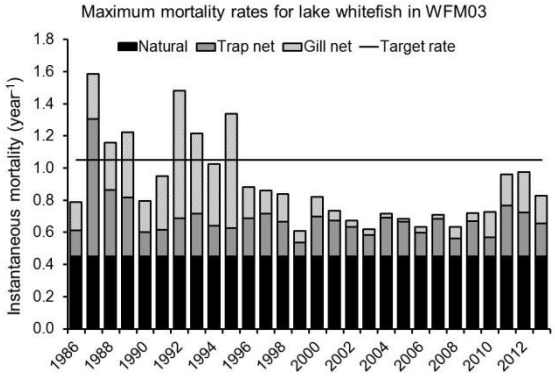
<u>Notable Fishery Dynamics and Model Changes:</u>

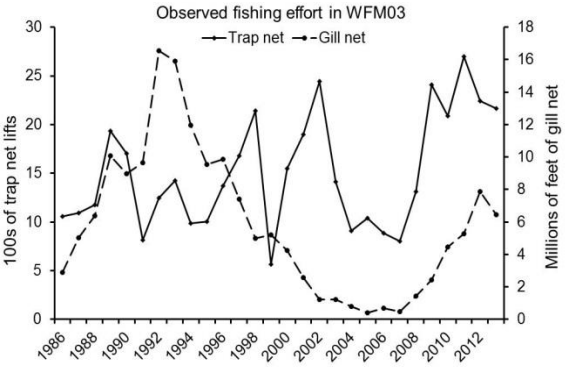
Changes to the model for this year included incorporating random walk into the gillnet selectivity and adjustments to the structure of the random walk for catchability, a slight change in reference lengths and the incorporation of length and weight values from a time-varying growth model. While biomass has been fairly constant over the last decade, harvest in 2013 was less than half of what it was in 2012 and was nearly the lowest in the last 25 years, with the bulk of the harvest coming from the gill-net fishery. The CPE for the trap-net fishery dropped dramatically (almost 50%) in the past year, while gill-net CPE remained essentially the same. Recruitment, which had dropped significantly from 2011 to 2012, is estimated to have picked up in 2013 to levels similar to the last decade. The maximum annual mortality rate of 40% was experienced by the oldest age classes in 2013, with total mortality markedly

lower on those ages than in the last 5 years. Agreement in proportions at age in the modeled and observed catch are fairly good, though there are a number of years for both gears for which there are no monitoring data, leading to skepticism in the model's ability to accurately portray what is happening in the fishery in those years. This model continues to be ranked Low due to concerns over diagnostics, including retrospective patterns, and the lack of monitoring data in past years.

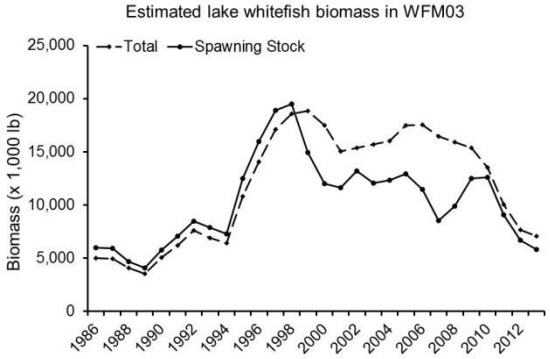
WFM-03 (Naubinway) Ted Treska







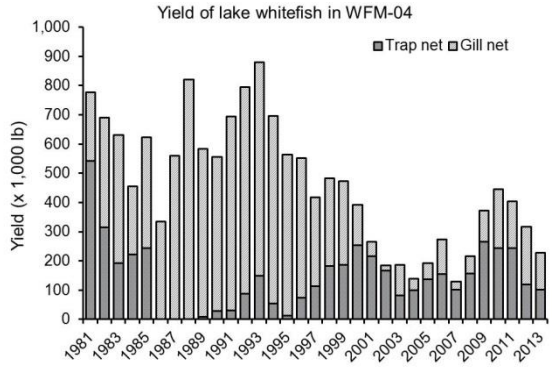
Parameter	Value
Base SSBR	1.20 lb
Current SSBR	0.90 lb
Target SSBR	0.19 lb
Current SPR	0.75
M	0.45 y^{-1}
F, trap net (2011-2013)	0.15 y^{-1}
F, gill net (2011-2013)	0.09 y^{-1}
Z (2013)	0.68 y^{-1}
Recommended TAC	622,700 lb
Actual TAC	780,800 lb
Model Rating	Low

