Personal observations on the management of the Mille Lacs walleye fishery

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Summary

1. The Mille Lacs fisheries management goal of protecting large walleye has suppressed young walleye survival and reduced walleye productivity

2. The current Mille Lacs walleye spawning stock biomass is plentiful and the population can produce ample walleye eggs and very large numbers of young walleye.

3. The walleye populations has not collapsed, weakened, or failed; however, the management system has struggled. Suggestions are provided on how to improve the system.

The current Mille Lacs fishery predicament, without a comprehensive management plan and dependence on complex fisheries models, demonstrates the challenges of managing a mixed fishery with passionate interests in the outcomes. The walleye population is in good condition. While the environment is changing and new species have arrived, the Mille Lacs fish populations remain robust in their ability to reproduce and sustain harvests. Now is a good time to modernize the fishery management system. Nature is resilient, governments can improve, and citizens can help us better manage these precious resources.

Introduction

The Mille Lacs walleye fishery is a complex biological and socioeconomic system. Given the complexity, there are many differences of opinion on the status of the fishery and on how the fishery should be managed. In 20l5 for a keynote presentation at a fisheries professional meeting, I presented evidence that the policy of continual stockpiling and maintenance of high spawning stock biomass may have been an important causal factor to the Mille Lacs walleye fisheries predicament. With additional data and information that assessment will be revisited without prejudice.

There is a rich source of data on the Mille Lacs walleye population dynamics. Agency staff are diligent in the collection, compilation, and analyses of annual data on fish relative abundance, fish growth, angler creel statistics, and walleye population size. The agency has described their management procedure. This management procedure includes an annual cycle of assessments that produce an estimated walleye population size, a method of determining and deciding on the total desired walleye harvest/kill, the selection of harvest regulations, and regular monitoring of angler creel and various biological communities. The agency provides an annual fishery report to the joint Fisheries Technical Committee. The annual reports provide quantitative information and unfortunately, they do not summarize the status of the fishery. The first question to be addressed is: **What aspects of Mille Lacs fisheries management need improvement?**

The substantial restrictions on walleye angling in recent years has led many to properly ask: at are the reasons that some have a bleak view of the walleye population? While some point

to system change as the main factor in the reduction of the walleye population[1], the best scientific-based summary might be a 2014 contract report[2]. This report concluded that low juvenile walleye survival may be due to predation primarily from adult walleye (secondarily other predators) and that the high walleye cannibalism was likely due to an abundant adult walleye population made of up of large fish. Is this a reasonable conclusion? **What factors were important in the reduction of the walleye population?**

Related to the second question on the cause of the recent walleye reduction, some suggest that the Mille Lacs walleye productivity is unlikely to return to levels experienced 20 years ago.[3] Water clarity increases, impacts from non-native species (zebra mussels and spiny water fleas in particular), and a changing climate are cited. The final question: **Is reduced walleye carrying capacity reasonable and supported by science conducted on similar fisheries?**

1. On the question of how to improve the agency's management approach

There are several weaknesses and shortcomings with the Mille Lacs fishery management. First, misunderstanding the status of the walleye fishery can lead to unduly conservative measures that create local hardship and foregone harvest. Second, ambiguous management goals and objectives can lead to overly simplistic or ad hoc management decisions[4]. Third, the lack of a strong governance structure or a complicated governance structure can lead to problems with accountability and credibility.

Recent walleye quotas were set assuming that spawning stock biomass was at or near critically low levels. *This assumption is incorrect*. **The current Mille Lacs walleye spawning stock biomass is plentiful and the population can produce ample walleye eggs and very large numbers of young walleye.** The latest Mille Lacs spawning stock biomass estimates are similar or greater to other walleye populations. In 2017, the estimated Mille Lacs walleye spawning stock biomass was 6.6 pounds/acre with mature female biomass at 3.0 pounds/acre[5], which is higher than levels found in other Minnesota large walleye lakes[6]. In addition, the estimated natural walleye fry production for Mille Lacs in 2016 was about 7,000 walleye fry/littoral acre[7], which is *seven times greater* than the typical DNR walleye-stocking rate used to produce a good

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1 http://www.dnr.state.mn.us/millelacslakeunderstanding.html

2 Mille Lake Walleye Blue Ribbon Panel Data Review and Recommendations for Future Data Collection and Management 2014. Other contracted studies are also available. Several peer-reviewed scientific articles on the Mille Lacs fishery have been published, but these articles focus on specific elements of the fishery and do not fully address the questions posed here.

