Technical Fisheries Committee Administrative Report 2014: 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 2014

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

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EXECUTIVE SUMMARY

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This document outlines the status of lake trout and lake whitefish stocks 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 without losing focus on the primary purposes of the report, which are 1) to briefly 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. We expect to retain this format in all subsequent annual reports.

Model-generated yield limits and actual yield and effort limits for 2014 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 and thus may differ from the model-generated limits.

Table 1. Yield and effort limits for 2014.

Species	Lake	Management unit	Model-generated yield limit (lb)	Actual yield limit (lb)	Gill net limit (ft)
Lake trout	Superior	MI-5	145,304	145,304	NA
		MI-6	172,412	172,412	3,564,000
		MI-7	91,065	85,088	2,916,000
	Huron	MH-1	204,000	400,775	10,567,000
		MH-2	143,800	143,800	NA
	Michigan	MM-123	0	503,000	12,954,000
		MM-4	145,183	171,500	842,000
		MM-5	57,225	98,000	139,000
		MM-67	441,022	441,022	NA
Lake whitefish	Superior	WFS-04	102,000	102,000	NA
		WFS-05	372,000	372,000	NA
		WFS-06	No model estimate	210,000	NA
		WFS-07	539,000	539,000	NA
		WFS-08	130,000	130,000	NA
	Huron	Northern Huron	735,000	437,157	NA
		WFH-05	727,000	634,300	NA
	Michigan	WFM-01	1,354,000	2,000,000	NA
		WFM-02	559,000	559,000	NA
		WFM-03	976,000	976,000	NA
		WFM-04	548,000	548,000	NA
		WFM-05	492,000	365,000	NA
		WFM-06	273,000	250,000	NA
		WFM-07	No model estimate	500,000	NA
		WFM-08	1,576,000	1,400,000	NA

Lake Trout

In 2014, the MSC continued the lake trout model rotation strategy first implemented in 2009. Full stock assessments were not completed for lake trout units MI-7 and MM-67. Instead, output from the 2012 assessment was used, along with current harvest and sea lamprey mortality information, to project the population forward an additional year. The mortality provisions of the Consent Decree were then applied to the projected populations to calculate harvest limits for 2014. Full stock assessments for these units are next scheduled for 2015. For the first time since the rotation strategy was implemented, one of the predetermined rotation "triggers" was met – i.e a condition that requires the MSC to conduct a full assessment for a unit that would otherwise have remained in rotation. Specifically, the doubling of sea lamprey-induced mortality (from the prior year's average for fish ages 6-11) in unit MH-2 required a full assessment to be conducted for the 2014 fishing season.

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. Aside from natural mortality, sea lamprey-induced mortality (SLIM) represents the greatest individual source of mortality in all modeled Superior units and current average SLIM estimates (ages 6-11) range between 0.05 to 0.10 y^{-1}. Estimated SLIM rates tend to be higher for fish greater than age 11, ranging between 0.10 to 0.19 y^{-1} .

Commercial mortality in Lake Superior remains low (generally below 0.05 y^{-1}), though, as in 2012, commercial yield from unit MI-6 in 2013 (28,120 lb) was considerably higher than the long-term average for the modeled time series. Whether the fishery continues to operate at this level remains uncertain. The recreational fishery has operated at a fairly consistent level in the western units (MI-5 and MI-6), while recreational harvest has been more variable in unit MI-7. Current recreational fishery mortality rates are below 0.03 y^{-1} in all management units.

Mortality and harvest of lean lake trout remain below targets throughout Lake Superior, thus our projections suggest yield could be increased in all modeled Lake Superior management unit in 1836 waters. There have been no efforts to fit a stock assessment model for lake trout in MI-8 of Lake Superior because this is a deferred area.

Recruitment of wild lake trout to the adult population continues to be evident throughout Lake Huron. In 2013, unclipped fish represented 41% of the commercial and 56% of the recreational fishery samples in unit MH-1. In unit MH-2, the proportion of unclipped fish in the Canadian commercial fishery exceeded 95%, while the proportion in the recreational fishery (US waters) was 36%. This disparity is the result of stocking practices in the north-central region, where only U.S. waters are stocked with hatchery-reared fish. Since these wild fish are predominately younger than age 9, hatchery fish still represent the largest proportion of the adult stock in US waters. To account for the growing proportion of wild fish in the population, the Lake Huron assessments are now structured to include both wild and hatchery fish.

Commercial fishing is the largest source of mortality in northern Lake Huron (unit MH-1), where total commercial yield exceeded 300,000 lb for the second consecutive year. Commercial yield from the Ontario waters of north-central Lake Huron (unit MH-2) was just below 30,000 lb, the lowest value since 1999. The sport fishery harvested less than 20,000 lb of lake trout from each unit during 2013 and recreational fishery mortality rates are below 0.02 y^{-1}. Sea lamprey-induced mortality rates in north-central Huron were above 0.10 y^{-1} for the first time since 2007, while rates in northern Lake Huron declined slightly to 0.10 y^{-1}.

Estimated spawning biomass in northern Lake Huron has declined approximately 35% since 2009, while the lower overall mortality rates in north-central Lake Huron have allowed spawning biomass to continue to increase there. Substantial declines in survival of stocked fish since the middle 2000s has helped contribute to the decline in hatchery biomass, particularly in the north, where wild fish compose 18% of the spawning biomass. Nearly 38% of the spawning

biomass in the north-central region is composed of wild fish.

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. Sea lamprey-induced mortality has slowly declined in MM-123 since the early 2000s, yet rates remain above 0.2 yr^{-1}. Commercial fishing mortality rates increased to the 0.4 yr^{-1} in 2013 and the estimated number of fish killed by commercial fisheries was the highest in the modeled time series. Recreational fishery mortality rates are modest by comparison, having remained below 0.03 y^{-1} since the onset of the Decree. Biomass of young fish is increasing 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 current rates of sea lamprey mortality would prevent any harvest under the original terms of the Consent Decree. The stipulated limits will remain in place until conditions of the amendment are met.

Estimated biomass has declined slightly in unit MM-4 after the marked increase observed in the middle 2000s. Mortality from sea lamprey (0.06 y^{-1}), commercial fishing (0.15 y^{-1}), and recreational fishing (0.08 y^{-1}) are factors in this unit, though current total mortality rates remain below target. Total yield of lake trout from MM-4 in 2013 (173,706 lb) was the highest observed since the Decree was implemented, though only slightly above the level reported in 2012. Recruitment has been enhanced by the substantial increase in stocking in adjacent MM-123, a mitigating factor for the relatively intense harvest that occurs in the unit. There is a Consent Decree stipulation for MM-4 which establishes the 2014 harvest limit at 171,500 lb, nearly double the model-recommended value. Actual harvest has been well above the model-generated limit for the past five years, yet model estimates of mortality remain below target. Recent analyses by the MSC suggest that the application of certain rules relating to the calculation of target spawning-stock biomass per recruit (SSBR) in the TAC projection process help explain this apparent disconnect. Mortality rates in units MM-5 and MM-67 remain below target and natural mortality is currently the largest source of mortality in these units. Recreational fishery yield from MM-5 increased nearly four-fold in 2013 to the highest level observed since the Decree was implemented and fishery mortality rates approached 0.07 yr^{-1}. The recreational fishery in MM-67 is a minor component (<0.03 yr^{-1}) of the overall mortality in the unit. The 2013 commercial fishery yield was modest in MM-5 (25,600 lb) and nearly non-existent in unit MM-67. Sea lamprey-induced mortality had recently shown a marked increase in MM-5 for a two year period (2009-2010), but rates are now below 0.10 yr^{-1}. Rates in MM-67 have remained below 0.10 yr^{-1} for the past ten years. The relatively low mortality rates in these southernmost Lake Michigan units have allowed adult biomass to build over the past decade. There is a Decree stipulation for MM-5 which establishes the 2014 harvest limit at 98,000 lb.

Lake Whitefish

In the western 1836 treaty waters of Lake Superior (WFS-04 and WFS-05), commercial harvest of lake whitefish declined during the middle 2000s in response to declining effort. Effort has recently increased in unit WFS-05 and fishing mortality rates are on par with natural mortality (0.13 yr^{-1}). Stable recruitment, combined with generally low mortality rates, has resulted in stable to increasing biomass in the west. Effort, and hence yield, has been more variable in the eastern units (WFS-07 and WFS-08) and mortality rates are higher overall. A long-term decline in recruitment was evident during the late 1980s and 1990s in unit WFS-07 and biomass had predictably declined in concert with recruitment, though recent estimates suggest some improvement. In contrast, recruitment in adjacent unit WFS-08 appears to have been stable-to- increasing during much of the 1990s. The small, variable fishery in WFS-06 restricts the utility of the SCAA assessment, which has not been populated since 2004. As a result, only fishery harvest and effort data are presented in this report.

In northern Lake Huron treaty waters (WFH-01-WFH-04), whitefish biomass peaked in the mid to late 1990s, as did commercial yield, which has declined by more than 50% in the last decade. Although similar patterns in biomass are evident in unit WFH-05, commercial yield peaked there in 2007, following substantial increases in effort since the late 1990s. Effort and yield have since declined. As is the case with all whitefish stocks, these biomass patterns are driven by recruitment, which has demonstrated a steep decline since the early 2000s. Catch rates, which are at their lowest point in the time series, have followed suit. Sea lamprey-induced mortality on lake whitefish has increased over the past decade and remains a significant mortality source in Lake Huron management areas, though a change to the estimation method resulted in a scaling down of this mortality component relative to prior years (see *Technical Changes* section for description). Certain age classes in northern Lake Huron are experiencing mortality near the 65% annual target. High adult mortality, coupled with low recruitment, presents a troubling scenario for Lake Huron lake whitefish stocks. Growth appears to have improved somewhat in Lake Huron treaty waters, likely in response to the release of density-dependent factors.

Northern Lake Michigan whitefish stocks had, in recent years, provided a contrast to those in northern Lake Huron - strong recruitment in the late 1990s and early 2000s and relatively low mortality allowed stocks to build through the middle 2000s. The most recent assessments from northern Lake Michigan (WFM-01 to WFM-04) suggest that recruitment and biomass have declined from those peaks. Yields have remained stable to increasing, thus mortality rates have generally increased across most northern Lake Michigan stocks. Nonetheless, peak mortality rates remain below target. The decline in biomass was most pronounced in unit WFM-01, where estimated biomass was more than 50% lower than the mid-2000 peak. The uncertainty associated with model estimates of stock size, coupled with the low performance rating, resulted in the TFC recommending a harvest limit of 2 million lb for WFM-01 in 2014, a limit that was first established by the TFC for the 2013 fishing season.

Although estimated recruitment has declined in unit WFM-05, fishing effort and mortality have declined as well; as a result biomass has remained fairly stable in recent years. 2012 yield was the lowest in the modeled time series, eclipsing the low from 2011. In contrast, trap-net fishery effort increased dramatically in unit WFM-06 during 2010- 2012, mainly due to the entrance of a State-licensed commercial operation. As a result, trap-net yield remains substantially higher than it has been since the Decree was implemented. The dramatic shift in the trap-net fishery dynamics and the sporadic nature of the gill-net fishery have resulted in widely varying estimates of stock size; as a consequence, the TFC has recommended a constant harvest limit of 250,000 lb in unit WFM-06 until model performance improves.

Trap-net fishery effort and yield in unit WFM-07 has declined since reaching a peak in 2007. The lack of available data has precluded development of a SCAA model and the HRG for this unit has remained at a constant level since 2007. The MSC will continue to evaluate the available data to ascertain whether it is feasible to develop a model in the future.

Trap-net fishery yield has remained fairly stable in unit WFM-08, though model estimates suggest that recruitment, and hence biomass, has not declined as it has in the north. Natural mortality is the largest source of mortality in this unit and historical model-generated harvest limits suggest that fishery yield is small relative to stock size. The assessment for unit WFM-08 has generated highly variable estimates of stock size over the years, a condition which 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:

$$m_{a,t} = \frac{m_{a,y}}{1 - \left(\frac{m_t - m_y}{m_t} \right)}$$

where m is the average number of sea lamprey marks per fish, a is age class, t is year, and y is the time period. 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.

To address concerns over the application of these methods, the MSC agreed to evaluate 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 assessments. While the revised method seemed preferable to the previous method, we note that it did result in highly suspect values for age classes that were not well represented in the samples in a given year (as evidenced by certain extreme mortality values in the mortality graphs for Northern Lake Huron and WFH-05 on pages 32 and 34). Thus the MSC considered another alternative, which was to employ the methodology utilized to estimate sea lamprey-induced mortality for lake trout, where size-based wounding rates are fit to an asymptotic function and are then translated to mortality rates based on growth parameters of the stock. We will continue to explore this option in the coming year.

We also note that most of the Lake Michigan lake trout assessments, as well as the Lake Superior whitefish assessments, now incorporate the revised variance estimation structure which was described in this section of the 2013 Status Report.

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), which 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 deepwater 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 deepwater 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.

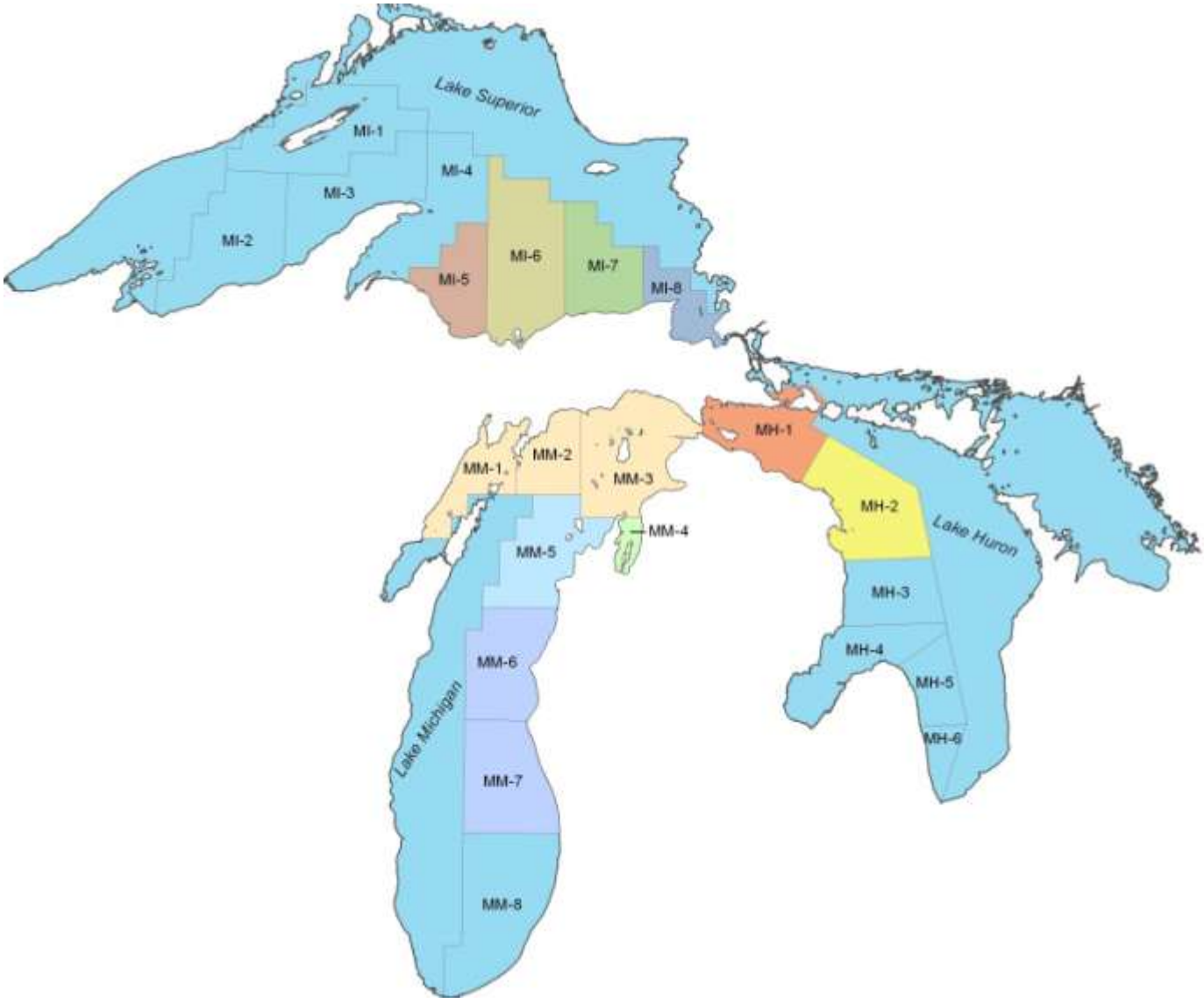


Figure 1. Lake Trout Management Units. Shaded areas denote units which are subject to provisions of the 2000 Consent Decree. Like shading indicates where statistical districts have been combined into a single management unit for stock assessment purposes. No stock assessment has been developed for Lake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

