WALLEYE LAKES OF CONCERN MANAGEMENT PLAN

Clear and Katherine Lakes, Oneida Co.

Anvil and Laura Lakes, Vilas Co.

A joint approach by the Wisconsin Department of Natural Resources (DNR), the Lac Du Flambeau (LDF) Band of Lake Superior Chippewa Indians, and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) to address walleye declines in four select populations

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INTRODUCTION

A number of lakes across northern Wisconsin have experienced declines in walleye (ogaa) recruitment over the past two decades. This has prompted numerous efforts to mitigate walleye population declines (e.g. more conservative regulations, increased stocking of large fingerlings, research projects, habitat restoration) while continuing to provide shared fishing opportunities. While these measures are showing preliminary signs of benefit within some walleye populations, other populations are not responding as hoped. Lake ecosystems and their fisheries may respond differently to management actions, possibly resulting in mixed responses and different timetables for recovery. As waterbodies and fisheries experience change, fisheries management strategies must adapt to conserve walleye resources.

The following lakes have experienced walleye recruitment declines and subsequent decreases in the adult walleye population: Clear (Oneida), Katherine (Oneida), Anvil (Vilas), and Laura (Vilas). Historically, these lakes had self-sustaining walleye populations where natural reproduction and recruitment provided good walleye fisheries. Some management actions have already been implemented to aid these struggling populations, but it is our intent to take additional steps to expedite their recovery.

Within the corresponding sections of this plan, we will identify:

1. Walleye management objectives aimed at population recovery and sustainable fishing opportunities,
2. walleye management strategies to achieve the objectives,
3. evaluation timeline, monitoring requirements, and key measures of success,
4. a public outreach and reporting process to inform stakeholders of project plans and progress.

5. summaries of historic fisheries data and fisheries management strategies within each lake for perspective and understanding.
6. Lake-specific habitat, aquatic plant management, and aquatic invasive species for perspective on potential influences with the associated fisheries.

The goal of this plan is to promote the restoration of sufficient walleye natural reproduction to sustain walleye populations and maintain continued fishing opportunities in these four lakes. We feel that the objectives identified in this plan are realistic, despite uncertainty that these walleye populations will return to historic levels due to ecosystem changes (e.g. increasing water temperatures and shifts in fish communities) out of our control. This uncertainty is reason to pursue a conservative approach to walleye rehabilitation efforts in these lakes. Achievement of these objectives will indicate a recovering walleye population and sustained fishing opportunities going forward.

SECTION 1: WALLEYE MANAGEMENT OBJECTIVES

The following objectives apply to each of the four walleye lakes of concern described in this plan (Clear, Katherine, Anvil, Laura). These long-term objectives are intended to be broad in nature, acknowledging the unique characteristics of each lake's walleye populations and associated ecosystems. For clarity on the "observed range of historic walleye…", we generally refer to the following time periods when natural age-0 recruitment sustained shared walleye fisheries: Clear 1990-2006, Katherine 1990-2008, Anvil 1990-2003, Laura 1990-2006 (see Section 5: 1a, 2a-2b and appendices A-D for adult density and recruitment values). However, we recognize that regional trends indicating changing conditions will need to be considered when evaluating population performance. We do not expect that all objectives will be met within the five-year initial evaluation timeline (see Section 3 below). However, with implementation of this plan we do expect that these walleye populations will begin to improve. As a measure of accomplishment of the objectives, either condition 1a or 1b should be met for objective 1, and either condition 2a, 2b, or 2c should be met for objective 2. Accomplishment of objective conditions is indicative of progress toward population rehabilitation, however, the ultimate goal of this plan is to return these four walleye populations to a naturally-reproducing, self-sustaining state.

Objective 1: Increase and maintain current adult walleye densities to either:

- **a.** the observed range of historic walleye densities when natural reproduction and recruitment were adequate to sustain the walleye population and its fisheries, or
- **b.** an adult walleye density ≥ 3 fish per acre as identified by the 1988 biological issues group report; thought to be the level at which a walleye population is generally deemed "healthy" and able to be self-sustaining.

Objective 2: Increase walleye recruitment to either:

- **a.** the observed range of historic walleye recruitment which sustained the walleye population and its fisheries, or

b. fall electrofishing catch rates of age-0 walleye to at least 15/mile observed once every three years, or

c. fall electrofishing catch rates of age-1 walleye (from either successful natural recruitment and/or successful stocked fish survival) to a minimum of 5/mile observed once every three years.