3 July 21, 201; News Release Mille Lacs Lake FAQ for summer 2017

4 In 2001, respected fisheries scientists encouraged a management plan for reasons stated. See Bence, J. R., and T.J., Quinn II, 2001 Review of the Minnesota DNR's Mille Lacs Lake walleye assessment.

5 2017 MN DNR Mille Lacs Annual Report, 70. Metric conversion: hs3.0 pounds/acre = 3.4 kg/ha; 3.4kg/ha x 50,000 eggs/kg = 170,000 eggs/ha

6 The reader is encouraged to examine the annual large lake reports from Leech, Upper Red, and Winnie.

7 DNR walleye fry estimates from marked fry stocked in spring of 2016. This is an independent assessment of spawning stock biomass from the fisheries gillnet survey. The 95% confidence interval was about 5,000 to 9,000 natural fry per littoral acre. This estimate and confidence interval are unbiased if the mark-recapture experiment assumptions were not violated (e.g., marked fry and natural fry had equal survival; see Ricker 1975, section 3.3, for a description of this and other Peterson estimate assumptions). Recent fisheries research estimated natural fry production to average about 1000 fry/littoral acre in four Minnesota lakes (Vermillion, Winnie, Woman, Otter Tail) and to have large year-to-year variability (D. Logsdon, DNR research scientist, personal communication).

walleye fishery in lakes without natural reproduction[8]. Yet the management goal continues to unduly protect spawning stock biomass.

It is likely that Mille Lacs now has a moderate to high amount of spawning stock biomass, down from the very high levels in the 2000s after several years of harvesting medium-sided walleye[9]. The spawning stock biomass to young walleye production relationship is such that the highest quantity of young fish is often produced when the spawning stock is at a moderate level. The exploitation of 4-year old walleye in the 2010-2012 period, which likely resulted in a slightly reduced spawning stock biomass in the years following had the beneficial effect of producing favorable conditions for high young fish production and survival. **The management goal of protecting large fish has suppressed young walleye survival and reduced walleye productivity**. The unfortunate consequences of these conservative actions likely diminished the economic value of the fishery as maintaining high spawning stock biomass reduced surplus production[10].

The Mille Lacs management procedure has a benchmark of 10 pounds of mature walleye per gillnet survey net (established in 2015). This benchmark is used to trigger walleye harvest closure, and presumably it may influence quota setting. The spawning stock biomass to young walleye production relationship can only be fully understood with a broad range in spawning stock biomass. Unfortunately, the available data on the Mille Lacs walleye population lacks any records of low spawning stork biomass (i.e., the time series of estimates include only high levels of walleye abundance, unlike the datasets from other Minnesota lakes, such as Upper Red Lake which had many years low or very low spawning stock biomass). It appears to be little biological support for the selection of 10 lbs/net, and it appears to be based on it being close to the minimum of the 52-net dataset (1998-2015). **Therefore, a benchmark that is used to influence quota setting and close the Mille Lacs walleye fishery appears arbitrary.**

The Mille Lacs fisheries management approach consists of a set of procedures that is heavy dependent on numerical computations with minimal stakeholder involvement and accountability. A comprehensive Mille Lacs fisheries management plan does not exist. A management system update plan has not been developed, approved, or implemented. A decision support system for the Fisheries Technical Committee has not been fully developed or implemented. The goal for the fishery is to maintain or to produce a very high level of spawning stock biomass, which is unduly conservative and, unfortunately given conditions of the fishery today, detrimental to the vitality of the fishery.

It is important to develop a set of goals and objectives in managing an important fishery[11] The DNR's Lake Management and Planning Guide compels managers to explicitly slate goals and objectives. Plans provide a process for continuity, a means of evaluating the management

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8 Typical walleye stocking rates for lakes is 1000 fry/littoral acre, while rearing ponds acre stocked with approximately 3000 fry/littoral acre.

9 Suppressed young walleye survival and the harvest of medium fish reduces the number of fish that continue in the population thereby reducing spawning stock biomass in future years. Experienced fisheries managers that I spoke to noted that the current Mille Lacs walleye spawning stock biomass remains high (rather than moderate).