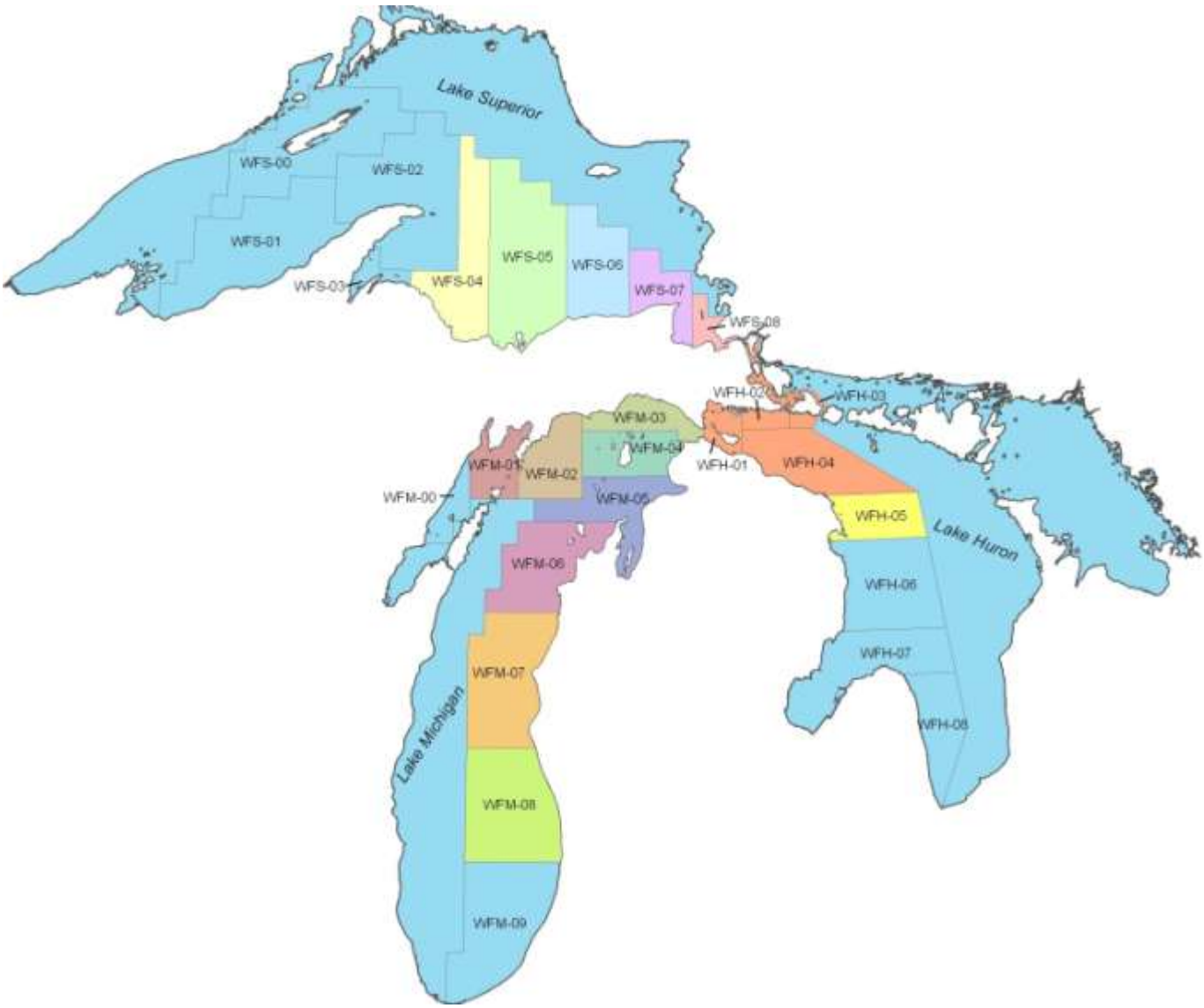


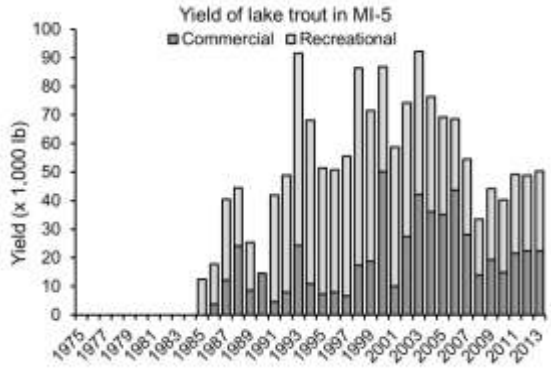
Figure 2. Lake Whitefish Management Units. Shaded areas denote units which are subject to provisions of the 2000 Consent Decree. Like shading indicates where units have been combined into a single management area for stock assessment purposes. No stock assessment model has been developed for Lake Michigan unit WFM-07 and the stock assessment model for Lake Superior unit WFS-06 has limited utility due to a paucity of available data.

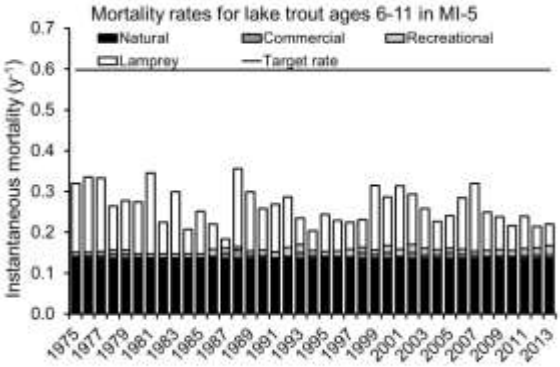
STATUS OF LAKE TROUT POPULATIONS

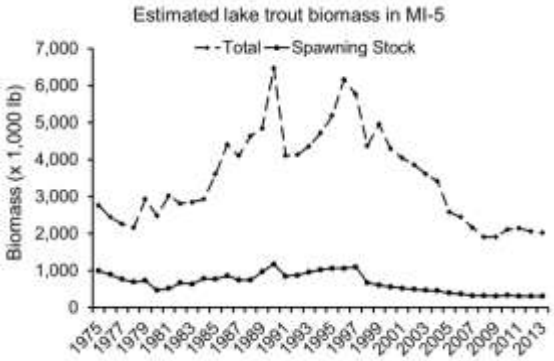
Lake Superior

MI-5 (Marquette)

Shawn Sitar





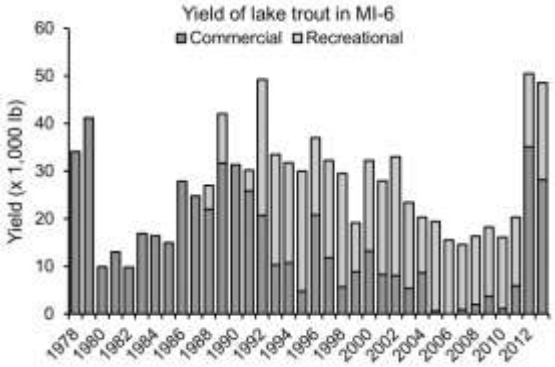


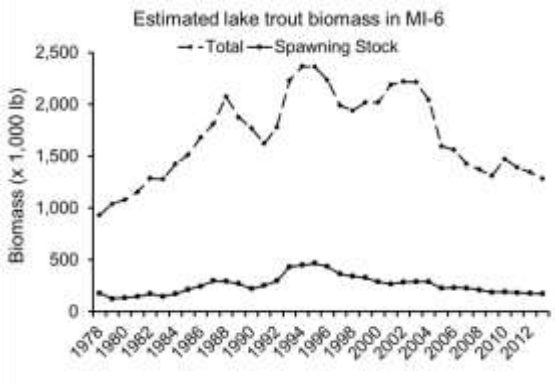
Parameter	Value
Base SSBR	7.13 lb
Current SSBR	2.18 lb
Target SSBR	0.40 lb
Current SPR	0.31
M	0.14 y^{-1}
F, Commercial (2011-2013)	0.01 y^{-1}
F, Recreational (2011-2013)	0.02 y^{-1}
Sea Lamprey Mort (2010-2012)	0.06 y^{-1}
Z	0.22 y^{-1}
Recommended TAC	145,304 lb
Actual TAC	145,304 lb
Model Rating	Medium

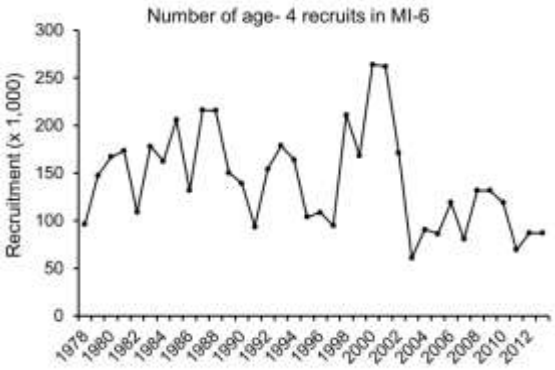
Notable Fishery Dynamics and Model Changes:

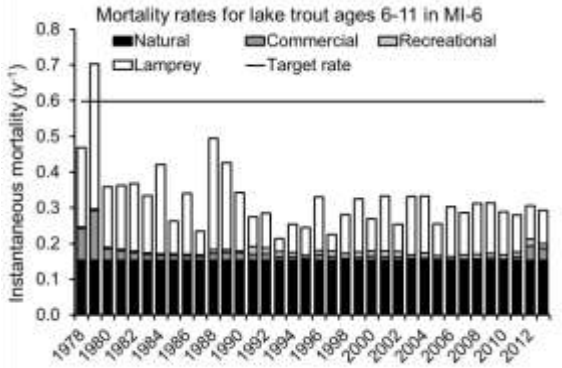
Lake trout abundance has progressively declined since the 1990s, driven by reduced recruitment. Total mortality rates have declined since 2007, largely due to declining sea lamprey-induced mortality, which is at its lowest point since the mid-1990s. Recreational harvest increased by 33% from 2012-2013 and continues to exceed commercial landings. Total annual mortality for lake trout ages 6-11 averaged 20% in the last three years. The lake trout harvest limit in 2014 increased by 9% due to slightly higher estimates of abundance in the fishable population.

MI-6 (Munising) Shawn Sitar







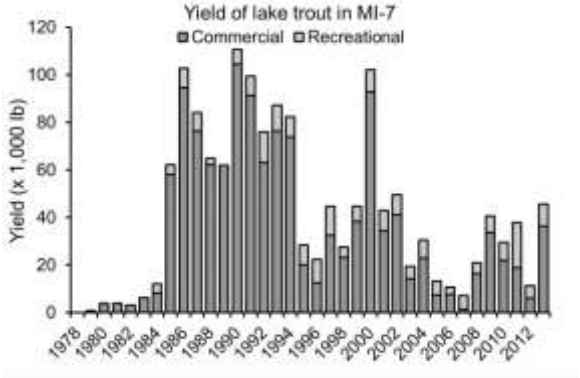


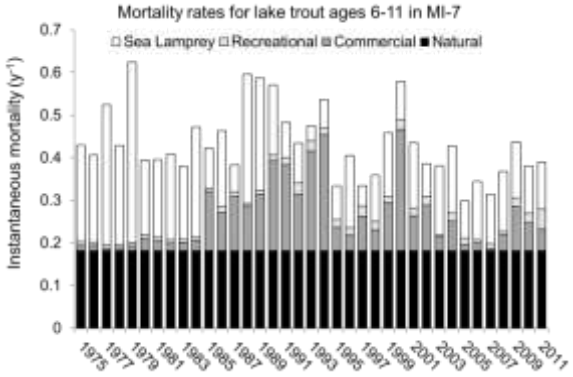
Parameter	Value
Base SSBR	5.36 lb
Current SSBR	1.45 lb
Target SSBR	0.59 lb
Current SPR	0.27
M	0.15 y^{-1}
F, Commercial (2011-2013)	0.03 y^{-1}
F, Recreational (2011-2013)	0.02 y^{-1}
Sea Lamprey Mort (2010-2012)	0.10 y^{-1}
Z	0.29 y^{-1}
Recommended TAC	172,412 lb
Actual TAC	172,412 lb
Model Rating	Low

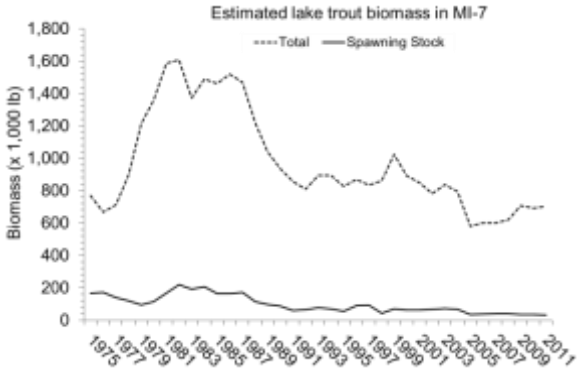
Notable Fishery Dynamics and Model Changes:

Abundance of lake trout continues to decline due to major declines in recruitment since 2001. Total mortality has not varied appreciably in the last 10 years and is mostly driven by sea lamprey predation. Commercial landings in 2012 and 2013 were five-fold higher than the previous decades, due to a new fisher entering the area. Total annual mortality for lake trout ages 6-11 averaged 25% in the last three years. The 2014 harvest limit for MI-6 increased by 6% due to small increases in predicted recruitment. This model retains a low rating because it still relies on a key abundance scaling parameter from the MI-5 model to produce output consistent with our professional perception of stock size in this area.