SECTION 2: WALLEYE MANAGEMENT STRATEGIES

1. Proposed Harvest Reduction Strategies

a. Angling Harvest

A new, experimental 18-inch minimum length, with a no harvest slot between 22-28 inches and 1 walleye daily bag limit regulation is scheduled for implementation at the start of the 2022 angling season. This regulation increases the protection of adult walleye compared to an 18-inch minimum length and 3 fish daily bag limit regulation. This is an aggressive harvest reduction strategy that sends a clear message to anglers that harvest opportunities are very limited in waters where applied.

Angler creel survey data supports the expectation that the proposed 18-inch minimum length, no harvest slot between 22-28 inches and 1 walleye daily bag limit regulation will reduce angler harvest. Creel surveys conducted on lakes managed under the 18-inch minimum length and 3-walleye daily bag limit regulation (commonly used for rehabilitation) have shown it to be effective at reducing angler harvest. Less than 1% of walleye-specific anglers catch more than one legal-sized walleye, and those anglers spend over 70 hours of fishing, on average, to harvest a walleye under this regulation (Eslinger unpublished data). Additionally, angler exploitation (% of the estimated adult walleye population harvested by angling) on lakes managed under the 18-inch minimum length and 3-walleye daily bag limit has averaged 3.5% (DNR unpublished). However, this regulation has generally been applied on lakes with low density adult walleye populations.

The 18-inch minimum length limit, no harvest slot between 22-28 inches, protects significantly more walleye from harvest compared to the current angler length limits in these four lakes. From the most recent population estimates in Clear (2017), Katherine (2021), Anvil (2021), and Laura (2021), the current angling regulations would have protected about 14%, 38%, 31%, and 0% of the adult walleye populations from harvest, respectively. Whereas under the proposed 18 inch minimum size limit and no harvest slot between 22-28 inches, about 68%, 95%, 41%, and 65% of the adult walleye populations would have been protected from harvest, respectively.

b. Tribal Harvest

LDF recognized the need for harvest reductions on these lakes, and began reducing harvest in 2021, taking less than 50% of the 698 walleye available for spearing on these four lakes. Under the safe harvest system, tribal quotas are set at levels that have resulted in exploitation rates that average around 7% in lakes with natural reproduction (Fishery Status Update 2019). However, lakes such as these with declining recruitment have lower populations than an average lake and would benefit from additional reductions in harvest.

Tribal harvest will continue at reduced levels with considerations made for each lake. Tribal quotas will be intended to be small enough to allow the walleye populations to increase in accordance with plan goals, while still allowing for some harvest opportunities.

c. Signage

DNR, LDF, and GLIFWC worked with Headwaters Chapter of Walleyes for Tomorrow to create and place signage on the four lakes in 2021. The signs inform anglers about this cooperative rehabilitation effort and promote voluntary catch-and-release by anglers.

2. Walleye Stocking

The main goal of stocking is to produce year-classes large enough to increase the spawning population of walleye when they mature, and for these walleye to naturally reproduce. Evaluation of stocking strategies to determine whether they are meeting these goals will be ongoing throughout the plan duration. Adjustments to the strategies will be made as needed to meet the stocking goals. Walleye are being stocked in all four lakes as either small or large fingerlings. Stocked small-fingerling walleye have been used to help rehabilitate some walleye populations (e.g. those with a fish community containing low abundance of predators like largemouth bass (ashigan) and northern pike (ginoozhe)) and cost less to produce than large fingerlings. Large fingerlings are more effective in lakes with abundant predators or other impediments to small-fingerling survival. Research indicates large fingerling walleye have higher survival rates when compared with small-fingerling stocking. Recent concerns over a female-dominated sex ratio in hatchery-reared large fingerlings are currently being investigated. Results from this investigation will be used in upcoming stocking considerations.