10 Richer, W. E. 1975 Computation and interpretation of biological statistics of fish populations, Fisheries Board of Canada Bulletin 191. See page 309 for the 3 reasons this is true. For surplus production definition see https://en.wikipedia.org/wiki/Glossary_of_fishery_terms

11 DNR has excellent fisheries management plans on many lakes. The reader is encouraged to review the Leech Lake Fisheries Management Plan, which has a clear goal and 7 specific objectives. Thoughtful citizens were critical to the development of the plan.

efforts, a way of documenting issues with the fishery, and a process to listen and include stakeholder feedback. As noted, the goal for Mille Lars has been maintaining a high walleye

spatting stock biomass[12]. What is a good goal for the Mille Lacs fishery, which has important angling and tribal harvest components?

An important driver in creating the current management crisis has been the governance structure. **The Mille Lacs walleye population has not collapsed, weakened, or failed, nor does it need to be rebuilt; however, the management system has struggled.** To improve management, one may need to start with setting reasonable goals and objectives for the Mille Lacs fish populations and fishery. Second, **meeting a quota with hard edges and undue protection of large fish is not likely in the best interest of a tribal or sport angler fishery**. A more pragmatic approach to managing harvest could be considered. For a mixed walleye fishery, it may be best to have a management goal that strives to seek a walleye population with a diverse age and size structure and not one that is top heavy with undue levels of spawning stock biomass, especially given the potential future ecological effects of zebra mussels and spiny water fleas (see Fig. 1 to see how the Mille Lacs walleye age distribution has changed and see Question f#3 below). Third, **the management system could be simpler. It could be more pragmatic on the difficulties of estimating the number of walleye in the lake with enough accuracy for a hard-edged quota** (see Fig, 2 that shows the inherent uncertainties of the models used). In addition, the management system could be more pragmatic with angling regulations (over a dozen different angling regulations have been employed since the enactment of the management procedure).

Specifically, improvements to the fisheries management and governance system could undertake the following steps:

1. **Create a process and facilitate that process to develop a management plan.** Thoughtful citizens representing tribal community, the sport angling community, and the local communities could be the source of the fishery goals and objectives, with fisheries managers providing, technical guidance on specific measurable objectives. This will take time, but "well begun is half done"[14].

2. **Seek a short-term moratorium on Protocol #5- Attachment A and the Harvest Plan**, which specifies the current management procedure and operational directives. A moratorium will provide the space necessary for a good management plan to be created. In absence of the existing management procedure and directives:

a. Set a reasonable average annual walleye target harvest, with appropriate tribal and state allocations that will be suitable for use while the plan is being developed (e.g., one or two years). The target harvest would not be overly conservative, nor excessively liberal. Given possible decreasing walleye carrying capacity, consider an annual target harvest closer to 200,000 pounds rather than 40,000 pounds or 500,000 pounds[15].

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12 To the public, it is a goal without specifics and one that is not placed in context with other large walleye lakes in Minnesota.

13 The current system is complex with its management procedures. Harvest plans, allowable overages, overage caps, Consensus plans, etc.

14 Quoted by Aristotle in his *Politics*

15 200,000 pounds for Mille Lacs translates into 1.5 lbs/acre, which is lower than walleye harvest elsewhere (e.g., recent harvest on Upper Red) and lower than the time period before the current management procedure (3.6 lbs/acre; 475,000 pounds was the median walleye harvest for Mille Lacs from 1983-1996). The recent 40,000 pound quotas were likely a result of perceptions of the fishery and not likely a direct result of the protocols, the models, or the data. The size of the walleye harvested is also important, the plan could encourage a harvest over a broad size range. In a changing environment that mat reduce carrying capacity, the reduction in abundance of the old fish is a prudent action

b. Use walleye population metrics to judge the consequences of annual harvests. Metrics that can be used to compare the Mille Lacs fishery with other Minnesota large lakes would be preferred.
c. Apply a sport fishing regulation likely to be consistent with target harvests and to produce a walleye age or size distribution similar to other Minnesota large walleye lakes (e.g.. protected slot with a low bag limit[16]).