MI-7 (Grand Marais) Shawn Sitar



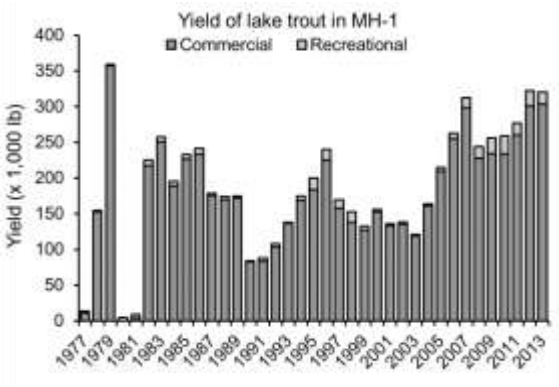


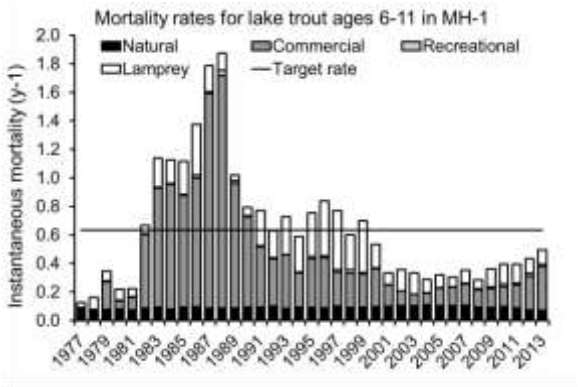


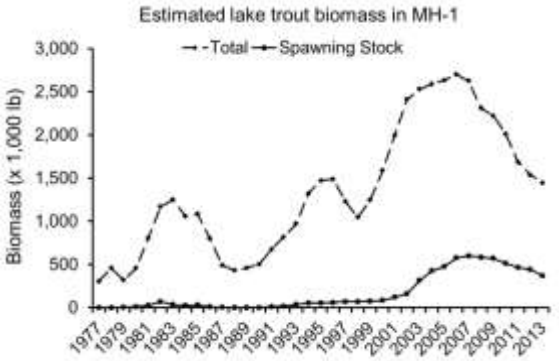
Parameter	Value
Base SSBR	3.08 lb
Current SSBR	0.43 lb
Target SSBR	0.22 lb
Current SPR	0.14
M	0.18 y^{-1}
F, Commercial (2009-2011)	0.07 y^{-1}
F, Recreational (2009-2011)	0.03 y^{-1}
Sea Lamprey Mort (2010-2012)	0.10 y^{-1}
Z (2011)	0.39 y^{-1}
Recommended TAC	91,065 lb
Actual TAC	85,088 lb
Model Rating	N/A

Notable Fishery Dynamics and Model Changes:
This model was in rotation status for 2014; therefore, the harvest limits were projected from 2012 model estimates of abundance and recruitment, with updated fishing and sea lamprey mortality rates. After declines in 2012, harvest in 2013 returned to average levels for both the recreational and commercial fisheries in this unit. Sea lamprey mortality slightly declined from 0.10 y^{-1} in 2011 to 0.09 y^{-1} in 2012. The 2014 TAC for MI-7 increased 23% from 2013 because of recent increases in abundance as estimated by the 2012 model. A complete assessment will be completed in 2015.

Lake Huron
MH-1 (Northern Lake Huron) Ji He



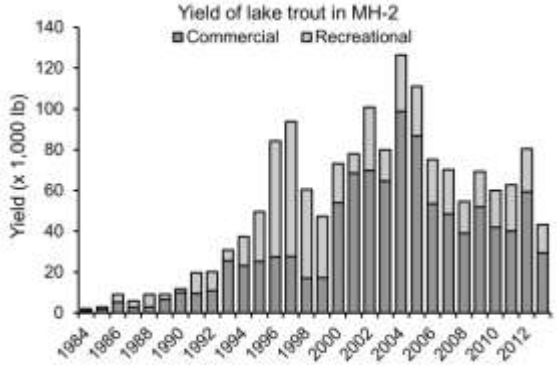


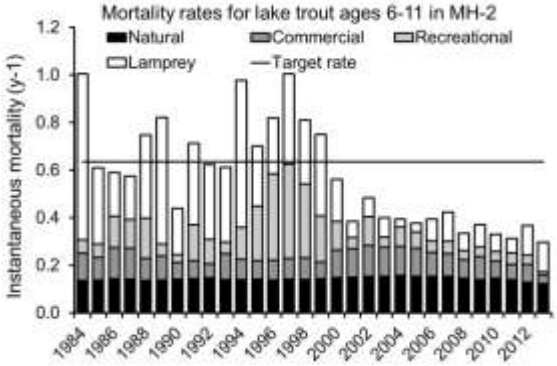


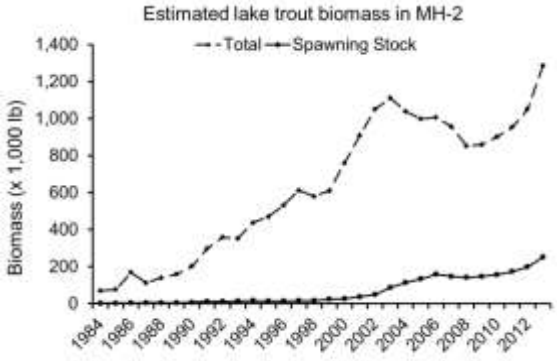
Parameter	Value
Base SSBR	2.58 lb
Current SSBR	0.16 lb
Target SSBR	0.11 lb
Current SPR	0.06
M	0.08 y^{-1}
F, Commercial (2011-2013)	0.23 y^{-1}
F, Recreational (2011-2013)	0.02 y^{-1}
Sea Lamprey Mort (2010-2012)	0.12 y^{-1}
Z	0.44 y^{-1}
Recommended TAC	204,000 lb
Actual TAC	400,775 lb
Model Rating	Low

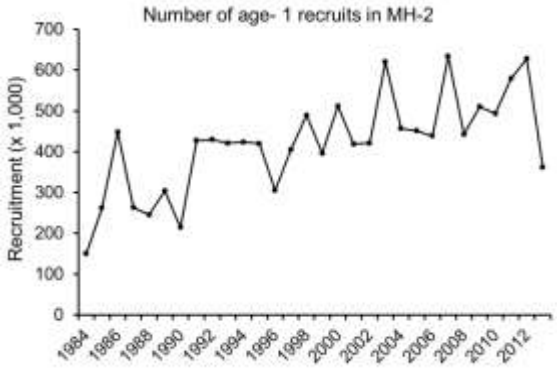
<u>Notable Fishery Dynamics and Model Changes:</u>
No changes were implemented to the assessment model this year. Fishery yield in 2013 was similar to previous years. Average estimated annual mortality was 39%, and sea lamprey induced mortality declined from 0.13 y^{-1} to 0.10 y^{-1}. The 2014 model-generated harvest limit declined by 59% from 2013 due to uncertainties surrounding recruitment of age 4 and age 5 lake trout. A long-standing issue is that the fisheries and surveys do not provide sufficient observations of age-4 or age-5 fish, despite the fact that we observed major increases in fishery and survey catch of age 3-5 lake trout during 2013. The model realized these increased catches by elevating selectivity of small fish, which is suspect. The low rating is a result of the highly uncertain recruitment estimates, coupled with less than optimal diagnostics.

MH-2 (North-Central Lake Huron) Ji He







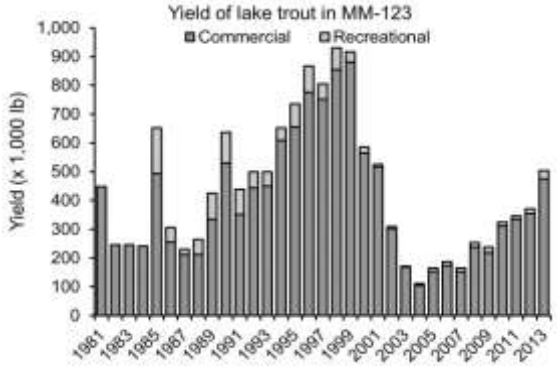


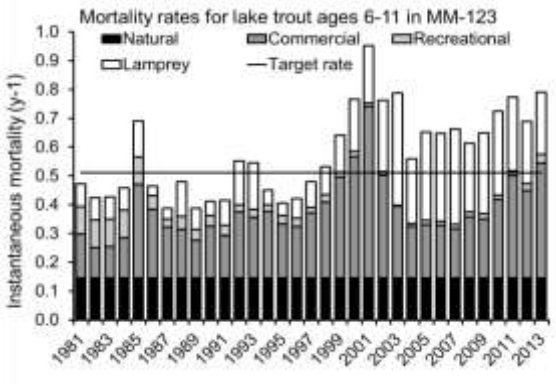
Parameter	Value
Base SSBR	0.52 lb
Current SSBR	0.11 lb
Target SSBR	0.04 lb
Current SPR	0.22
M	0.13 y^{-1}
F, Commercial (2011-2013)	0.06 y^{-1}
F, Recreational (2011-2013)	0.03 y^{-1}
Sea Lamprey Mort (2010-2012)	0.08 y^{-1}
Z	0.33 y^{-1}
Recommended TAC	143,800 lb
Actual TAC	143,800 lb
Model Rating	Low

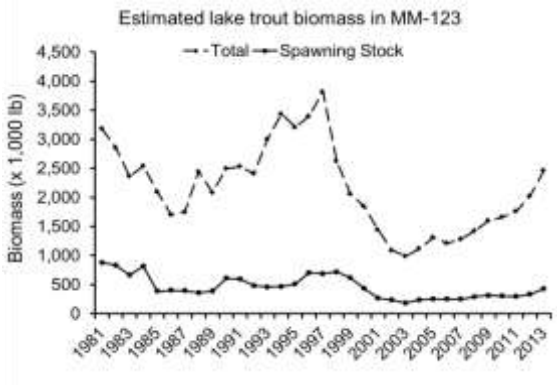
Notable Fishery Dynamics and Model Changes

The MH-2 model structure was fundamentally the same as MH-1, but it did not encounter the issue of an unreasonable increase in juvenile selectivity and the apparent underestimate of age-4 recruitment. Consistent recruitment of wild juvenile lake trout in this unit, particularly in commercial fishery, started much earlier than MH-1. Harvest in 2013 was well below the established limits. Sea lamprey-induced mortality doubled from 0.06 y^{-1} to 0.12 y^{-1}, triggering a full assessment for a unit that would otherwise have been in rotation. Estimated annual mortality averaged 26%. The 2014 model-generated TAC was 143,800 lb, a 10% increase over 2013. This increase is the result of an expanding adult stock.

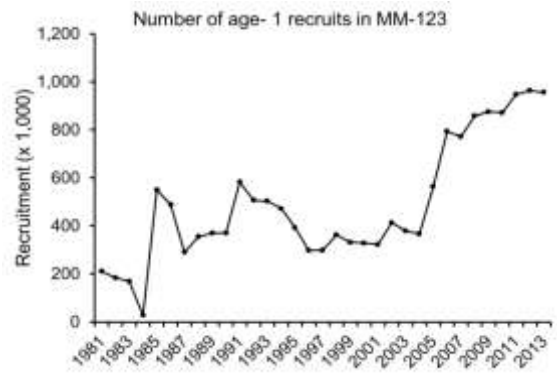
Lake Michigan
MM-123 (Northern Treaty Waters) Jory Jonas





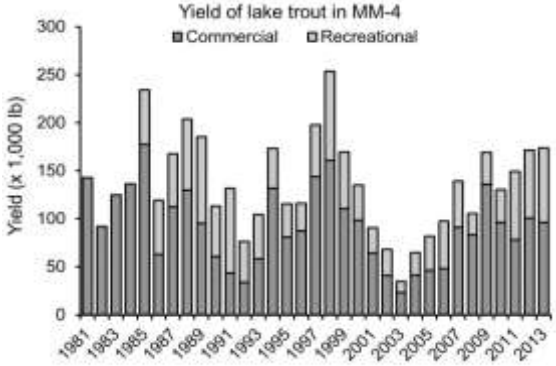


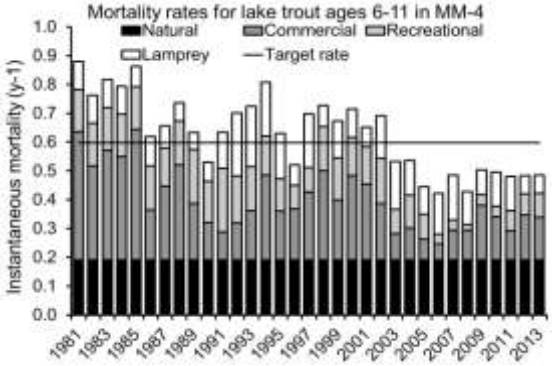
Parameter	Value
Base SSBR	9.75 lb
Current SSBR	0.59 lb
Target SSBR	2.2 lb
Current SPR	0.06
M	0.14 y^{-1}
F, Commercial (2011-2013)	0.35 y^{-1}
F, Recreational (2011-2013)	0.02 y^{-1}
Sea Lamprey Mort (2010-2012)	0.25 y^{-1}
Z	0.82 y^{-1}
Recommended TAC	0 lb
Actual TAC	503,000 lb
Model Rating	Medium

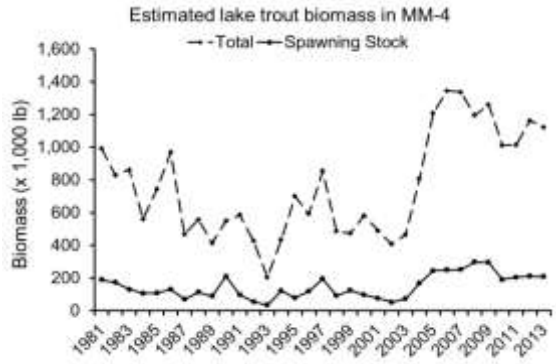


<u>Notable Fishery Dynamics and Model Changes:</u>
The model-generated harvest limit in this unit is zero due to mortality rates which substantially exceed target levels - total annual mortality averaged 53% in 2013. Sea lamprey mortality remains high (0.22 y^{-1}) and commercial yield has increased three-fold since 2006 (the harvest limit was exceeded in 2013). Recreational yield doubled in 2013 compared to 2012. The number of stocked fish recruited to this unit has more than doubled since 2004, from 367,000 to 964,000 fish, resulting in continued increases in total biomass despite high mortality on adult lake trout. The harvest limits in MM-123 are set by stipulation, which allocates 453,000 lb to tribal fisheries and 50,000 lb to the state.