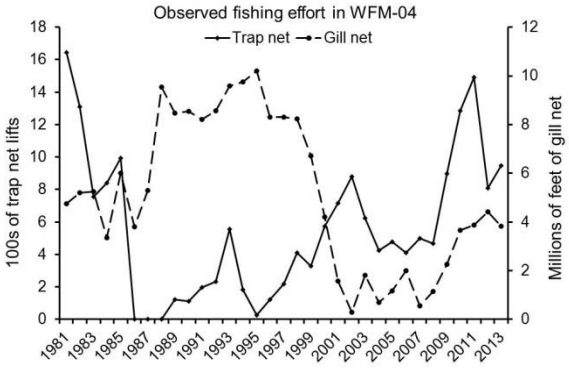


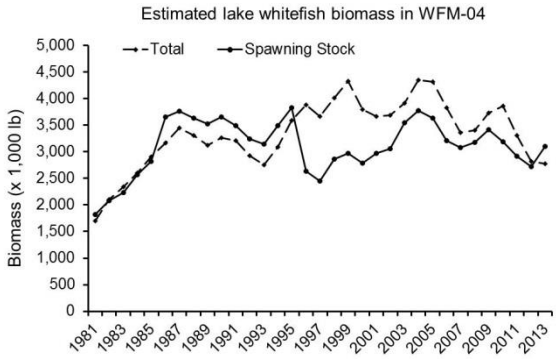
<u>Notable Fishery Dynamics and Model Changes:</u>
The 36% decrease in the harvest limit to 622,700 lb is likely a result of declines in recruitment and changes made to the model structure. Trends, however, are similar to those estimated in the 2014 assessment. Changes to the model for this year included incorporating a random walk into the gill-net selectivity and adjustments to the structure of the random walk for catchability, a slight change in reference lengths, and the incorporation of length and weight values from a time-varying growth model. While the model indicates a sharp decline in recruitment from an overall high in 2005 to 2011, the model is predicting increases in both 2012 and 2013. The maximum annual mortality rate of 56% (Z=0.83) was experienced by the age 14 and older fish in 2013. Natural mortality is estimated to be relatively high (0.45 yr^{-1}) in this unit. Fishery catch rates continue to slide downward and are now at the lowest point in the time series. Effort for both fisheries declined, with a larger decline

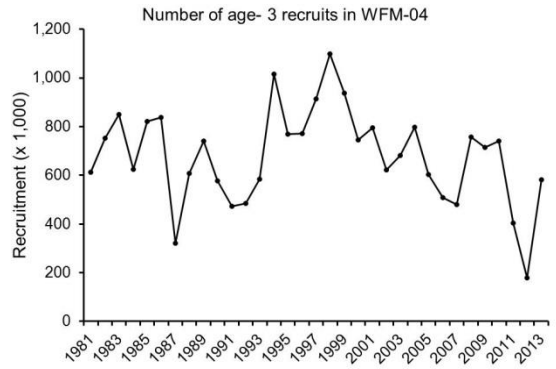
of 1.4 million feet seen in the gill-net fishery, whereas the trap net effort dropped less than 100 lifts. Overall weight at age seems to be increasing for most age classes, but the youngest ages have seen a reduction in average weight from 1.2 to 0.66 lb in the last 2 years. Issues with covariance persist from the previous year, but could not be remedied and there are some concerns with the retrospective patterns observed, leading to a low rating for this assessment.