3 **Improve the governance structure.** This work would greatly benefit from University of Minnesota experts to help on effective governance
   a. Create a process to update the management system so that it better deals with the shortcomings of the kill-at-age models and avoids serious management traps.
      i. This process would also benefit from the wisdom of the Red Lake Nation and the DNR Bemidji Office[17], as they have created a cooperative management system that provides valuable insight in how to move to a simple system that is both more flexible yet protective of a valuable fishery. Notably they have a system that attempts to avoid the trap of stockpiling excessive spawning stock biomass.
   b. A fairer structure for making decisions would be helpful. How can the joint Fisheries Technical Committee be improved?
   c. The revised fishery management approach would incorporate periodic audits and have a fair and transparent management system.
      i. Blind reviews allow frank assessments that will not damage existing professional relationships[18].
      ii. Audits would also include more topics than fish population kill-at-age models and other fisheries technical issues. They would be expanded to review how decisions are made and assess biases and transparency issues.
      iii. Accountability is insufficient in the current system, Mistakes are made, as we are all human, but how are those mistakes communicated, fixed, and addressed? Are they addressed in the best interest of the management of the resource and the staff involved? Currently mistakes may be hidden and accountability for various actions unclear. Who is currently held accountable and who should be in an improved governance system?

2. On the question of Mille Lacs walleye population reduction

The likely primary reason for the reduction in the walleye population is the direct consequence of the long-running Mille Lacs fisheries management goal of protecting spawning stock biomass (as evidenced in the protection of large fish since 1999; see Fig, 3 & 4). Spawning stock has recently been reduced due to exploitation on medium-sized walleye from 2010 through 2012 (Fig. 5; the estimated exploitation rate exceeded 50% on the 4-year-olds in 2012[19]). The management goal of protecting large fish has suppressed young walleye survival and reduced

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16 Preferably a regulation that produces a harvest length frequency distribution distinct from the tribal harvest length frequency distribution

17 Readers are encouraged to review the harvest Plan for Red lakes Walleye Stocks (2015 revision). Fisheries professional to seek guidance would include G. Barnard, A Kennedy, and W. Brown.

18 The DNR has received excellent external reviews, but a blind auditing and review process may be more suitable.

19 Ibid. 5, 84-85

walleye productivity, which is well-studied and understood phenomena[20]. The suppression of young walleye is supported by the data, for 10 years Mille Lacs has not had a strong walleye class. High exploitation rates can be a concern from a sustainability perspective. However, in this case the exploitation slightly reduced the high spawning stock biomass and created favorable conditions for the production of a strong walleye year class. **Strong year classes are more likely when spawning stock biomass is of moderate abundance rather than at high abundance**.

The causal agents for the low young walleye survival believed by others include clearer water, more predators (northern pike and smallmouth bass), aquatic invaders, food competition, and fewer cisco[21]. It was stated by an official that "fishing has been a small player" in reducing the walleye population, with a perfect storm of invasive species as the primary cause for the reduction.

There are several weaknesses with the hypothesis attributing non-native species as the primary cause of the lower walleye population. First, **the timing of the arrival of non-native species and their supposed consequences are ill-aligned.** Zebra mussels, while detected in Mille Lacs in 2005, only had high densities since 2011. Spiny water fleas were first detected in 2009. Persistent long-term reduced walleye recruitment is evident in the population assessment data (since~2000), and only recently, at the time of the highest zebra mussel density and an abundant spiny water flea population, did Mille Lacs produce a strong walleye year class (the 2013 cohort). Second, in a contractors' study on identifying the parts of the walleye life cycle that are likely contributing to a reduced population, the investigators concluded that predation on juvenile walleyes, mainly from adult walleye, was a likely cause[23]. Their conclusion is consistent that the likely agent for the reduced walleye population is the undue protection of spawning stock biomass and the resulting young walleye survival suppression. They also stated that found no evidence that Mille Lacs walleye were food-limited nor any sustained decline in the relative abundance of older or larger adults, The investigators note that increased abundance of older walleye was an important factor in low walleye recruitment:

> *Population regulation through cannibalism is an interesting phenomenon that is present in some fish species and can lead to cycles in fish populations, especially when fishing rates are low (Lantry and Stewart 2000) These cycles occur because cannibalism limits recruitment and ultimately erodes adult abundance; however fewer adults leads to less cannibalism, higher recruitment, and an eventual increase in adult abundance.*

Therefore, it is reasonable lo conclude that a policy of continual stockpiling and maintenance of high spawning stock biomass was the most likely factor in the lower Mille Lacs walleye population.

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20 Richer, W.E. l975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada Bulletin 191. See section 11.5 and page 309.