MM-4 (Grand Traverse Bay) Jory Jonas



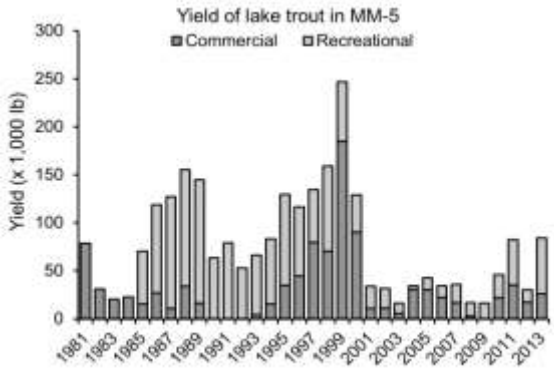


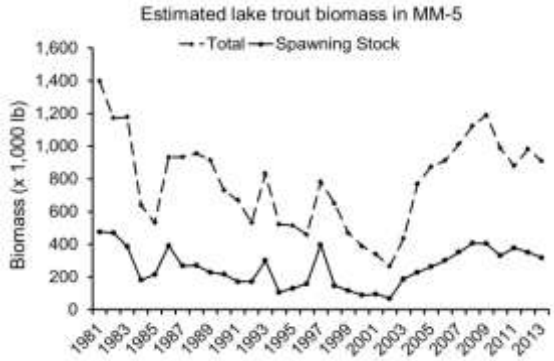


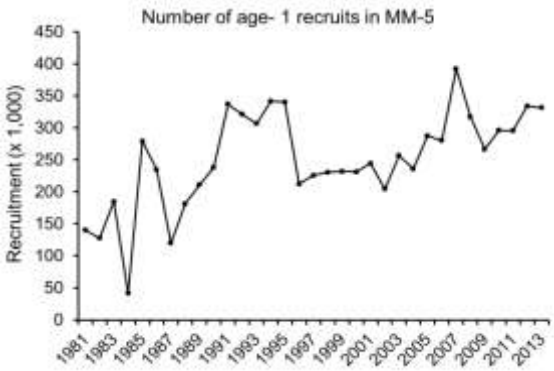
Parameter	Value
Base SSBR	3.11 lb
Current SSBR	0.53 lb
Target SSBR	0.52 lb
Current SPR	0.17
M	0.19 y^{-1}
F, Commercial (2011-2013)	0.14 y^{-1}
F, Recreational (2011-2013)	0.08 y^{-1}
Sea Lamprey Mort (2010-2012)	0.10 y^{-1}
Z	0.48 y^{-1}
Recommended TAC	145,183 lb
Actual TAC	171,500 lb
Model Rating	Medium

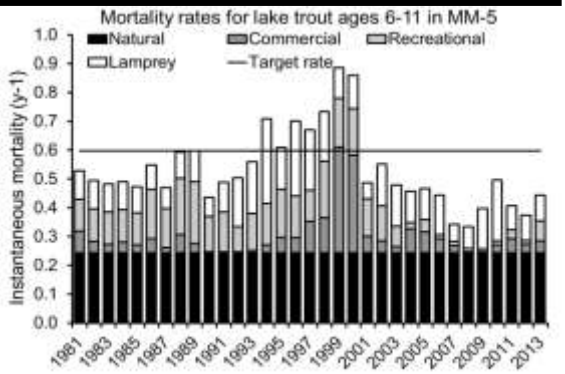
Notable Fishery Dynamics and Model Changes:
The projected harvest limits for 2014 were higher than 2013, due to continued increases in recruitment, a reduction in sea lamprey induced mortality (declined from 0.11 y^{-1} to 0.06 y^{-1}), and modifications to the model structure (new variance estimation approach). Total yield slightly declined in 2013, but still exceeded model-generated harvest limits. Total annual mortality averaged 38%. The actual harvest limits in MM-4 are set by stipulation, which allocates 94,300 lb to tribal fisheries and 77,200 lb to the state. The state slightly exceeded its harvest quota in 2013, so a transfer of unused quota did not occur in 2014.

MM-5 (Leelanau Peninsula to Arcadia) Jory Jonas





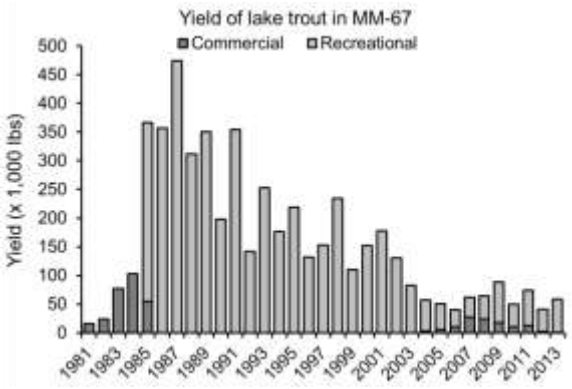


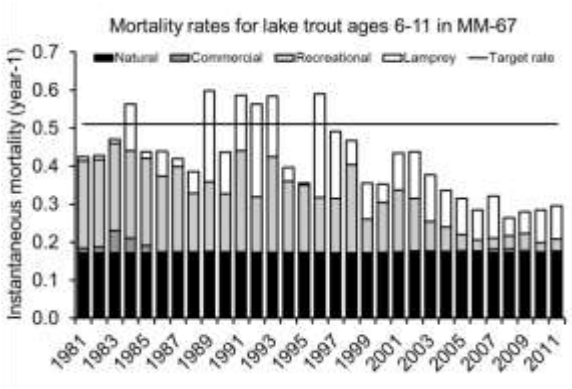


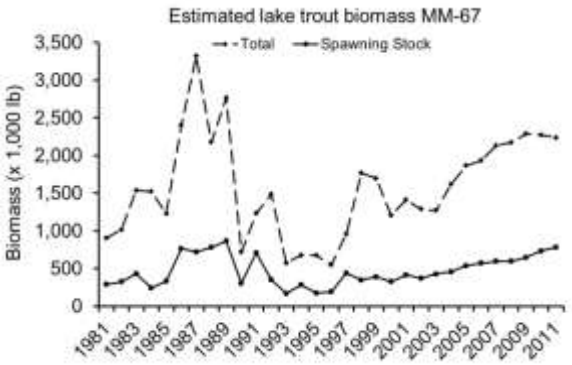
Parameter	Value
Base SSBR	1.22 lb
Current SSBR	0.47 lb
Target SSBR	0.43 lb
Current SPR	0.39
M	0.24 y^{-1}
F, Commercial (2011-2013)	0.04 y^{-1}
F, Recreational (2011-2013)	0.04 y^{-1}
Sea Lamprey Mort (2010-2012)	0.13 y^{-1}
Z	0.41 y^{-1}
Recommended TAC	57,225 lb
Actual TAC	98,000 lb
Model Rating	Medium

Notable Fishery Dynamics and Model Changes:
The projected harvest limits for 2014 were approximately 15% lower than 2013. Mortality was estimated to be slightly higher, averaging 36%. The model structure was altered to incorporate the new variance ratio structure. Lamprey mortality and recruitment were largely unchanged, though recreational fishery harvest was the highest in more than a decade. This increase was due to a poor Chinook Salmon fishing year, causing charter and sport anglers to target lake trout. The harvest limits in MM-5 are set by stipulation, which allocates a minimum of 39,200 lb to tribal fisheries and 58,800 lb to the State recreational fishery.

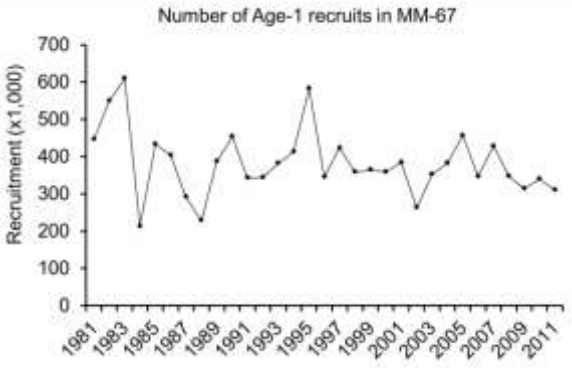
MM-67 (Southern Treaty Waters) Jory Jonas







Parameter	Value
Base SSBR	2.26 lb
Current SSBR	1.09 lb
Target SSBR	0.40 lb
Current SPR	0.48
M	0.17 y^{-1}
F, Commercial (2010-2012)	0.01 y^{-1}
F, Recreational (2010-2012)	0.03 y^{-1}
Sea Lamprey Mort (2010-2012)	0.08 y^{-1}
Z	0.27 y^{-1}
Recommended TAC	465,272 lb
Actual TAC	465,272 lb
Model Rating	N/A



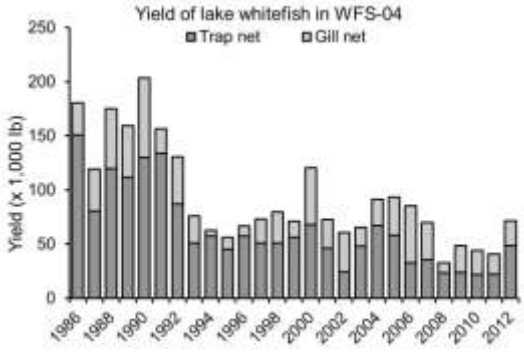
Notable Fishery Dynamics and Model Changes:

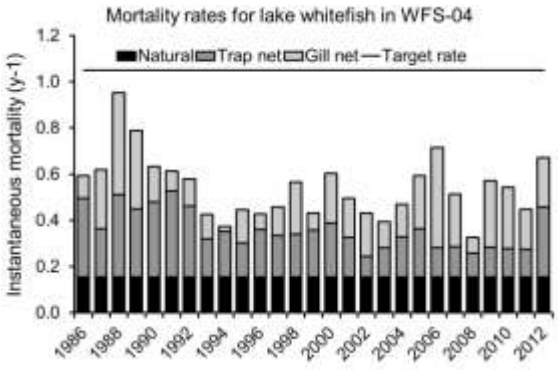
This unit was in rotation for 2014 and a full assessment was not conducted. Harvest and sea lamprey data were updated to project the 2014 harvest limits. The projected harvest limits for 2014 were lower than those established in 2013. Recreational harvest in 2013 increased closer to the level extracted in 2011. The commercial fishery experienced complications in 2013 and only harvested 160 lb of lake trout, the lowest yield since fishing began in 2004. The average annual mortality rate for lake trout ages 6-11 in this unit was estimated to be 26% when the last full assessment was run in 2012. A full assessment will be completed in 2015.

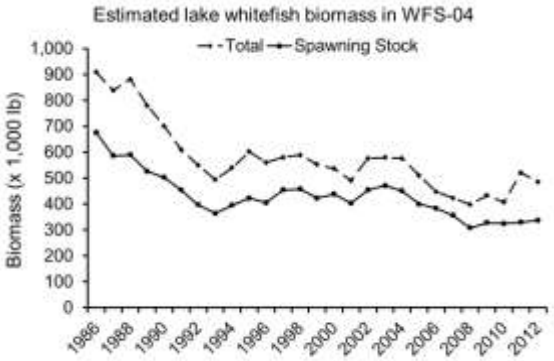
STATUS OF LAKE WHITEFISH POPULATIONS

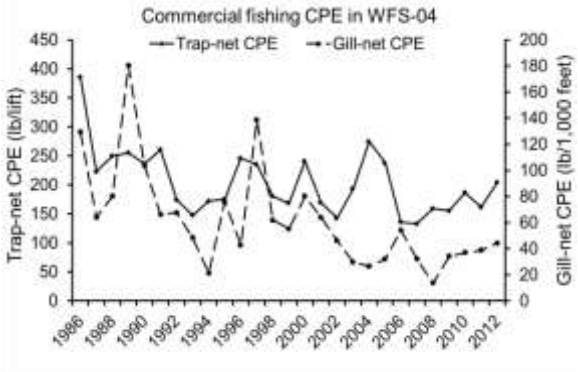
Lake Superior

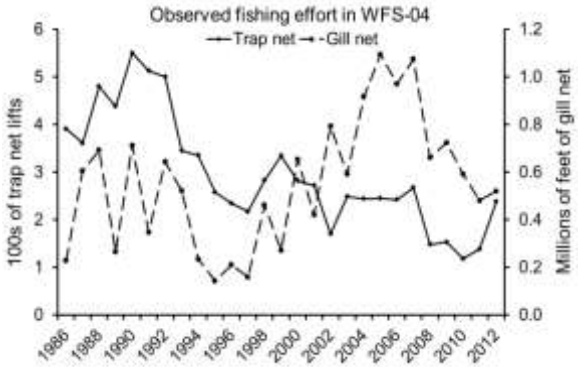
WFS-04 (Marquette-Big Bay) Mike Seider

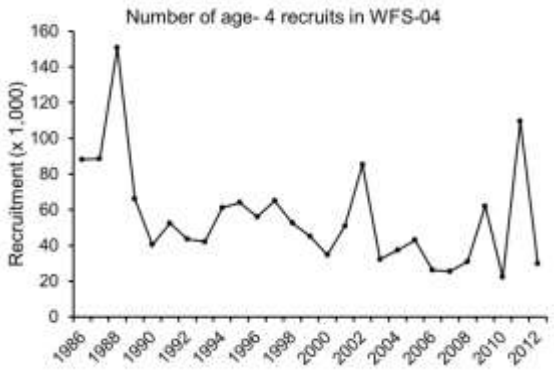










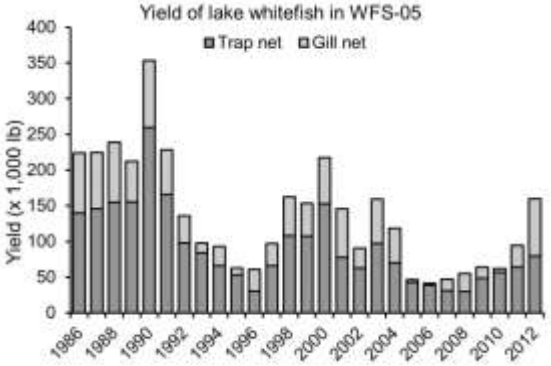


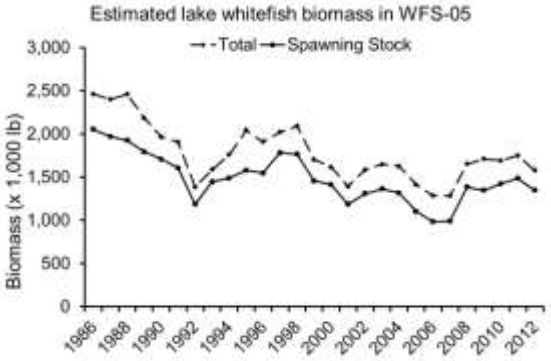
Parameter	Value
Base SSBR	8.84 lb
Current SSBR	2.58 lb
Target SSBR	0.22 lb
Current SPR	0.29
M	0.15 y^{-1}
F, trap net (2010-2012)	0.12 y^{-1}
F, gill net (2010-2012)	0.09 y^{-1}
Z	0.37 y^{-1}
Recommended TAC	102,000 lb
Actual TAC	102,000 lb
Model Rating	Medium

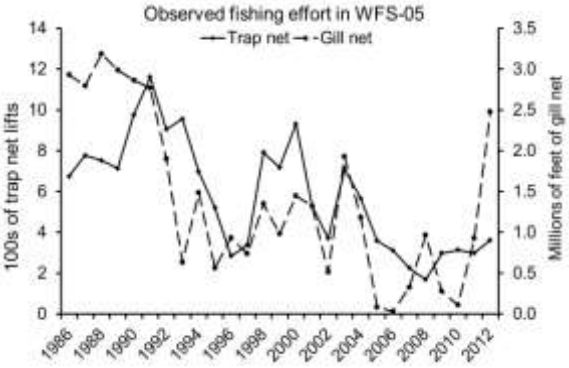
Notable Fishery Dynamics and Model Changes:
Commercial CPUE has been relatively stable over the past decade. Annual mortality for the most vulnerable age class was 43% in 2012. Changes to the 2014 assessment model included incorporating the ratio approach to estimating variance, a switch to random walk function for time varying selectivity, a switch to length-based selectivity, and allowing catchability to vary

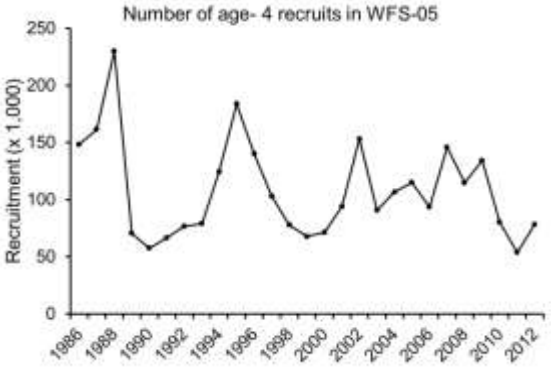
over time via a random walk function. Structural changes improved data fits and model stability but did suggest a more pronounced decline in recruitment than previous model versions. The 2014 yield limit was 10% lower than for 2013.