Anvil, Clear, and Katherine lakes are being stocked with large-fingerling walleye every other year (rate of 10/acre) after small-fingerling stockings were attempted with little apparent success. Small fingerlings (35/acre) and large fingerlings are being stocked in Laura Lake. Every other year stocking is intended to minimize the risk that stocked fish

will suppress any natural reproduction in adjacent year-classes as noted in Li et al. (1996), and the rates are the current standard recommended rates in the DNR stocking guidance. If these stocking rates, frequencies, and sizes are ineffective, other strategies will be considered. DNR has committed to alternate year stocking efforts on these four lakes through the duration of the evaluation timeline if necessary. If additional hatchery-reared fish are available from DNR or LDF, then additional stocking may be considered if they are determined to be of potential benefit. If natural reproduction reaches objective levels, then, stocking should be reevaluated.

SECTION 3: EVALUATION TIMELINE, MONITORING REQUIREMENTS, & MEASURES OF SUCCESS

The initial evaluation of this plan will occur in 2027 after full implementation of the harvest-management strategies (2022) identified in *Section 2* (acknowledging that LDF began harvest reductions in 2021). The partners identified in this plan should meet annually to review population performance measures, management strategies and progress towards the plan objectives. Additional information relative to the objectives of this plan and successful walleye rehabilitation (e.g., fish community and habitat data) will be incorporated into the full project report identified in *Section 4*.

1. All walleye populations should be monitored annually by means of fall electrofishing surveys to determine levels of age-0 and age-1 walleye recruitment.
2. At least one adult walleye population assessment should be completed on each lake within the initial evaluation period of five years. Suitable population assessments could consist of preferably an adult walleye population estimate, or alternatively a single-run electrofishing survey to index adult abundance and detect presence of recruitment into the adult population. Other gamefish population assessments should also be completed as opportunities arise to obtain more thorough assessment of the entire fish community.
3. Angling harvest monitoring following standard DNR creel procedures should occur on the lakes, with a goal of at least one creel survey per lake in 10 years. A creel survey was conducted on Clear Lake in 2020, while the lake was regulated under a 15 inch minimum length limit and 20 to 24 inch protected slot. Katherine Lake is scheduled for an angler creel survey in 2023.
4. Tribal harvest monitoring should occur as usual following standard Great Lakes Indian Fish and Wildlife Commission (GLIFWC) creel procedures.

Five years is a relatively short amount of time relative to the walleye life cycle (e.g. it takes most female walleyes five years to mature). Considering that, early measures of success will include:

1. Increases in age-0 walleye recruitment (indicating stocked small-fingerling survival and/or successful natural reproduction).

2. Increases in age-1 walleye recruitment (indicating stocked walleye survival and/or successful natural reproduction).
3. Increases in walleye numbers and increased presence of young adults in the adult population (indicating successful recruitment).

After the initial evaluation at 5 years, plan details will be reassessed, and joint decisions will be made with respect to the continuation or modification of the plan. If parties agree to continue strategies to rehabilitate these four walleye populations, we recommend another 5-year extension of the plan to include the following evaluations.

1. All walleye populations should be monitored annually by means of fall electrofishing surveys to determine levels of age-0 and age-1 recruitment.
2. At least one adult walleye population abundance estimate should be completed on each lake within the secondary evaluation period.
3. Angling harvest monitoring following standard DNR creel procedures should occur. Currently, Anvil Lake is scheduled for an angler creel survey in 2028, Laura Lake in 2029, and Clear Lake in 2030.
4. Tribal harvest monitoring should occur as usual following standard GLIFWC creel procedures.
5. Conduct centrarchid (e.g., largemouth bass, smallmouth bass (noosa'owesi)) surveys on each of these lakes at least twice during the 10-year rehabilitation period. These surveys should be comparable to historical surveys of centrarchid populations in these and other regional lakes.

After the recommended 5-year extension, measures of success will include the accomplishment of the walleye management objectives (*Section 1*). An evaluation of the full plan will be completed, and joint decisions will be made regarding continued efforts.

Collaborators recognize that ecosystems are changing rapidly due to anthropogenic stressors (e.g., climate change, overharvest, habitat destruction, changes in land use, invasive species). The ability of these systems to support cool-water fisheries may be limited now and in the future (Embke et al., 2019; Hansen et al., 2017; Isermann, 2021; Raabe et al., 2020; Sass et al., 2021). Moreover, the ability of resource managers to reverse the course of these changes is limited by the tools at their disposal (e.g., stocking, harvest regulations) (Rahel, In Press), and their limited ability to influence regional (e.g., shoreline development) and national policy (e.g., carbon emissions). The Resist-Accept-Direct (RAD) Framework is an emerging tool that can be overlayed onto existing adaptive management strategies outlined in this plan (Figure 1)(Lynch et al., 2022). Specifically, the RAD Framework provides a way for resource managers to respond to the trajectory of an ecosystem, using an approach of either *resist* (restore historical services and function), *accept* (allow ecosystems to change unabated, no management intervention) and/or *direct* (management intervention that creates new ecosystem functions or services)

(Schuurman et al., 2022). The trajectory of the ecosystems in the four lakes of concern will likely be an ongoing discussion among the collaborators, but a formal discussion should occur at the 5 and 10 year evaluation periods as specified in this plan.