21 See Why is this happening? http://www.dnr.state.mn.us/millelacslake/understanding.html. The agency has stated that the state and tribal fisheries management has played a role in the reduction of the walleye population. http://content.govdelivery.com/accounts/MNDNR/bulletins/afec9a. This statement is not specific and the agency continues to emphasize the effects of non-native species and other ecosystem changes (e.g., http://news.dnr.state.mn.us/2016/05/09/dnr-releases-walleye-fry-into-mille-lacs-lake-capping-milestone-in-renewed-management-efforts/). Dave Schad, DNR Deputy Commissioner, reminded me that an internal DNR presentation acknowledged that harvest played a role in Mille Lacs fisheries predicament (8/24/2015 email).

22 DNR official on July 18, 2017: American Fisheries Society Walleye Technical Committee, Mille Lacs workshop, McQuoid Inn, Isle, MN.

23 Other predators were also cited as contributing to lower survival rates of juvenile walleye.

Actions of other fisheries managers appear to support a growing consensus that policies of regulations that result in excessive stockpiling of old walleye may create less productive walleye fisheries. For Upper Red Lake, which has a DNR-Red Lake Nation joint harvest plan, a recent news release stated:

> "The new harvest plan recommends a more aggressive approach when walleye spawning stock is in surplus, as it currently is," Barnard said. "The extra fish allowed by the daily bag limit will increase open water harvest some, and allowing one fish over 17 inches meets our harvest plan objectives by spreading harvest over a wide range of sizes and removing some of the surplus spawning stock[24].

Other recent examples of relaxed restrictions on old walleye harvest include:

1. Lake Winnibigoshish – no harvest of fish from 17-26" relaxed to 18-23"protected slot(PS), with only one longer than 23 inches.
2. Leech Lake – no harvest of fish from 18-26" relaxed to 20-26" PS. [growth and recruitment impacted]
3. Rainy Lake – no harvest of fish17-28" relaxed to 18-26" PS. [more harvest opportunities]
4. Lake Vermilion – no harvest of fish from18-26" relaxed to 20-26" PS. [more harvest, sufficient spawning stock biomass]

3. On the likelihood of a reduced Mille Lacs walleye carrying capacity

While the recent non-native species additions unlikely played a large role in the decline of the walleye fishery, is it likely that these additions and other changes may have substantial future negative consequences? Zebra mussels reduce phytoplankton, and increase submerged vegetation coverage and bottom-covering algal biomass, which can have fish population consequences. The addition of spiny water fleas has likely altered the zooplankton community. The food web and energy flow changes occurring in Mille Lacs may yet ultimately impact walleye productivity. The food web and energy flow changes can reduce resources available to walleye (e.g., nutrients and forage). In addition, these changes can influence walleye behavior and their distributional patterns in the lake, Lastly, future Minnesota climate conditions will likely be more suitable for warm-water fish species, like bass, and less suitable for cool water species such as walleye.

A reasoned inspection of the scientific literature concludes that there is sufficient strength of evidence to adequately conclude that the Mille Lacs walleye carrying capacity is likely beginning lo be affected and may be reduced in the future.

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24 April 3, 2017 DNR news release http://news.dnr.state.mn.state.us/201704/03new-upper-red-lake-walleye-regulations-announced

25 Two references: [1] Higgens, S.N., and M.J. Vander Zanden, 2010. What a difference a species makes: a meta analysis of dreissenid mussel impacts on freshwater ecosystems. Ecological Monographs 80(2): 179-196. [2] Neinhaus, S., T.J. Haxton, and T.C. Dunkley 2014 An empirical analysis of the consequences of zebra mussel invasions on fisheries in inland freshwater lakes in southern Ontario. Management of Biological Invasions 5(3):287-302.

26 Ibid. 5, 48.

27 Kunar, R.D. Varkey, and T. Pitcher, 2016.

Simulation of zebramussels (*Dreissena polymorpha*) invasion and evaluation of impacts on Mille Lacs Lake, Minnesota: an ecosystem modeling 331:68-76.

28 Hansen, G.J.A., J.S. Read, J.F. Hansen, and L.A. Winslow, 2016. Projected shifts in fish species dominance in Wisconsin lakes under climate change. Global Change Biology 23: 1463-1476

Figure 1. The relative abundance of Mille Lacs walleye for two time periods – before and after the enactment of the management procedure. Note the reduced variability of young walleye (3-8 year olds) and higher relative abundance of old fish (9+) with the management procedure and continual stockpiling and maintenance of high spawning stock biomass.