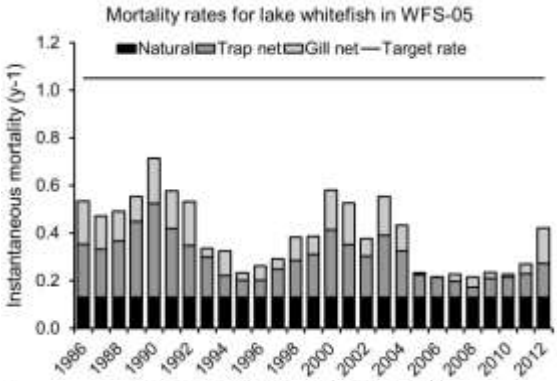
WFS-05 (Munising) Shawn Sitar

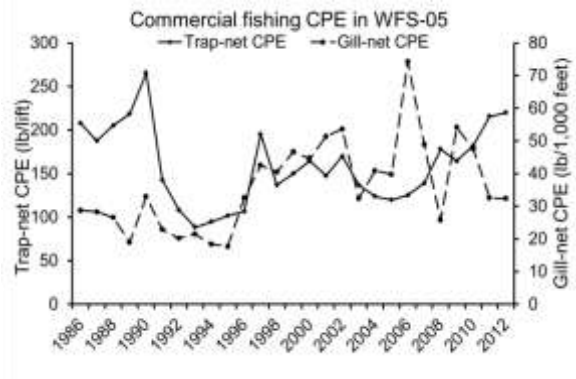








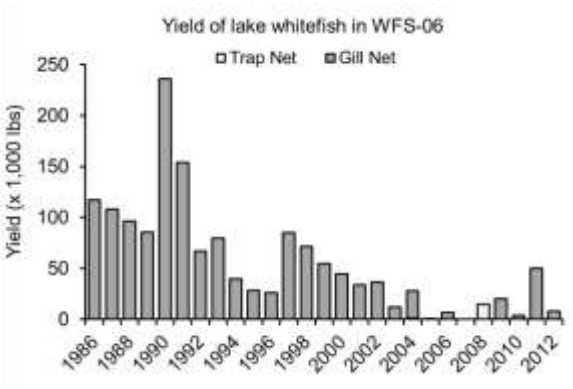


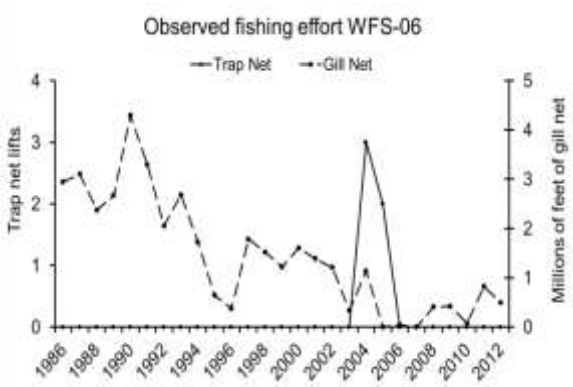


Parameter	Value
Base SSBR	10.11 lb
Current SSBR	5.27 lb
Target SSBR	0.21 lb
Current SPR	0.52
M	0.13 y^{-1}
F, trap net (2010-2012)	0.05 y^{-1}
F, gill net (2010-2012)	0.03 y^{-1}
Z	0.21 y^{-1}
Recommended TAC	372,000 lb
Actual TAC	372,000 lb
Model Rating	Medium

<u>Notable Fishery Dynamics and Model Changes:</u>
The 2014 yield limit was 15% lower than 2013. The decline was due to a decreasing trend in stock abundance since 2009. Key changes to the model included implementation of the variance ratio approach to specify the standard deviation of each data source used in model fitting and a random walk, time-varying gamma selectivity function for the fishery data. The maximum annual mortality for 2012 was 34%. Trap-net yield has increased since 2008 and gill-net yield nearly tripled from 2011 to 2012.

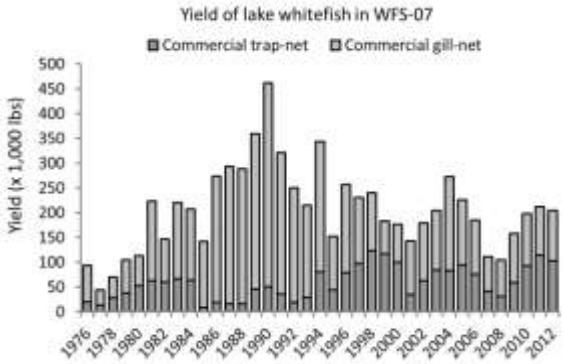
WFS-06 (Grand Marais)

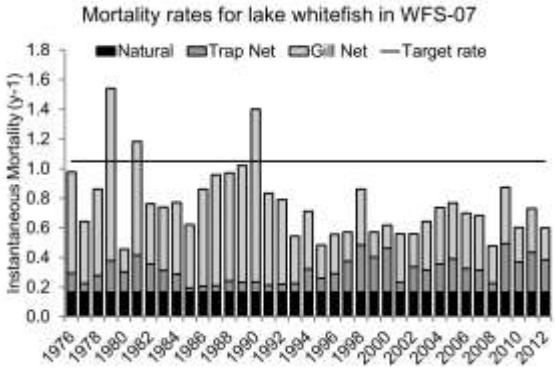


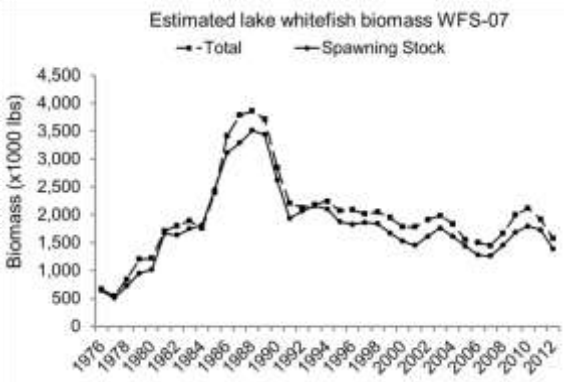


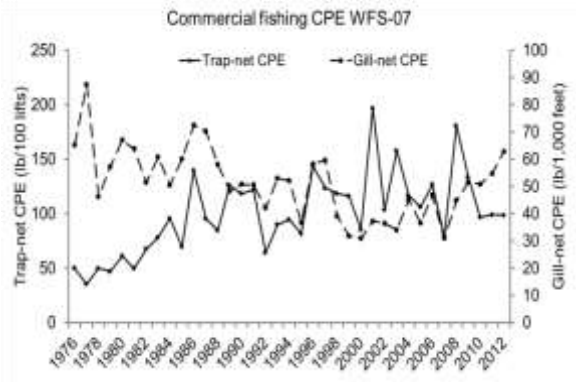
There is no current stock assessment model for WFS-06. Low levels of effort and harvest and a lack of fishery monitoring data since the early 2000s limit the ability to produce a model assessment in this unit.

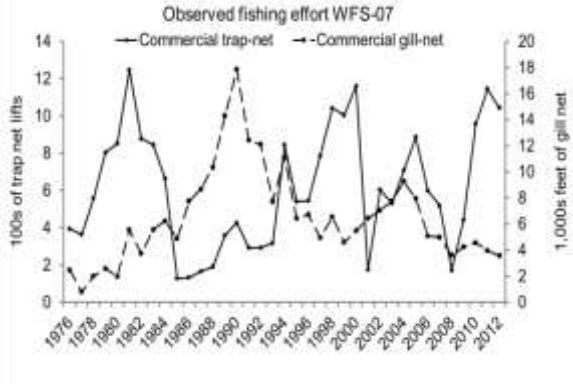
WFS-07 (Tahquamenon Bay) Mark Ebener

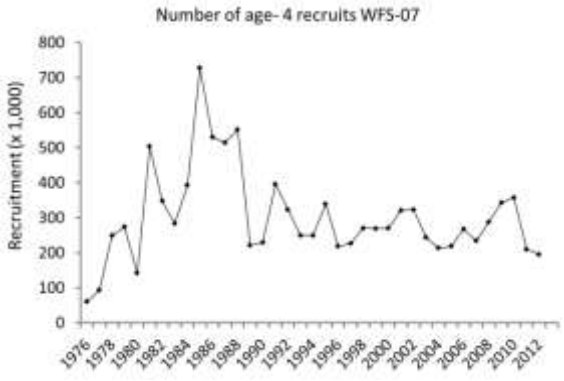












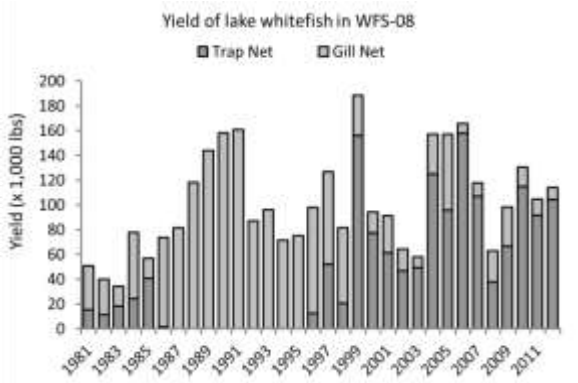
Parameter	Value
Base SSBR	6.61 lb
Current SSBR	1.21 lb
Target SSBR	0.24 lb
Current SPR	0.18
M	0.17 y^{-1}
F, trap net (2010-2012)	0.19 y^{-1}
F, gill net (2010-2012)	0.19 y^{-1}
Z	0.54 y^{-1}
Recommended TAC	539,000 lb
Actual TAC	539,000 lb
Model Rating	Low

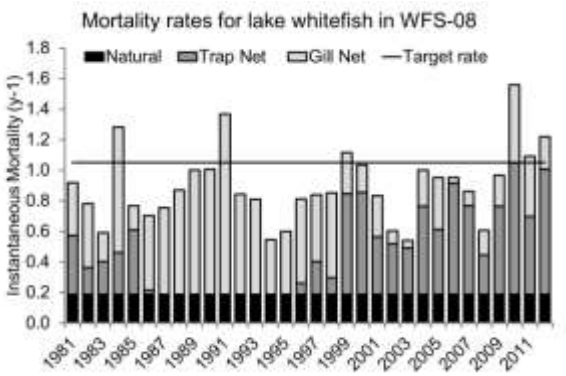
Notable Fishery Dynamics and Model Changes:

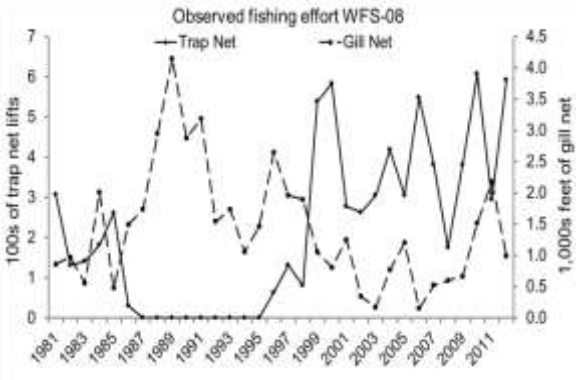
There were no structural changes made to the WFS-07 model, which was generally stable, but substantial differences in fishable biomass were obtained when the reference length for gear selectivity was changed. There were very strong and divergent retrospective patterns in estimated biomass, recruitment, and population size, with the most divergent patterns being for biomass. Fishable biomass in WFS-07 continued its two-

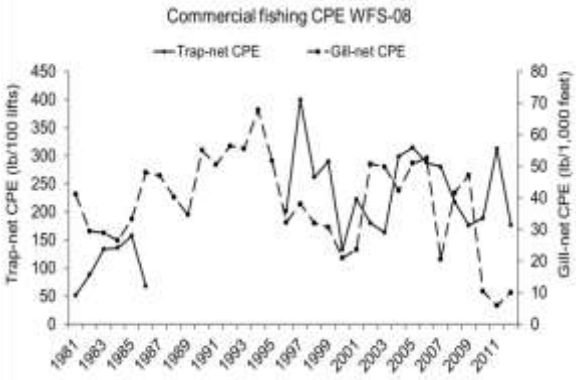
decade long decline in 2012. Annual mortality of the most fully vulnerable age class was estimated to be 45% in 2012. The model was rated as low because different starting values produced different final results, MCMCs were not quite normal, and because of the retrospective patterns.

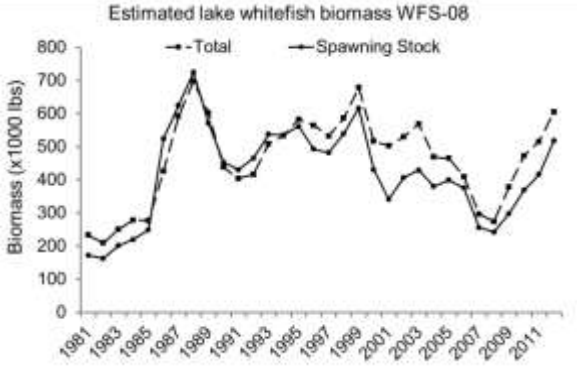
WFS-08 (Brimley) Paul Ripple









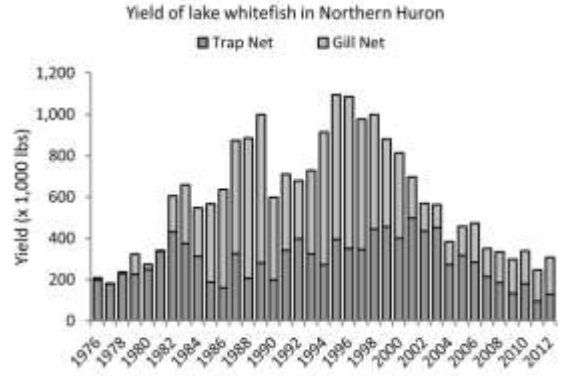


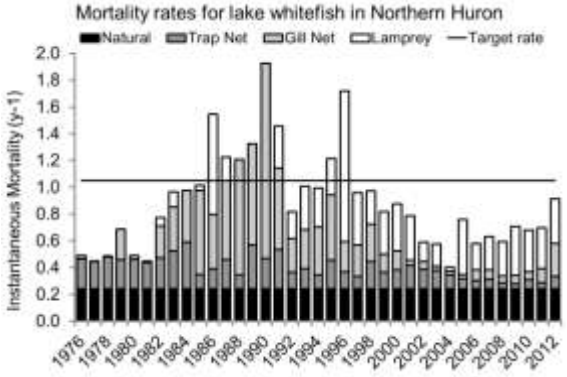
Parameter	Value
Base SSBR	4.08 lb
Current SSBR	0.85 lb
Target SSBR	0.21 lb
Current SPR	0.21
M	0.19 y^{-1}
F, trap net (2010-2012)	0.53 y^{-1}
F, gill net (2010-2012)	0.20 y^{-1}
Z	0.92 y^{-1}
Recommended TAC	130,000 lb
Actual TAC	130,000 lb
Model Rating	Low

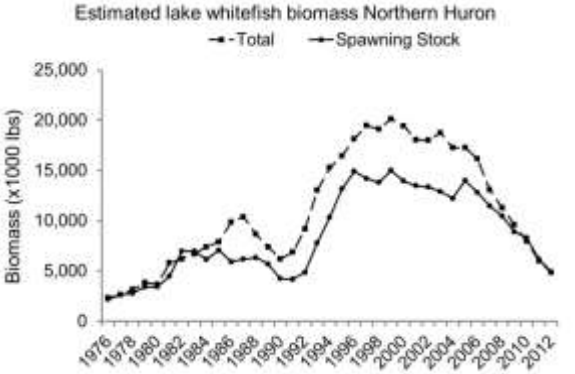
Notable Fishery Dynamics and Model Changes:

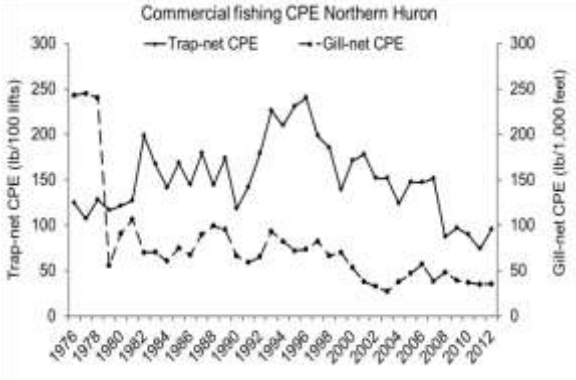
The 2014 yield limit was 50% lower than 2013. Fishery characteristics were mixed, with trap-net CPUE decreasing and gill-net CPUE increasing. Catch and effort have varied over the recent decade, and model diagnostics were poor, leading to a low model rating. Estimated maximum annual mortality was 70%, on ages 9 and 10.