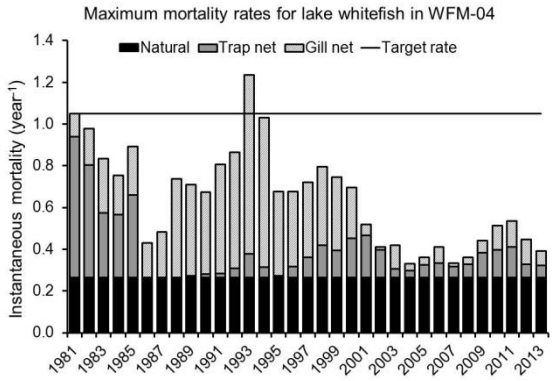
WFM-04 (Beaver Island) Kevin Donner











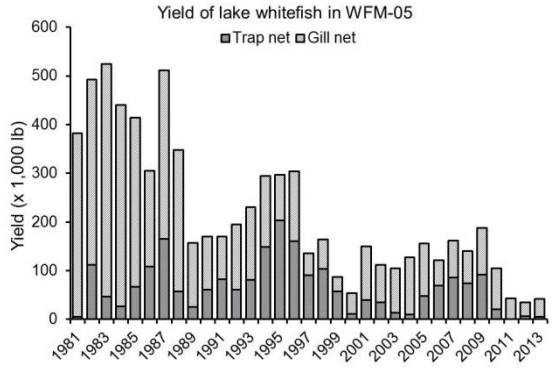
Parameter	Value
Base SSBR	3.16 lb
Current SSBR	1.84 lb
Target SSBR	0.28 lb
Current SPR	0.58
M	0.26 y^{-1}
F, trap net (2011-2013)	0.09 y^{-1}
F, gill net (2011-2013)	0.08 y^{-1}
Z (2013)	0.37 y^{-1}
Recommended TAC	920,000 lb
Actual TAC	548,000 lb
Model Rating	Medium

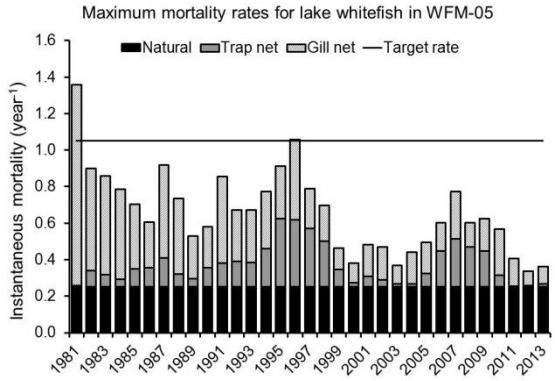
Notable Fishery Dynamics and Model Changes:

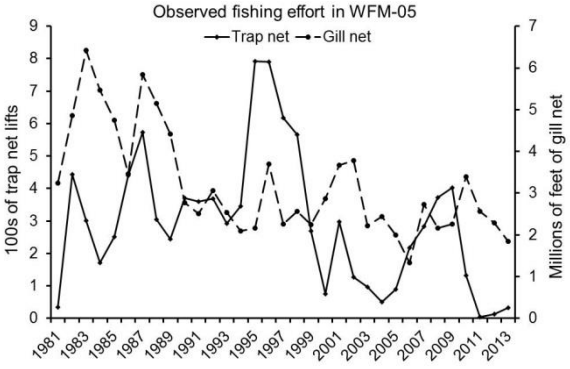
The 2015 model-generated harvest limit is 68% higher than the 2014 model limit, an increase mostly attributable to changes to the model structure. In the most recent version of the model, selectivity is normalized by reference length, which varies through time with adjustments to one parameter of the selectivity function. In addition, the age composition was expanded to age 16+ from age 11+. The age structure of whitefish in the unit appears to be expanding and, until 2014, the "plus group" regularly comprised 8-15% of whitefish examined during commercial sampling. In general, population trends reported by the 2014 model are similar to those observed in previous years. Biomass appears to be declining over the past decade but is no longer estimated to be the lowest observed in the times-series. Total annual mortality rates during 2013 were estimated to average 35% (max 39%) for the

fully-selected age classes. Yield declined in 2013, apparently driven by a decrease in estimates of catchability. Lake Trout catch-per-effort in this unit is near historic highs and may be a factor in this trend. Gill-net effort has increased substantially since 2007 and, during 2013, gill-net yield exceeded trap-net yield for the second time in two years and only the third time since 2000. Catch-per-effort in the trap-net and gill-net fisheries has declined substantially since the mid-90s and 80s, respectively, and both are near historic lows.