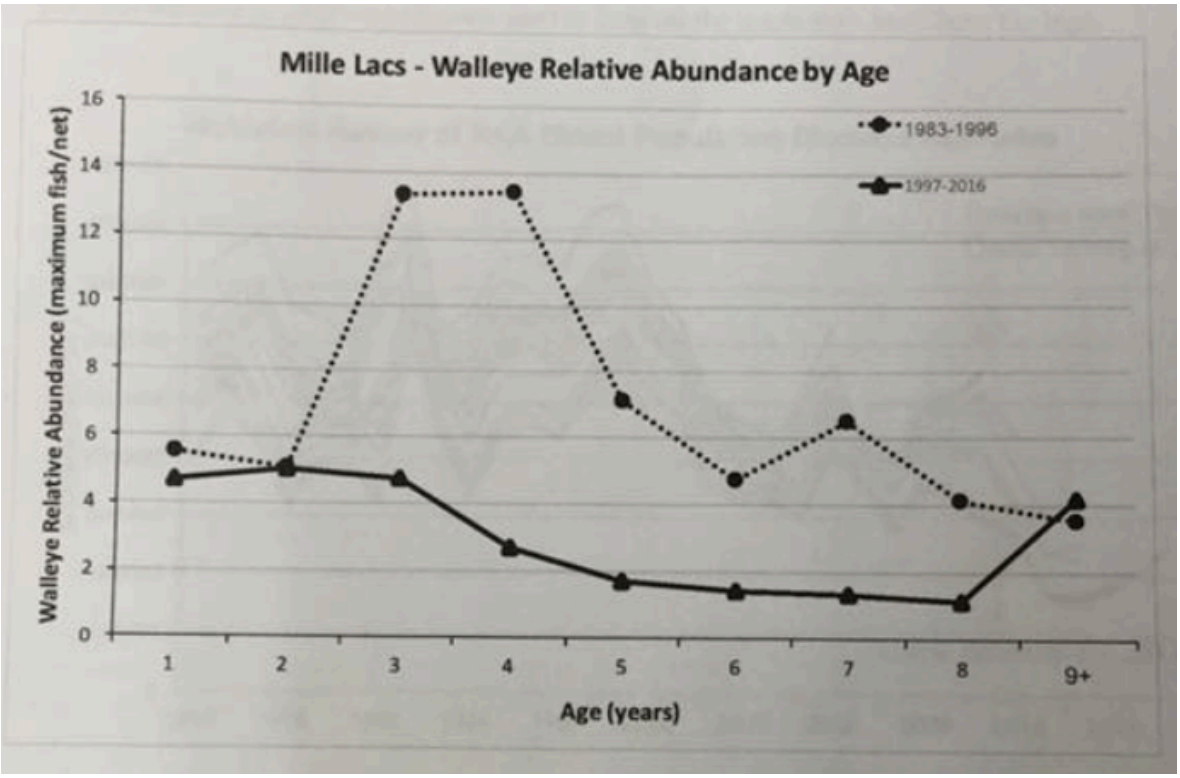

Figure 2. Estimates of the Mille Lacs walleye population (biomass in pounds) from 2004 to 2017 using kill-at-age models. The 2017 estimate is the red line. Note the large variation in estimates for all years. The population estimate made for the quota setting in 2011 was 87% higher than the estimate made in 2017 for that year (note the difference between the two arrows). The2017 year estimates (red line) are generally lower than the estimate used for quota setting. This is a problem because population estimates used to set the quota may have been too high.