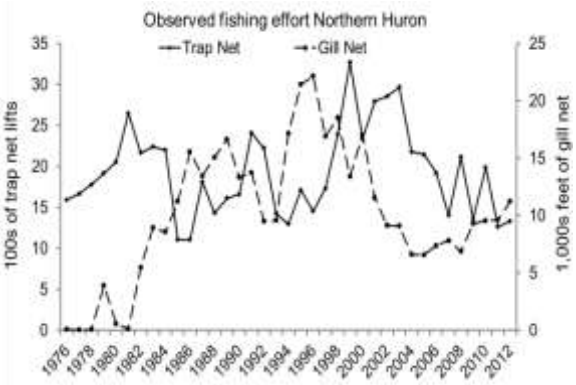
Lake Huron
Northern Huron (WFH-01 to WFH-04) Mark Ebener

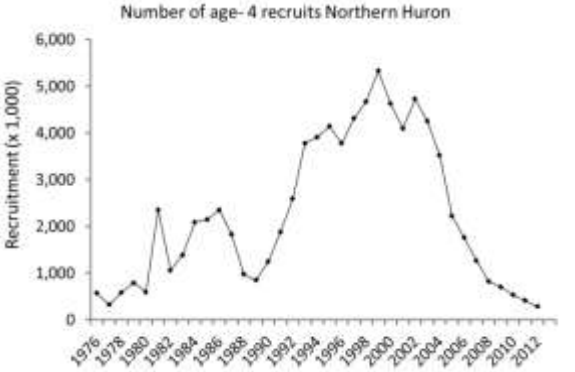












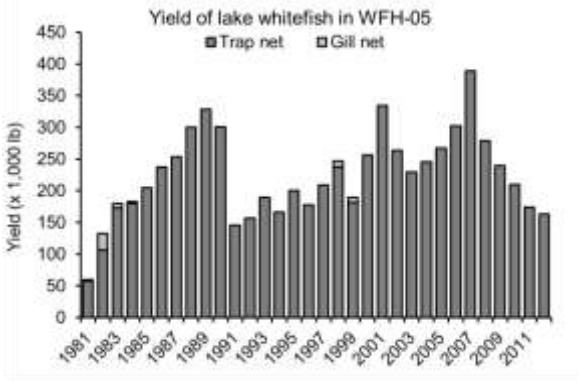
Parameter	Value
Base SSBR	2.99 lb
Current SSBR	1.13 lb
Target SSBR	0.46 lb
Current SPR	0.38
M	0.24 y^{-1}
F, trap net (2010-2012)	0.06 y^{-1}
F, gill net (2010-2012)	0.07 y^{-1}
Z	0.53 y^{-1}
Recommended TAC	735,000 lb
Actual TAC	437,157 lb
Model Rating	Medium

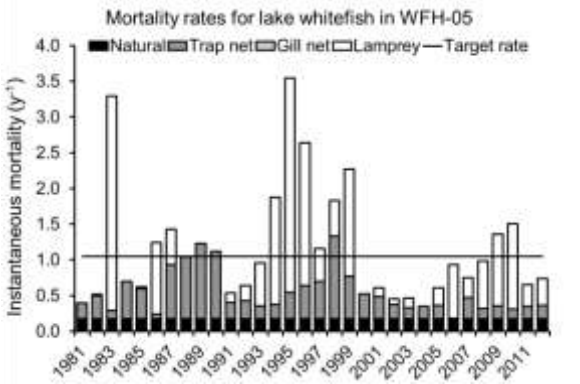
Notable Fishery Dynamics and Model Changes:

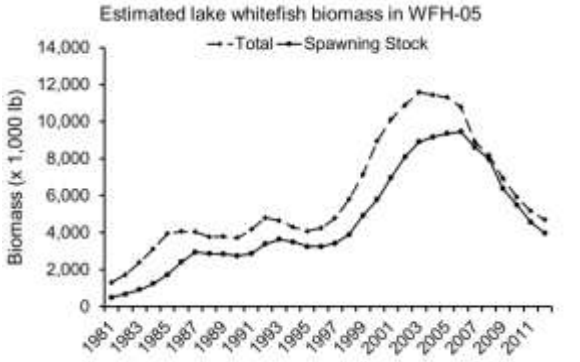
Sea lamprey mortality was calculated differently in 2014 than past years. Instead of estimating the deviation of annual sea lamprey marking from the long-term mean and adjusting age-specific marking rates, age-specific sea lamprey marking rates were directly estimated from the number of marks observed for each age class and the number of fish sampled of that age. Biomass levels in Northern Huron continue to

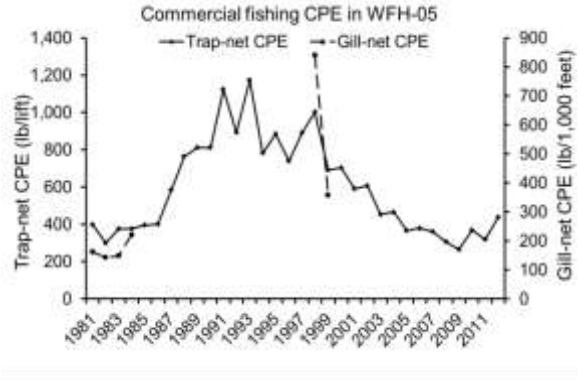
decline and are currently near an all-time low. The dramatic decline in biomass was due partly to huge declines in recruitment after 2004 and to increased sea lamprey predation over the last few years. Total mortality on the most fully vulnerable age class was estimated to be 60%, with about one-half of this mortality being attributable to sea lamprey (28%). The yield limit increased nearly two-fold in northern Lake Huron from 2013 and 2014 because estimates of sea lamprey mortality were 50% lower on the oldest and most vulnerable age class in the current stock assessment than in the 2013 stock assessment. The Northern Huron model was rated medium because the model appeared stable, without troubling retrospective patterns.

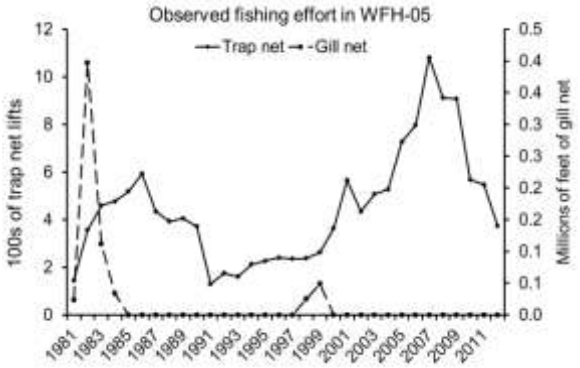
WFH-05 (Alpena) Steve Lenart

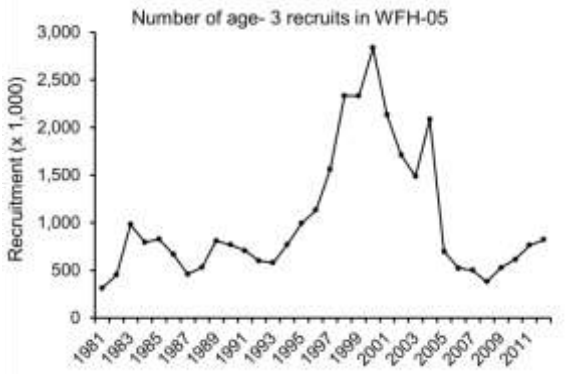












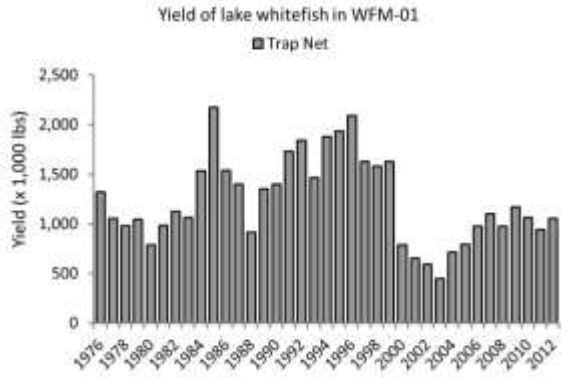
Parameter	Value
Base SSBR	4.03 lb
Current SSBR	1.51 lb
Target SSBR	0.26 lb
Current SPR	0.37
M	0.18 y^{-1}
F, trap net (2010-2012)	0.10 y^{-1}
F, gill net (2010-2012)	0 y^{-1}
Z	0.41 y^{-1}
Recommended TAC	727,000 lb
Actual TAC	634,300 lb
Model Rating	Medium

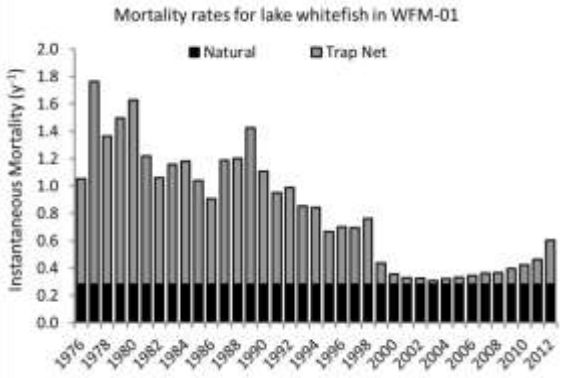
Notable Fishery Dynamics and Model Changes:

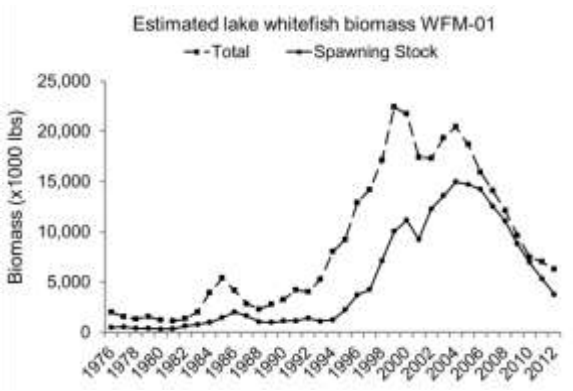
Biomass continues to decline in response to declines in recruitment. Maximum annual mortality was 52% (age 13) in 2012. Sea-lamprey induced mortality continues to be high on older age classes, though estimates are, on average, lower than previous assessments due to a change in the calculation methodology (see Northern Huron narrative). The 2014 yield limit declined 5% from 2013, primarily because the

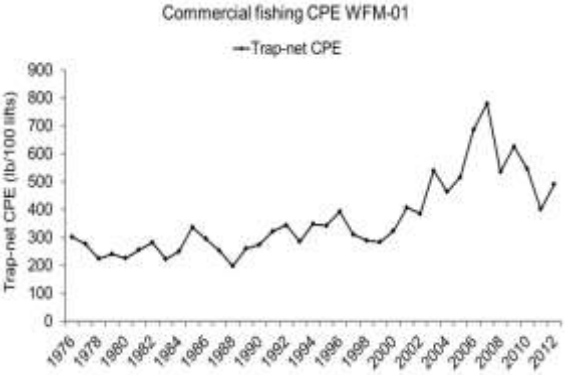
projected abundance of the fishable stock is lower than last year, a result of declining recruitment in the face of relatively high mortality on older age classes. Aside from allowing fishery catchability to vary freely through time, no substantive changes were made to the model structure. Model performance was rated medium, though strong retrospective patterns in spawning biomass remain an issue.

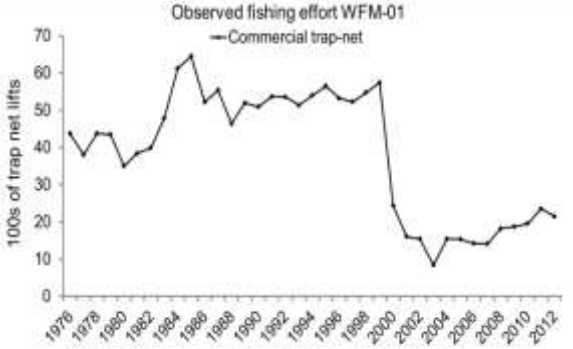
Lake Michigan
WFM-01 (Bays De Noc) — Mark Ebener

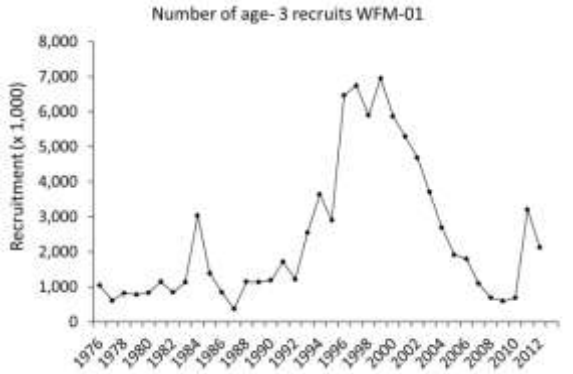












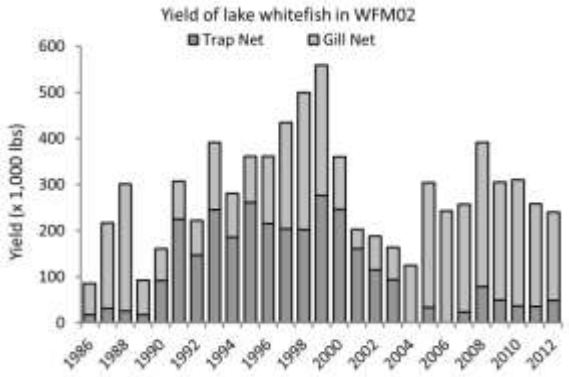
Parameter	Value
Base SSBR	1.61 lb
Current SSBR	0.73 lb
Target SSBR	0.18 lb
Current SPR	0.45
M	0.28 y^{-1}
F, trap net (2010-2012)	0.20 y^{-1}
F, gill net (2010-2012)	0 y^{-1}
Z	0.48 y^{-1}
Recommended TAC	1,354,000 lb
Actual TAC	2,000,000 lb
Model Rating	Low

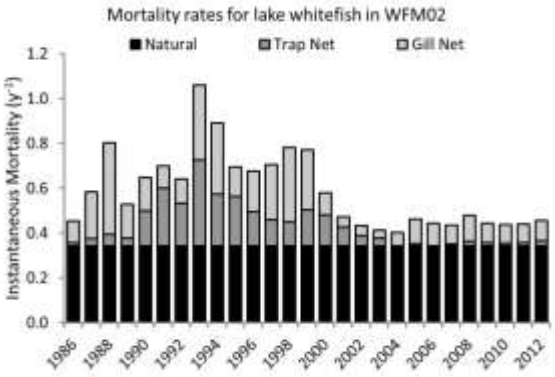
Notable Fishery Dynamics and Model Changes:

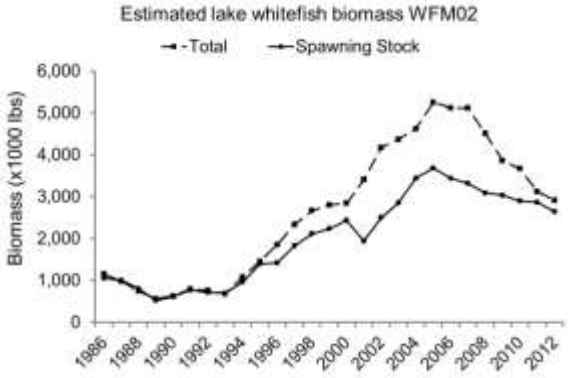
In the 2014 stock assessment model for WFM-01 the standard deviation around the Pauly equation was returned to 0.001 (from 0.1 in 2013), which resulted in a natural mortality estimate of 0.28 for 2014 compared to 0.17 in 2013. The 2014 SCAA stock assessment for WFM-01 was generally unstable because only slight changes to bounds or starting values produced assessments that did not converge or

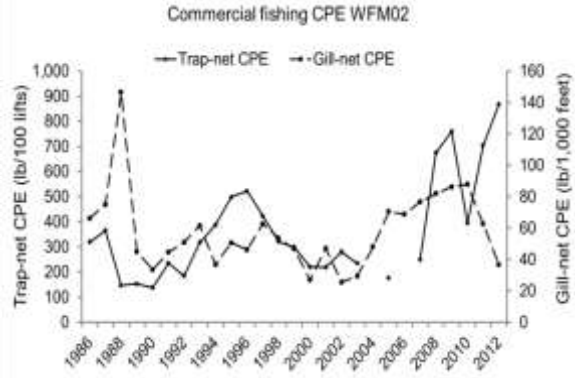
models that exited abnormally before reaching convergence. MCMC simulations were very poor showing bimodal probability distributions, sticky chains, and very high auto-correlation. As a consequence of a larger estimated natural mortality rate, 2012 estimated biomass in WFM-01 was roughly 55% greater than the 2011 value estimated with the 2013 SCAA. Biomass has declined over the last decade due to lower levels of recruitment. Age-12+ was the most fully vulnerable age group in 2012 with an estimated total annual mortality rate of 57%. The 2014 yield limit was 23% lower than 2013. Retrospective patterns of biomass, recruitment, and population size were mildly problematic. The WFM-01 stock assessment model is rated low because of the instability and poor MCMC results.

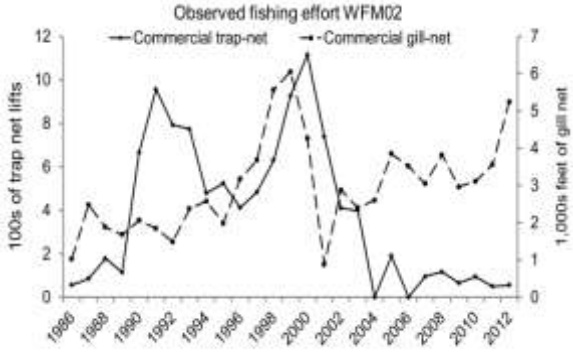
WFM-02 (Manistique) Ted Treska











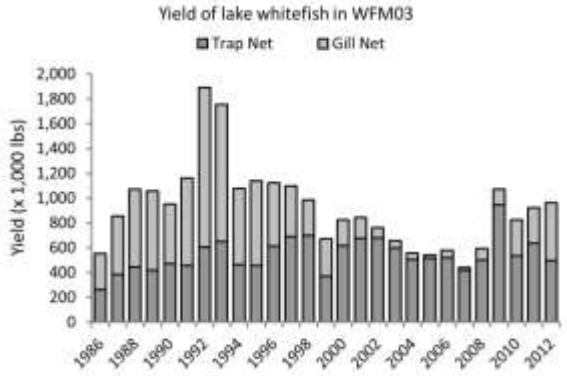
Parameter	Value
Base SSBR	1.40 lb
Current SSBR	1.09 lb
Target SSBR	0.19 lb
Current SPR	0.78
M	0.34 y^{-1}
F, trap net (2010-2012)	0.14 y^{-1}
F, gill net (2010-2012)	0.08 y^{-1}
Z	0.41 y^{-1}
Recommended TAC	559,000 lb
Actual TAC	559,000 lb
Model Rating	Low

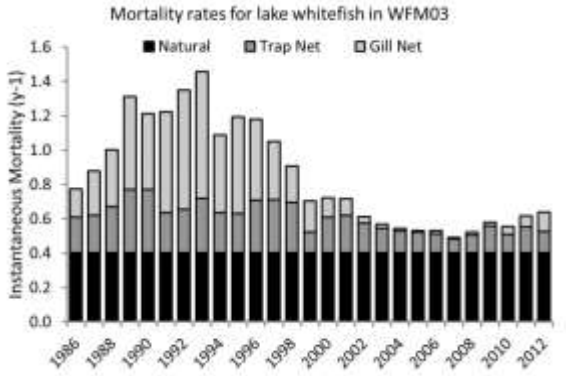
Notable Fishery Dynamics and Model Changes:

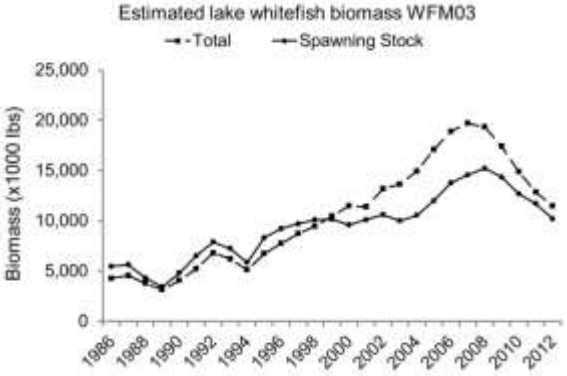
The 13% increase in the yield limit is likely due to increases in both population size and growth of older age classes, along with an apparent spike in recruitment in 2012. The 11 and 12+ age classes experienced the maximum annual mortality rate of 45%. Trap-net effort over the last decade is significantly lower than earlier in the time series, but trap-net CPUE has increased dramatically since 2004. Gill-net fishery effort

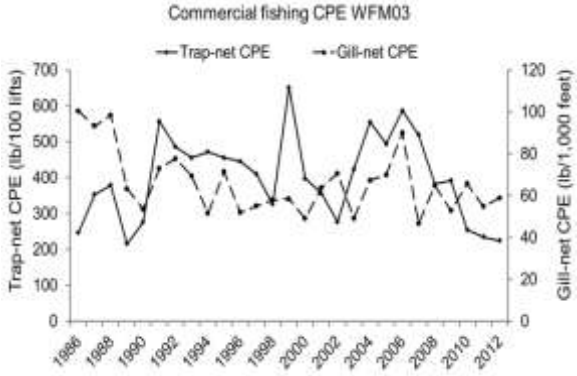
has expanded recently, yet catch rates have declined more than 50% in the last two years. A lack of a signal from the trap-net fishery during the mid-to-late 2000's continues to be a problem and model continues to struggle to match the gill-net age composition in the last 5 years. This model continues to be rated low due to convergence problems, retrospective analyses, and the requirement to fix some parameters for suitable model performance.

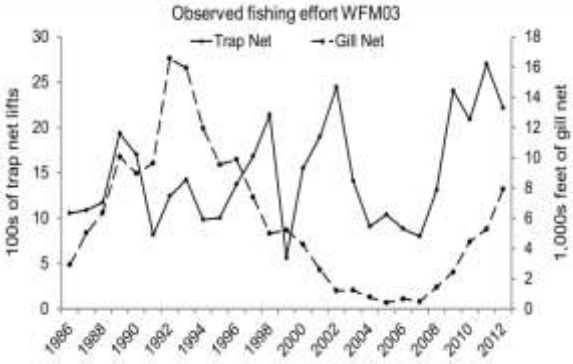
WFM-03 (Naubinway) Ted Treska









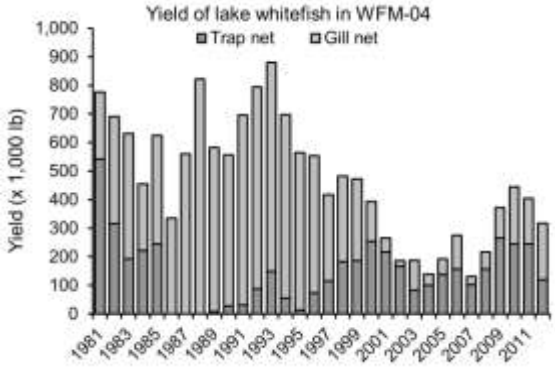


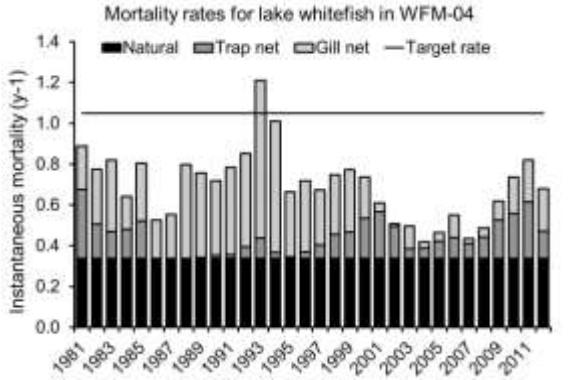
Parameter	Value
Base SSBR	1.45 lb
Current SSBR	1.09 lb
Target SSBR	0.15 lb
Current SPR	0.75
M	0.40 y^{-1}
F, trap net (2010-2012)	0.11 y^{-1}
F, gill net (2010-2012)	0.06 y^{-1}
Z	0.55 y^{-1}
Recommended TAC	976,000 lb
Actual TAC	976,000 lb
Model Rating	Low

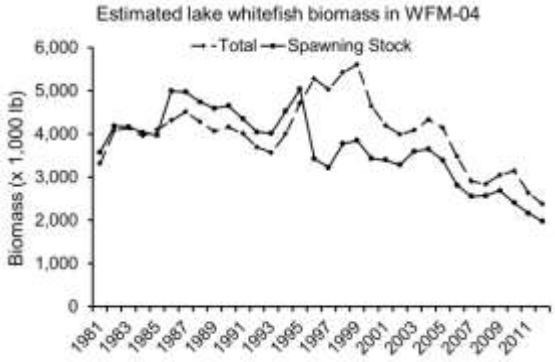
Notable Fishery Dynamics and Model Changes:
The 2014 yield limit declined 39% from 2013. In order to better track the population and the abundance of older fish, the "plus group" used in the model was changed from age 10+ to age 15+. Data in this year's model reduced the amount of expected recruitment over the last few years, which likely resulted in the decrease in harvestable biomass. The maximum annual mortality rate was 63% on age 13 fish. CPUE has remained relatively constant in both

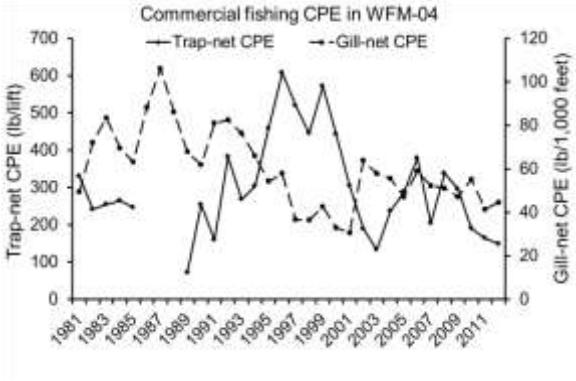
fisheries, with sizeable variations among the years, but a stable trend overall. Effort in WFM-03 has been increasing in both fisheries over the last 5 years, with trap net increasing almost 3 fold, and gill net increasing almost 20 fold. The model is rated low due to issues with retrospective patterns, including convergence issues in some iterations, and persistent covariance warnings.

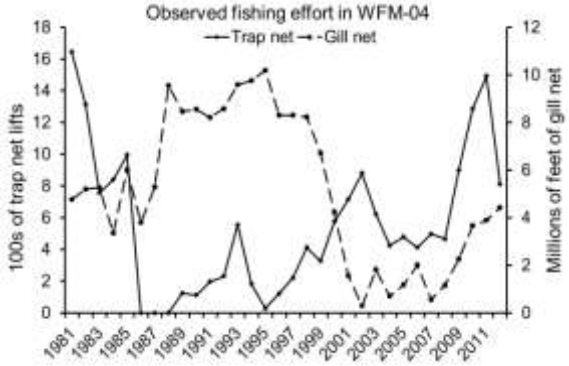
WFM-04 (Beaver Island) Kevin Donner











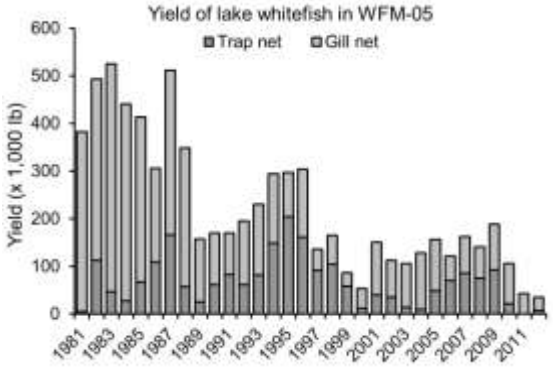
Parameter	Value
Base SSBR	1.52 lb
Current SSBR	0.76 lb
Target SSBR	0.20 lb
Current SPR	0.50
M	0.34 y^{-1}
F, trap net (2010-2012)	0.14 y^{-1}
F, gill net (2010-2012)	0.11 y^{-1}
Z	0.58 y^{-1}
Recommended TAC	548,000 lb
Actual TAC	548,000 lb
Model Rating	Medium

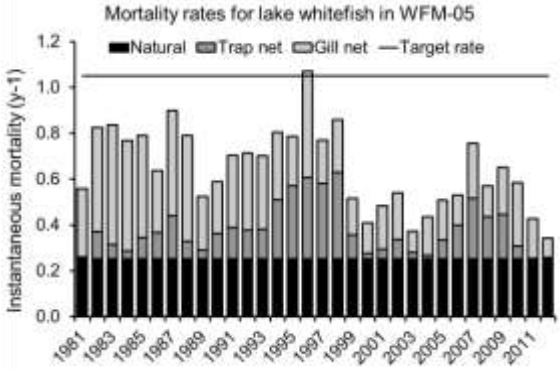
Notable Fishery Dynamics and Model Changes:

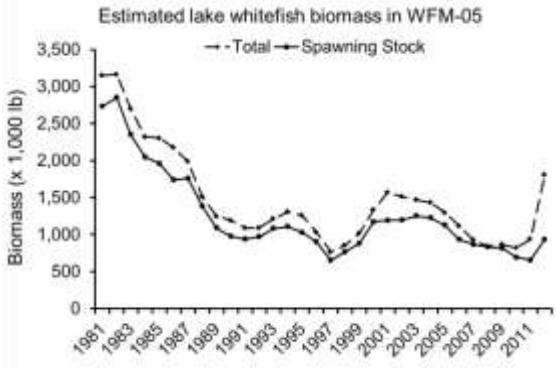
The 2014 yield limit is 14% lower than 2013, mostly attributable to a slow but steady decline in estimated biomass since the middle 1990s. Biomass trends are likely being driven by estimates of recruitment, since fishing mortality had declined markedly during 2000-2008 compared to the 1990s. The maximum annual mortality rate during 2012 was 34%. Yield declined predominantly due to a decrease in

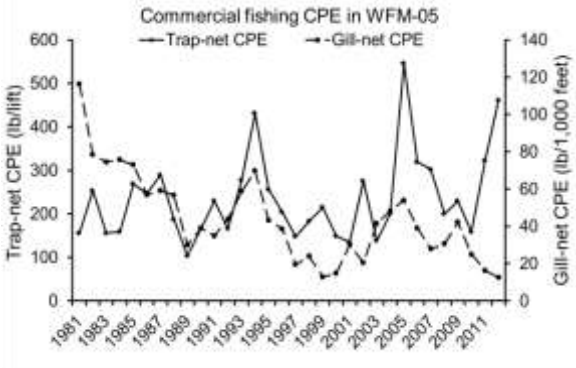
effort by the trap-net fishery after two operations moved from the unit. Gill-net effort has increased substantially since 2007 and, during 2012, gill-net yield exceeded trap-net yield for only the second time since 2000. Trap-net fishery catch rates have declined substantially compared to the middle 1990s and gill-net catch rates show a modest, but steady decline since 2002. The model was rated medium and exhibited generally good fit, no troubling retrospective patterns, and reasonable MCMC results.