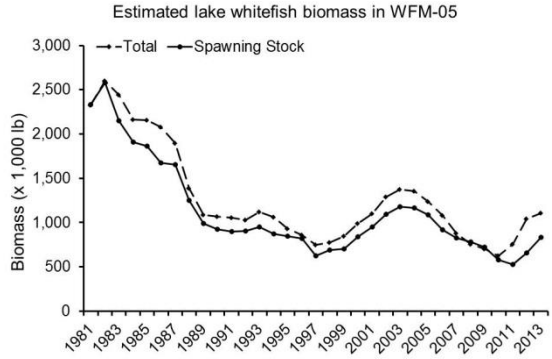
WFM-05 (Grand Traverse Bay) Steve Lenart

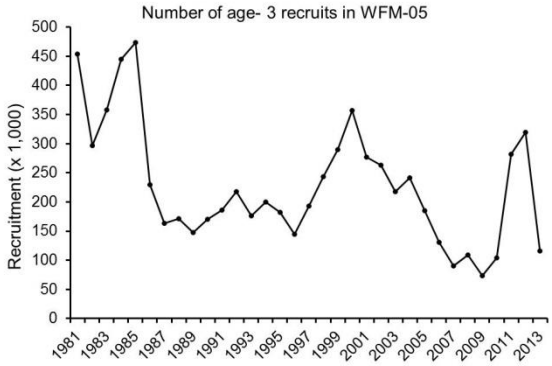






Parameter	Value
Base SSBR	2.96 lb
Current SSBR	2.09 lb
Target SSBR	0.26 lb
Current SPR	0.70
M	0.25 y^{-1}
F, trap net (2011-2013)	0.01 y^{-1}
F, gill net (2011-2013)	0.09 y^{-1}
Z (2013)	0.35 y^{-1}
Recommended TAC	427,000 lb
Actual TAC	365,000 lb
Model Rating	Medium

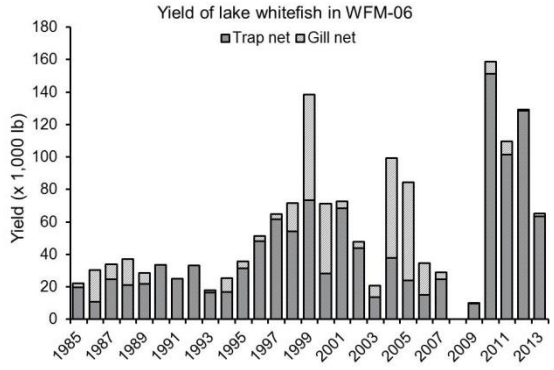


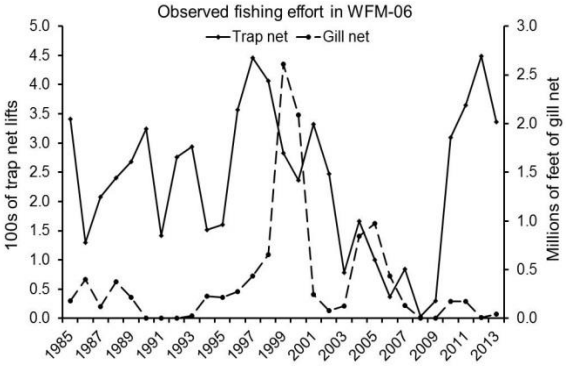


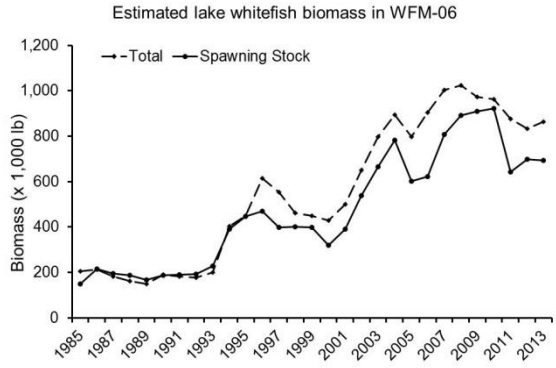
<u>Notable Fishery Dynamics and Model Changes:</u>