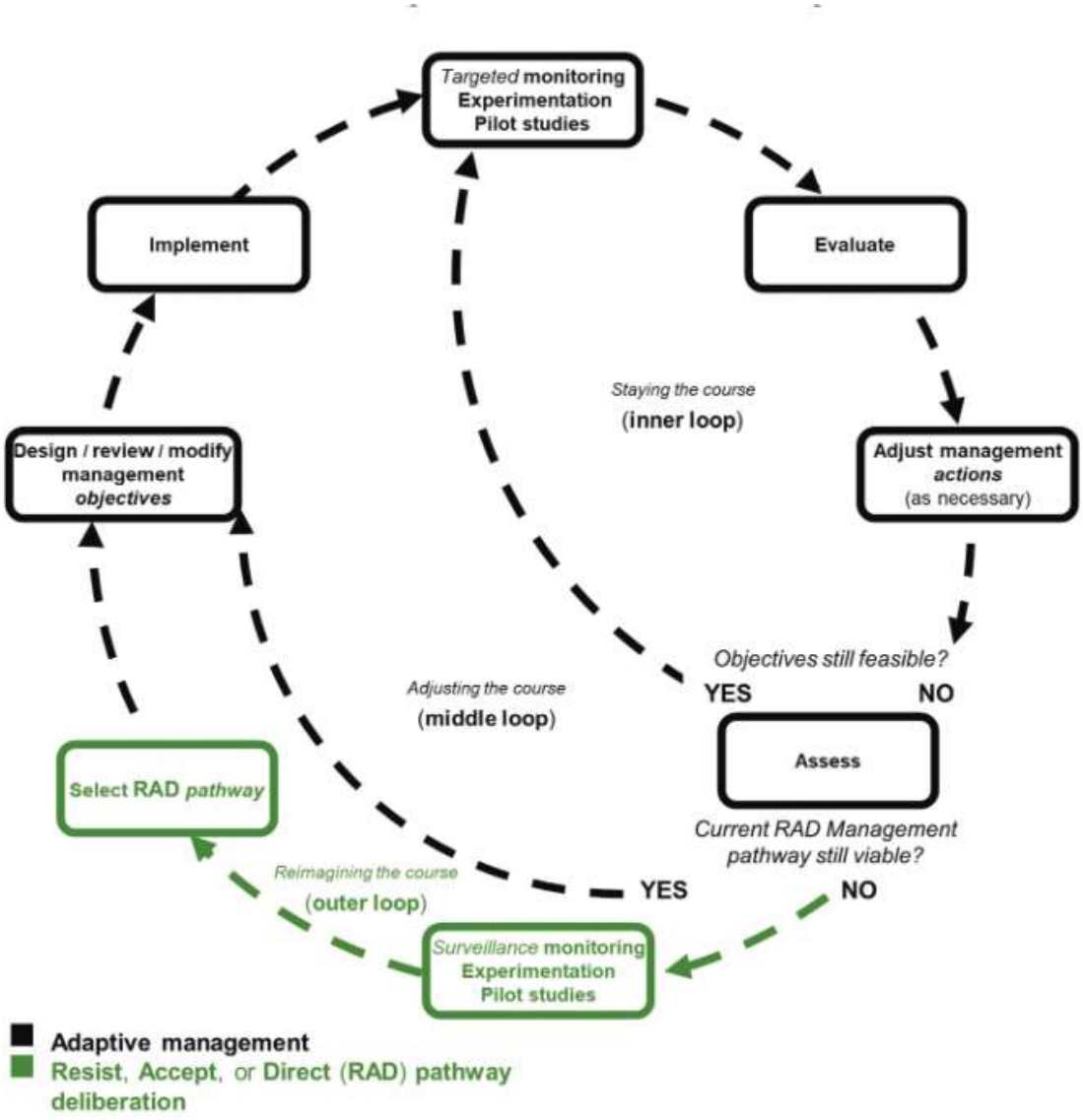

Figure 1. Adaptive management is generally defined as a six-step cycle (black). The resist–accept–direct (RAD) framework (green) can be overlaid on this process to assist informed risk taking for transforming ecosystems. Reproduced from Lynch et al., 2022.