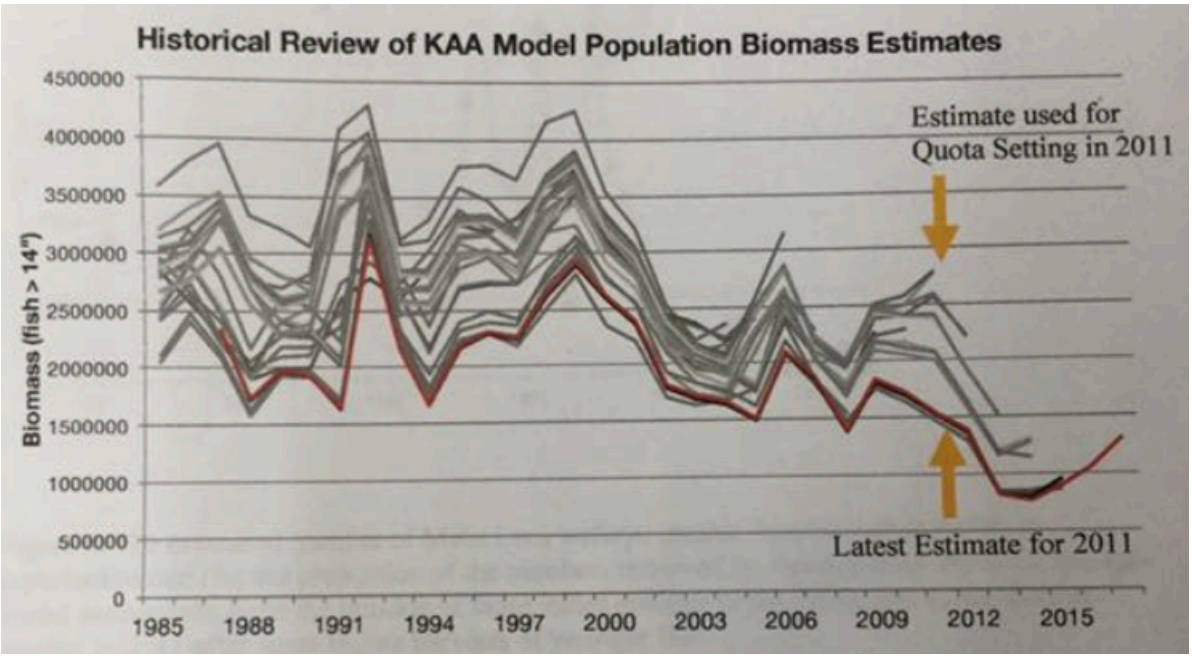

Figure 3. The estimated number of Mille Lacs walleye greater than 20 inches killed by state anglers. Note that since 2000 the number has dramatically declined.