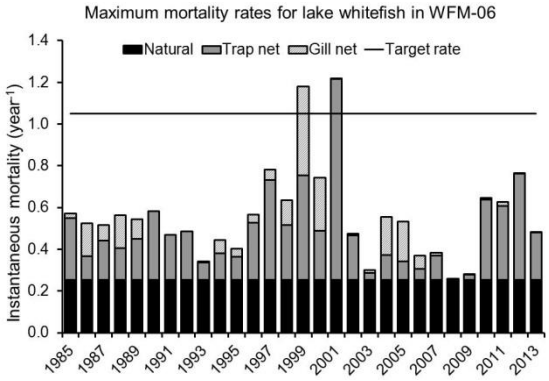
Recent increases in growth and abundance have contributed to an increasing trend in estimated biomass in WFM-05 since 2010. Although the trend is increasing, the overall scale of population abundance is lower than in last year's assessment, thus the model-generated limit in this unit declined by 13% to 427,000 lb. This reduced scale is linked to a significant reduction in recruitment estimates for the 2008-2009 cohorts, which, as pointed out last year, were thought to be highly inflated. Fishing effort remained low in WFM-05 for the third consecutive year and the average annual mortality rate was 28% in 2013 (the maximum rate was just above 30%). No substantive changes were made to model structure.

WFM-06 (Leland) Dave Caroffino







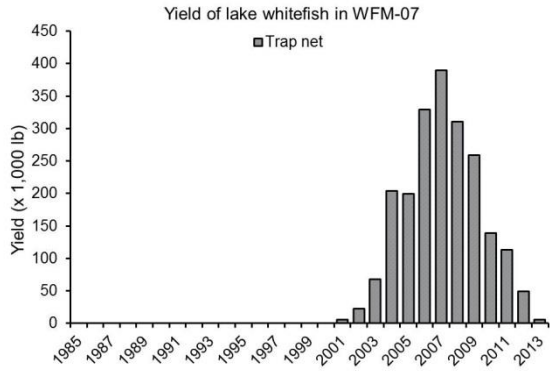


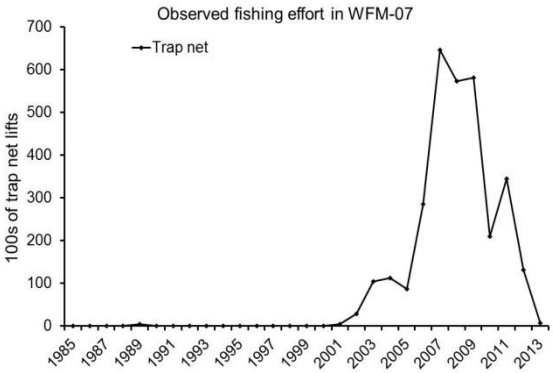
Parameter	Value
Base SSBR	4.23 lb
Current SSBR	2.10 lb
Target SSBR	0.46 lb
Current SPR	0.50
M	0.25 y^{-1}
F, trap net (2011-2013)	0.30 y^{-1}
F, gill net (2011-2013)	0.01 y^{-1}
Z (2013)	0.47 y^{-1}
Recommended TAC	250,000 lb
Actual TAC	250,000 lb
Model Rating	Medium

Notable Fishery Dynamics and Model Changes:

The model-generated harvest limit for WFM-06 declined by 26% from 2014. The additional year of data muted the record recruitment estimates from last year's model, and CPUE declined by roughly one third. The only structural change made to the model was the use of a different growth model for length-at-age estimation. Biomass estimates remained above the long-term average and annual mortality is well below target at 38%. A constant harvest limit of 250,000 lb was established for this unit beginning in 2010, when model performance was so poor that it could not produce a reliable harvest limit. Since then this model has substantially improved; however, the unit has been included in a Conditional Constant Catch Policy that also covers WFM-08. Despite lower CPUE and yield in 2013 compared to 2010-2012, the fishery does not appear to be limiting the population, and therefore, the constant harvest limit of 250,000 lb is recommended.