SECTION 4: PUBLIC OUTREACH & REPORTING PROCESS

We recommend the following public outreach and reporting efforts be conducted as part of this plan:

1. Prior to the implementation of this plan public stakeholder meetings with anglers and spearers were coordinated by DNR and GLIFWC biologists to provide details about the plan and the four lakes incorporated within.
2. Signage should be maintained at boat landings on lakes included in this plan. This effort will help educate anglers and other users about ongoing efforts and encouraging their participation in walleye rehabilitation efforts through voluntary catch and release.
3. Joint efforts will be made by DNR, GLIFWC, and LDF to direct media attention to this effort.
4. A public stakeholder meeting(s) should be conducted at the end of the five-year initial evaluation timeline to provide stakeholders with updated plan information, progress, and intentions going forward. Additional stakeholder meetings may be conducted as deemed necessary to keep stakeholders informed.
5. A project report should be completed at the conclusion of the plan. The findings of this report should be made available and shared at the public stakeholder meetings.

SECTION 5: HISTORIC FISHERIES DATA & MANAGEMENT STRATEGIES

The data specified in the following paragraphs come from standardized assessments conducted by either DNR or GLIFWC since 1990. Data for each lake follows in Appendices A through D.

Explanation of fisheries data metrics:

1. *Adult Walleye Abundance & Density (1a)*: *Adult walleye abundance* is the estimated number of sexually-mature (observed to be male or female of any size) and unknown-sex walleye ≥ 15 inches. *Adult walleye abundance* is used to establish safe harvest numbers for tribal harvest (spearing or netting). *Adult walleye density* is the adult walleye abundance per lake acre.
2. *Adult Walleye Male: Female Sex Ratio (1b)*: The estimated number of adult male walleye to adult female walleye. This ratio is a metric that provides insight into the relative health of the population. Healthy adult walleye populations typically have a male: female sex ratio of several males to every female as measured during spring spawning surveys. As the male: female ratio approaches 1:1, or when females out-number males, it is an indication that walleye recruitment is compromised. Males mature earlier and remain on the spawning grounds for a longer period of time than females, so we expect to see more adult males than females in populations with strong recruitment.
3. *Adult Walleye Size Structure (1c)*: The length-composition of the adult population. One metric to represent size structure is the estimated proportion of the adult walleye population that is 15 inches or larger. This metric provides insight into the relative recruitment, growth, and harvest being experienced by a walleye population. For example, a population experiencing relatively low levels of adult recruitment would likely have a

larger size structure due to low numbers of younger, smaller adults, and a greater proportion of larger, older fish.

4. *Adult Walleye Year Class Distribution:* The year class distribution of the adult population represents the number of individual age classes determined to be present in the population (from aging analyses), as well as those age classes that contribute significantly (≥ 15% of the total catch) to the overall adult population.
5. *Juvenile Walleye Fall Age-0 and Age-1 Recruitment (2a & 2b)*: The rate (number per mile) at which age-0 and age-1 walleye are collected during fall electrofishing surveys. Typically, the entire shoreline of a waterbody is electrofished, and the number of age-0 and age-1 walleye collected are divided by the shoreline mileage surveyed to derive catch rates that can be compared with long-term trends within and among lakes.
6. *Angling Walleye Harvest & Adult Exploitation (3di)*: *Angling Walleye Harvest* is the estimated number of walleye harvested by anglers. This estimate is generated by standardized DNR creel surveys. Creel surveys provide estimates of fishing effort, catch, and harvest. *Angling Adult Walleye Exploitation* is the estimated proportion (%) of the adult walleye population harvested by anglers. This estimate is determined by marking adult walleye during spring population assessments, and then determining the proportion of marked adult fish harvested by anglers observed during the creel survey. The estimated number of walleye harvested, along with the estimated adult exploitation, is used to evaluate angling harvest.
7. *Tribal Walleye Harvest & Adult Exploitation (3dii)*: *Tribal Walleye Harvest* is the actual number of walleye harvested by tribal fishers using spearing and netting. *Tribal Walleye Harvest* is observed during nightly creel surveys on individual lakes following GLIFWC standard methods. Nightly creel surveys provide an account of the actual number of walleye harvested by spearing and netting for each walleye population. *Tribal Adult Walleye Exploitation* is the estimated proportion (%) of the adult walleye population harvested by tribal fishers from spearing and netting. This estimate is determined by dividing the known tribal adult walleye harvest by the estimated number of adult walleye present (determined during spring population assessments) within each population where spring population assessments occurred. *Tribal Walleye Adult Exploitation* is combined with *Angling Adult Walleye Exploitation* to determine the total estimated exploitation *(3diii)* being exerted on each fishery.