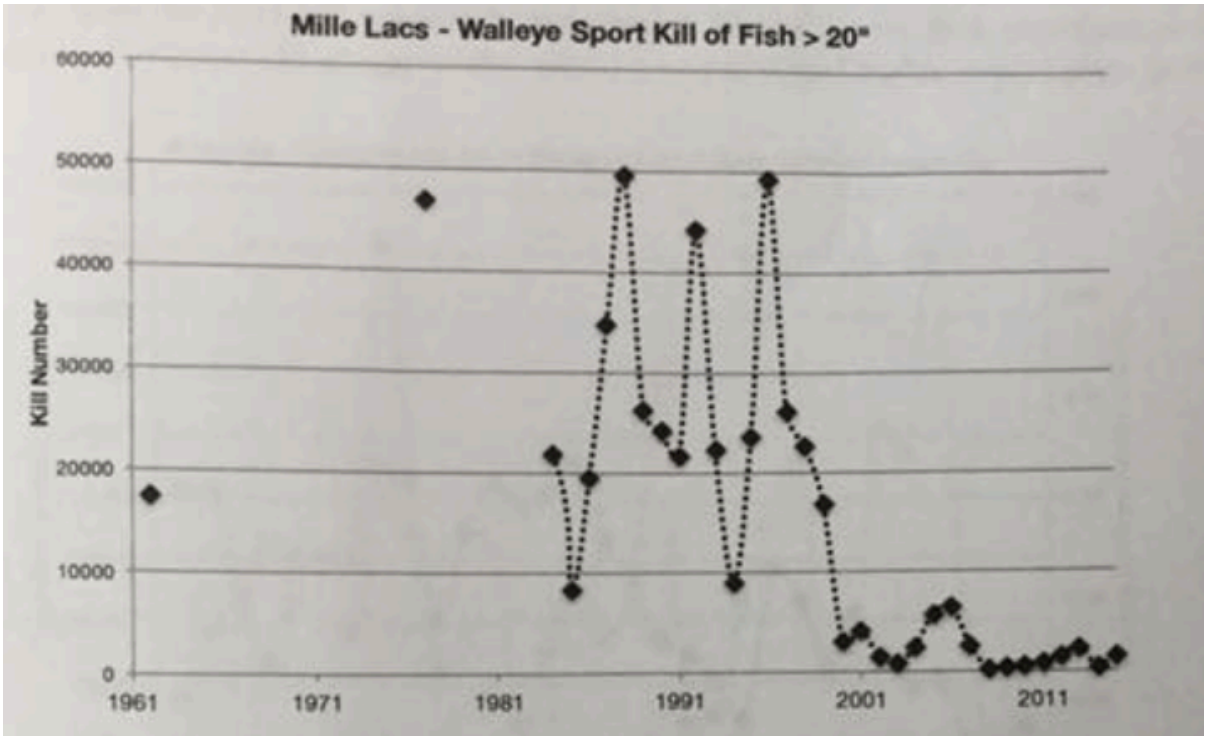

Figure 4. The estimated number of Mille Lacs walleye greater than 20 inches and their exploitation rate (%; the proportion of the numbers removed by fishing) from the 2015 kill-age-model assessment. Note the buildup of large, older walleye in the 2000s and then a decline starting in 2011 after some higher harvests of younger fish.

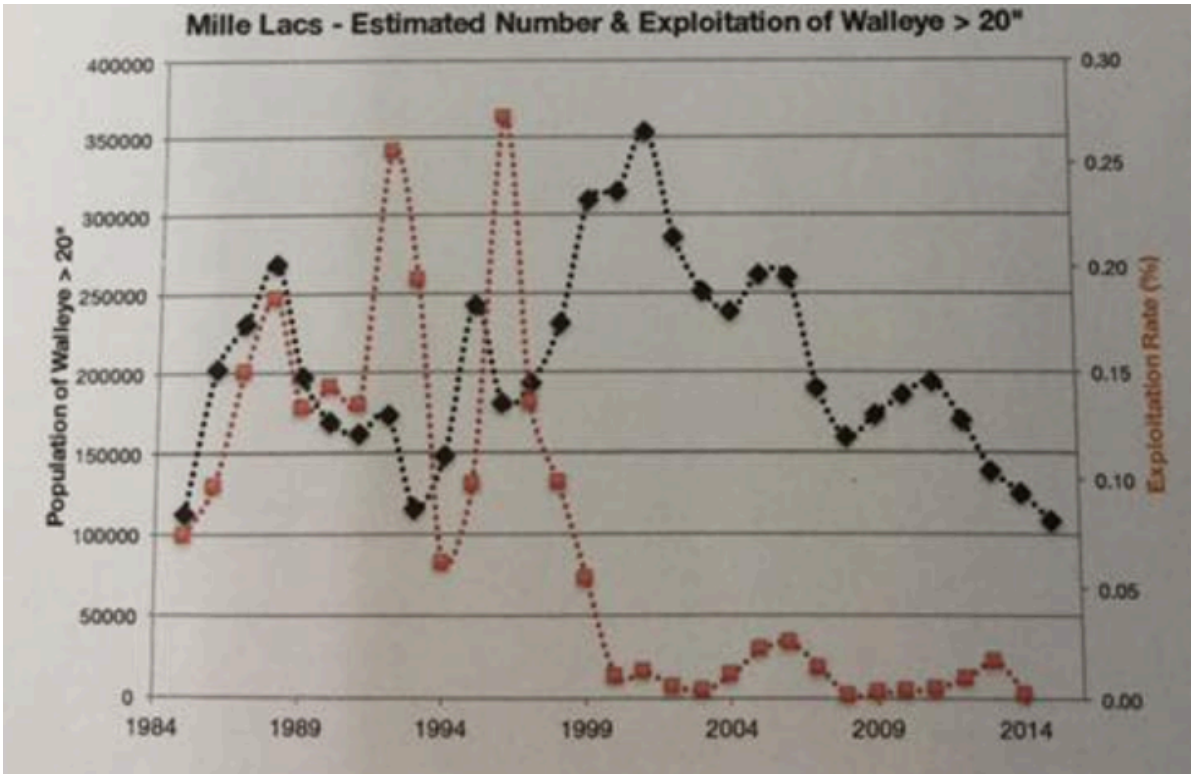

Figure 5. The estimated number of Mille Lacs walleye between l4 and 20 inches and the estimated exploitation rate (%; the proportion of the numbers removed by fishing) of 4-year-old fish from the 2015 kill-age-model assessment. Note the very high exploitation rates in 2010-2012. The latest kill-at-age model assessment estimated higher exploitation in these years.