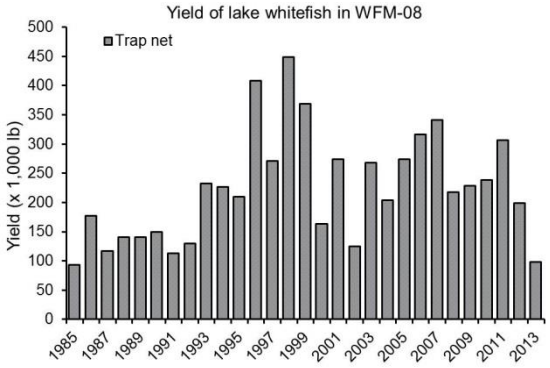
WFM-07 (Manistee to Pentwater)

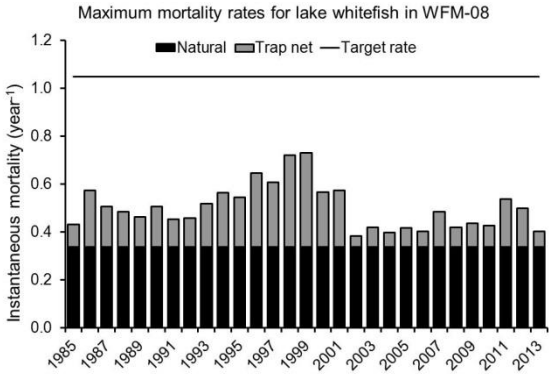


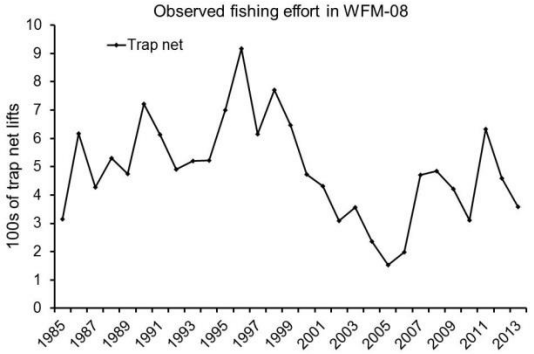


No stock assessment model has been developed for WFM-07. When the Consent Decree was initially signed, this unit lacked the necessary time series of data to populate a model. This time series continues to build as the fishery is executed under the terms of the Consent Decree and biological data continues to be collected from this whitefish stock.

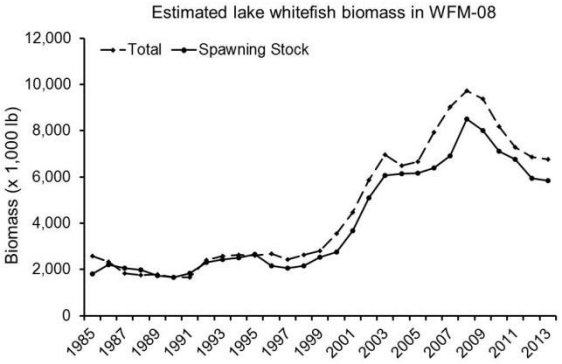
WFM-08 (Muskegon) Dave Caroffino







Parameter	Value
Base SSBR	2.26 lb
Current SSBR	2.00 lb
Target SSBR	0.40 lb
Current SPR	0.88
M	0.34 y^{-1}
F, trap net (2011-2013)	0.06 y^{-1}
Z (2013)	0.37 y^{-1}
Recommended TAC	1,400,000 lb
Actual TAC	1,400,000 lb
Model Rating	Low



Notable Fishery Dynamics and Model Changes:

Despite producing acceptable diagnostics, this model continues to be sensitive to changes in the ratios used to estimate the variance of model components. Fishing in 2013 was poor in many areas and WFM-08 was no exception. Both yield and CPUE were near historic lows. For these reasons, the model-based harvest limit for 2015 declined 49% from last year. The only structural change made to the model was the use of a different growth model for length at age estimation. This year's version of the model estimates that biomass has declined 30% from its 2008 peak. Recruitment of age-3 fish peaked in 2006 and has since declined and remains near the long-term average. Mortality in this unit is low and the maximum rate is estimated to be 33%. Despite low yield and catch rates, this stock is not limited by fishing mortality and the constant catch level of 1,400,000 lb is recommended.