CLEAR LAKE, ONEIDA COUNTY (see Appendix A)

1. Adult Walleye Population History
    a. Abundance & Density

    Adult walleye abundance and density in Clear Lake has been estimated six times since 1990. The average adult density was 2.6/acre. The highest density was estimated to be 3.8/acre (3,241 adult walleye) in 2000, while the lowest was

1.0/acre (807 adult walleye) in 2017 (most recent estimate). Between 1990 and 2006, adult density averaged 3.1/acre (n =4), ranging between 2.3 and 3.8/acre.

b. Male: Female Sex Ratio
The estimated adult walleye sex ratio in Clear Lake averaged 3.2 males to every female during adult population assessments. The highest sex ratio was 4.2 (2017), while the lowest was 2.6 (1996).

c. Size Structure
The proportion of the adult walleye population estimated to be ≥ 15 inches in Clear Lake averaged 59% during adult population assessments. The lowest proportion was 42% (1990), while the highest was 87% (2017).

d. Year Class Distribution
The number of adult year classes (measured during adult population estimate surveys) on Clear Lake has averaged 11 (high = 13, low = 8). On average, 3 (high = 3, low = 2) of those year classes were estimated to contribute significantly to the adult population (≥ 15% of the total survey catch). The number of male and female year classes have averaged 10 (high = 12, low = 8) and 10 (high = 13, low = 7), respectively.

2. Juvenile Walleye Recruitment History
   a. Fall Age-0 Recruitment
   Estimated age-0 walleye recruitment in Clear Lake averaged 4.5/mile since 1990 (n = 31), ranging between 0.1/mile (1990, 1993, 2017, and 2019) and 20.6/mile (1995). Between 1990 and 2006, age-0 recruitment averaged 7.1/mile (n = 16) but has declined to an average of 1.8/mile (n=15) since 2007.

   b. Fall Age-1 Recruitment
   Estimated age-1 walleye recruitment in Clear Lake averaged 1.3/mile since 1990 (n = 31), ranging between 0.0/mile (1991 and 2016) and 4.9/mile (1990). Between 1990 and 2006, age-1 recruitment averaged 1.8/mile (n = 16) but has declined to an average of 0.6/mile (n = 15) since 2007.

3. Historic Walleye Fisheries Management Strategies & Harvest Monitoring
   a. Angling Regulations
   The following table identifies angling regulations (length restrictions and daily bag limit) used in Clear Lake since 1990.

Clear Lake Regulation History		
Years	**Regulation**	**Bag Limit**
1990-2014	15" minimum length limit	3*
2015-2021	15" minimum length limit, walleye 20"-24" may not be kept, only 1 walleye over 24"	3

* Bag Limits were adjusted annually under a sliding bag system based upon the level of tribal harvest that had occurred earlier within the given season. Bag limits were 3 in most cases, although some seasons had daily bag limits of 2 fish.

b. Tribal Spearing Regulations

The tribal spring spearfishing season is regulated by a quota and nightly permit system so that harvested fish are counted and measured, and spring spearing harvest remains within the safe harvest level agreed to by biologists prior to the spring spearing season as stipulated by the Voigt Case. Walleye safe harvest levels are set so that, the harvest would be below the maximum exploitation rate of 35% at least 39 out of 40 instances throughout the ceded territory. Safe harvest is calculated using a recent population estimate (two years old or less) when available, or a model incorporating lake size, walleye abundance, and prior estimates on a given lake. Tribal spearers are also regulated by a size limit per permit: all walleye must be under 20 inches except one walleye can be any size, and one can be between 20 and 24 inches.