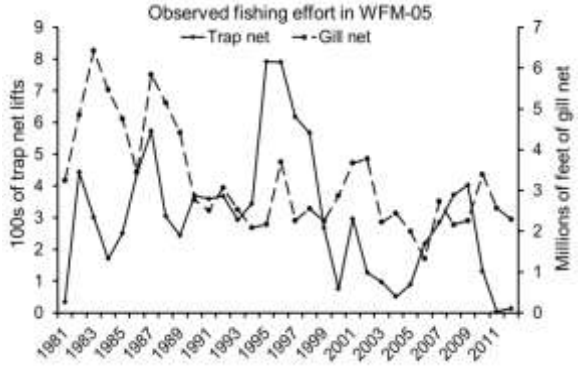
WFM-05 (Grand Traverse Bay) Steve Lenart

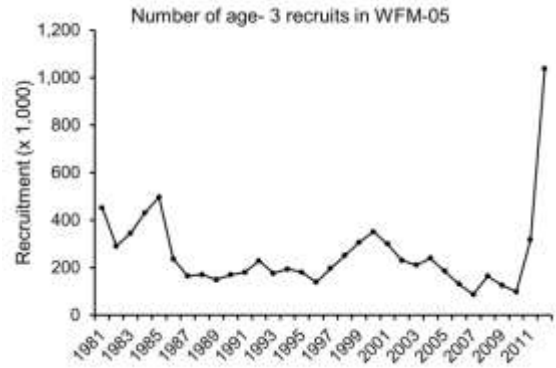












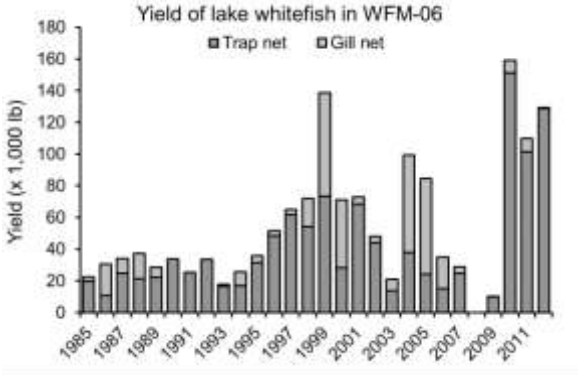
Parameter	Value
Base SSBR	3.45 lb
Current SSBR	2.11 lb
Target SSBR	0.30 lb
Current SPR	0.61
M	0.25 y^{-1}
F, trap net (2010-2012)	0.02 y^{-1}
F, gill net (2010-2012)	0.10 y^{-1}
Z	0.37 y^{-1}
Recommended TAC	492,000 lb
Actual TAC	492,000 lb
Model Rating	Medium

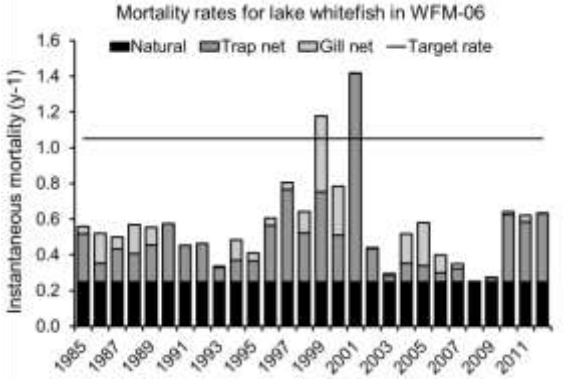
Notable Fishery Dynamics and Model Changes:

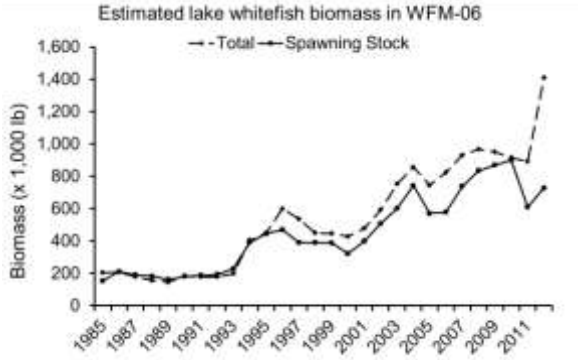
Estimated total biomass and abundance showed a substantial increase in 2012, driven by a huge estimated 2009 year class. Spawning biomass increased substantially as well, primarily as a result of substantial increases in growth over the past few years. This increase in mean weight-at-age was the primary factor driving the 35% increase in the model-generated TAC. Although gill-net effort remained fairly stable, the trap-net fishery has only recorded 18 lifts over the past

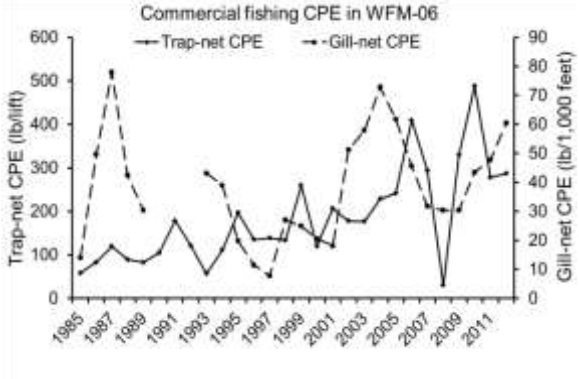
two years and fishery mortality rates remain low. No substantive changes were made to model structure and model performance was rated medium, although recent recruitment estimates are likely inflated. Recruitment estimates were influenced by the dominance of age 3-4 fish in the small number of 2012 fishery samples, all of which were collected late in the year. Maximum annual mortality was 29%.

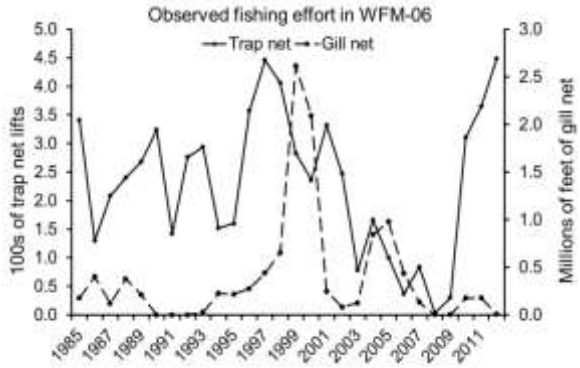
WFM-06 (Leland) — Dave Caroffino

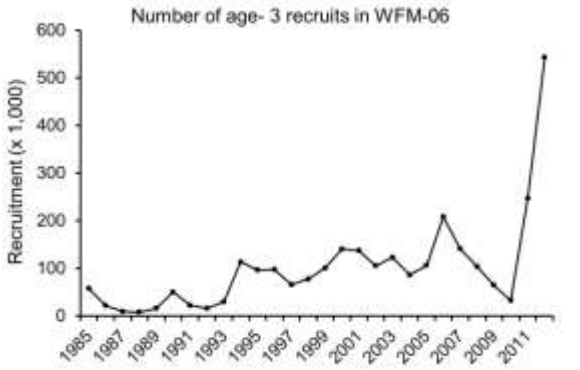












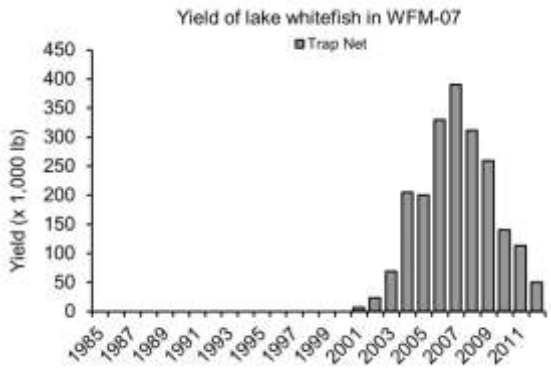
Parameter	Value
Base SSBR	3.86 lb
Current SSBR	1.84 lb
Target SSBR	0.45 lb
Current SPR	0.48
M	0.25 y^{-1}
F, trap net (2010-2012)	0.25 y^{-1}
F, gill net (2010-2012)	0.01 y^{-1}
Z	0.51 y^{-1}
Recommended TAC	250,000 lb
Actual TAC	250,000 lb
Model Rating	Medium

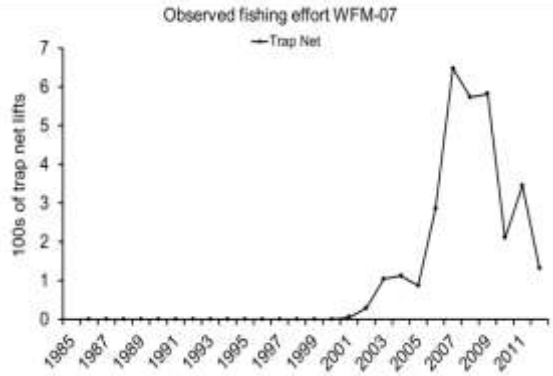
Notable Fishery Dynamics and Model Changes:

Recruitment in the last two years was estimated to be the highest in the time series. This was influenced by the highest proportion of age-3 and age-4 fish in the commercial biodata in the last decade. The maximum annual mortality rate experienced by the stock was 47%. The model structure was updated to include length-based selectivity, random walk catchability, and a modified approach to variance estimation. The model is rated medium because diagnostics have

improved with the new model structure. Yield was high in 2012, as was CPUE, and the evidence of young fish in the commercial monitoring data suggests that the potential exists for a strong recruit class to enter the fishery in the coming years. Therefore, the MSC recommends continuing the constant harvest limit for this unit (250,000 lb).

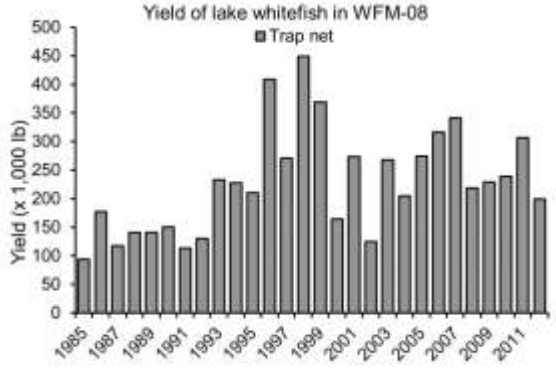
WFM-07 (Manistee to Pentwater)

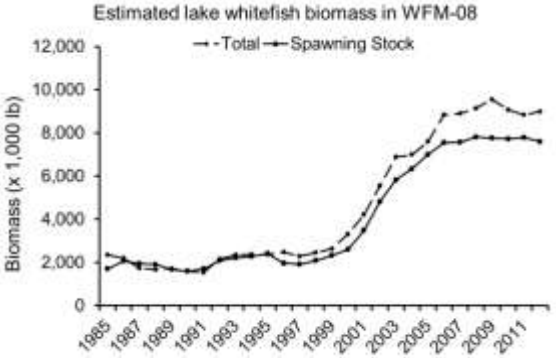


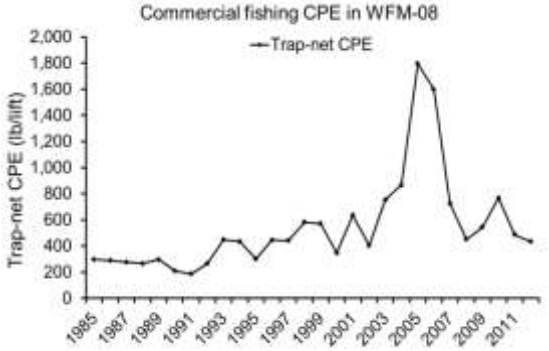


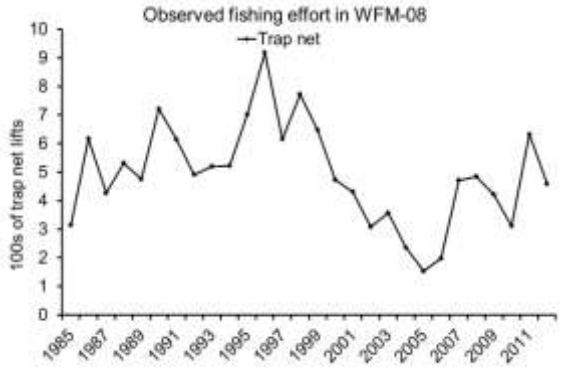
No stock assessment model has been developed for WFM-07. When the Consent Decree was initially signed, this unit lacked the necessary time series of data to populate a model. This time series continues to build as the fishery is executed under the terms of the Consent Decree and biological data continues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

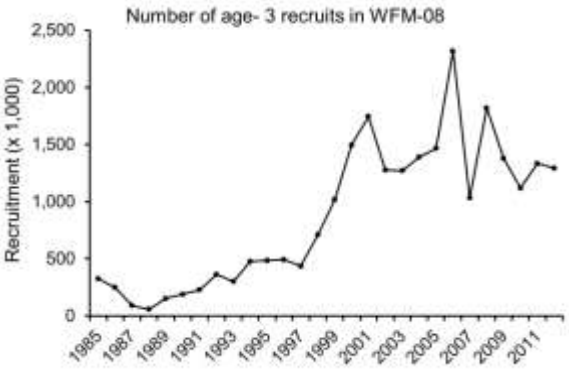
WFM-08 (Muskegon) Dave Caroffino











Parameter	Value
Base SSBR	2.41 lb
Current SSBR	2.06 lb
Target SSBR	0.40 lb
Current SPR	0.85
M	0.32 y^{-1}
F, trap net (2010-2012)	0.05 y^{-1}
F, gill net (2010-2012)	0 y^{-1}
Z	0.37 y^{-1}
Recommended TAC	1,500,000 lb
Actual TAC	1,500,000 lb
Model Rating	Low

Notable Fishery Dynamics and Model Changes:

The model structure has been updated to include length-based selectivity, random walk catchability, and a modified approach to variance estimation. Biomass has largely been unchanged since 2006, and recruitment over the past decade is above the long-term average, with particularly strong year classes in 2003 and 2005. The maximum mortality rate experienced by the stock was 35%. The model is rated low because it is somewhat sensitive to the variance

estimation technique. The model-generated harvest limit is 1,576,000 lb. Because overall yield is low and catch rates are near the long-term average, the MSC recommended that the constant harvest limit for this unit (1,400,000 lb), first adopted in 2013, be continued for 2014.