c. Stocking

No walleye stocking occurred in Clear Lake between 1990 and 2016. In 2017 and 2018 small fingerling walleye were stocked (29,626 and 30,544 fish, respectively) at a rate of approximately 35 small fingerlings per acre (standard DNR rate). Due to low survival of small fingerling walleye, extended growth (EG) fingerling walleye stocking began in 2019 when 8,728 were stocked. Additional EG walleye stocking occurred in 2020 and 2021 with totals of 4,352 and 9,588 in respective years.

d. Harvest & Exploitation

i. Angling

Angling walleye harvest and adult exploitation has been estimated during four angling seasons in Clear Lake since 1990. Angling walleye harvest averaged 416 fish, with a high of 596 (1996) and a low of 226 (2005). Angling adult walleye exploitation averaged 7.0%, with a high of 10.9% (1996) and a low of 2.6% (2005). An additional creel survey was conducted in 2020 but did not include harvest estimates from May and June due to complication with COVID related sampling protocols and therefore cannot be used for comparison with previous surveys. Additionally, no walleye population estimate was completed in 2020, preventing angler exploitation estimation.

ii. Tribal

Tribal walleye harvest by spearing or netting techniques has been censused every year in Clear Lake since 1990. Annual tribal walleye harvest averaged 163 fish, with a high of 298 (2016) and a low of 51 (2019). Tribal adult walleye exploitation has been estimated six times in Clear Lake, averaging 10.7%, with a high of 20.9% (2017) and a low of 5.6% (2000).

iii. Combined

During the four years in Clear Lake where combined walleye harvest (including both angling and tribal components) could be determined, estimated walleye

harvest averaged 605 fish (high of 865 in 1996, low of 405 in 2005). The combined adult walleye exploitation estimated during those same four years averaged 14.3% (high of 19.6% in 1996, low of 11.2% in 2005).

KATHERINE LAKE, ONEIDA COUNTY (see Appendix B)

1. Adult Walleye Population History
    a. Abundance & Density
    Adult walleye abundance and density in Katherine Lake has been estimated seven times since 1990. The average adult density was 4.5/acre. The highest density was estimated to be 9.8/acre (5,803 adult walleye) in 2008, while the lowest was 1.5/acre (885 adult walleye) in 1991; although this estimate contains a heavy male bias, making the resulting estimate conservative. The last time the adult population was assessed was in 2021 at 1.9/acre. Between 1990 and 2008, adult density averaged 5.4/acre (n =4), ranging between 1.5 and 9.8/acre.

    b. Male: Female Sex Ratio
    The estimated adult walleye male: female sex ratio in Katherine Lake averaged 4.4 males to every female during adult population assessments (excluding the 1991 survey, due to a heavy male bias). The highest sex ratio was 9.1 (2001), while the lowest was 2.2 (2018).

    c. Size Structure
    The proportion of the adult walleye population estimated to be ≥ 15 inches in Katherine Lake averaged 26% during adult population assessments (excluding the 1991 survey, due to a heavy male bias). The lowest proportion was 5% (2015), while the highest was 63% (2021).

    d. Year Class Distribution
    The number of adult year classes (measured during adult population estimate surveys) on Katherine Lake has averaged 10 (high = 13, low = 8). On average, 2 (high = 3, low = 2) of those year classes were estimated to contribute significantly to the adult population (≥ 15% of the total survey catch). The number of male and female year classes have averaged 9 (high = 12, low = 7) and 9 (high = 11, low = 6), respectively.

2. Juvenile Walleye Recruitment History
    a. Fall Age-0 Recruitment
    Estimated age-0 walleye recruitment in Katherine Lake averaged 25.7/mile since 1990 (n = 31), ranging between 0.0/mile (2014 and 2015) and 151.7/mile (1994). Between 1990 and 2008, age-0 recruitment averaged 42.1/mile (n = 18) but has declined to an average of 2.9/mile (n = 13) since 2009.

    b. Fall Age-1 Recruitment

Estimated age-1 walleye recruitment in Katherine Lake averaged 6.2/mile since 1990 (n = 31), ranging between 0.0/mile (2015, 2016, 2017, and 2019) and 19.7/mile (1995). Between 1990 and 2008, age-1 recruitment averaged 9.3/mile (n = 18) but has declined to an average of 1.9/ mile (n=13) since 2009.

3. Historic Walleye Fisheries Management Strategies & Harvest Monitoring
    a. Angling Regulations
    The following table identifies angling regulations (length restrictions and daily bag limit) used in Katherine Lake since 1990.

Katherine Lake Regulation History		
Years	**Regulation**	**Bag Limit**
1990-1996	15" minimum length limit	3*
1997-2014	No minimum length limit but only 1 walleye over 14"	3*
2015-2018	No minimum length limit but only 1 walleye over 14"	3
2019-2021	15" minimum length limit, walleye 20"-24" may not be kept, only 1 walleye over 24"	3

* Bag Limits were adjusted annually under a sliding bag system based upon the level of tribal harvest that had occurred earlier within the given season. Bag limits were 3 in most cases, although some seasons had daily bag limits of 2 fish.

    b. Tribal Spearing Regulations (same as identified in Clear Lake)

    c. Stocking
    No walleye stocking occurred in Katherine Lake between 1990 and 2016. In 2017 and 2018 small-fingerling walleye were stocked (18,323 and 18,338 fish, respectively) at a rate of approximately 35 small fingerlings per acre (standard DNR rate). In 2019 and 2021, 5,233 and 5,512 extended growth walleye fingerlings were stocked at a rate of approximately 10 large fingerlings per acre (standard DNR rate).

    d. Harvest & Exploitation
        i. Angling
        Angling walleye harvest and adult exploitation has been estimated during two angling seasons in Katherine Lake since 1990. Angling walleye harvest averaged 587 fish, with a high of 630 (2001) and a low of 543 (1993). Angling adult walleye exploitation averaged 8.2%, with a high of 9.4% (1993) and a low of 7.1% (2001).

        ii. Tribal
        Tribal walleye harvest by spearing or netting techniques has been censused every year in Katherine Lake since 1990. Annual tribal walleye harvest averaged 167 fish, with a high of 547 (2009) and a low of 50 (1993). Tribal adult walleye exploitation has been estimated seven times in Katherine Lake, averaging 8.3%, with a high of 20.1% (2021) and a low of 2.1% (1993).

        iii. Combined

During the two years in Katherine Lake where combined walleye harvest (including both angling and tribal components) could be determined, estimated walleye harvest averaged 675 fish (high of 757 in 2001, low of 593 in 1993). The combined adult walleye exploitation estimated during those same two years averaged 11.0% (high of 11.6% in 1993, low of 10.4% in 2001).

ANVIL LAKE, VILAS COUNTY (see Appendix C)

1. Adult Walleye Population History
    a. Abundance & Density
    Adult walleye abundance and density in Anvil Lake has been estimated six times since 1990. The average adult density was 4.6/acre. The highest density was estimated to be 11.2/acre (4,453 adult walleye) in 1991, while the lowest was 0.9/acre (372 adult walleye) in 2021. Between 1990 and 2003, adult density was only estimated once (11.2/acre in 1991).

    b. Male: Female Sex Ratio
    The estimated adult walleye male: female sex ratio in Anvil Lake averaged 6.5 males to every female during adult population assessments. The highest sex ratio was 20.3 (1991), while the lowest was 1.4 (2021).

    c. Size Structure
    The proportion of the adult walleye population estimated to be ≥ 15 inches in Anvil Lake averaged 72% during adult population assessments. The lowest proportion was 13% (1991), while the highest was 99% (2021).

    d. Year Class Distribution
    The number of adult year classes (measured during adult population estimate surveys) on Anvil Lake has averaged 8 (high = 9, low = 6). On average, 3 (high = 4, low = 2) of those year classes were estimated to contribute significantly to the adult population (≥ 15% of the total survey catch). The number of male and female year classes have averaged 8 (high = 9, low = 6) and 6 (high = 7, low = 5), respectively.

2. Juvenile Walleye Recruitment History
    a. Fall Age-0 Recruitment
    Estimated age-0 walleye recruitment in Anvil Lake averaged 11.2/mile since 1990 (n = 25), ranging between 0.0/mile (2005, 2018, and 2019) and 52.9/mile (2001). Between 1990 and 2003, age-0 recruitment averaged 18.6/mile (n = 13) but has declined to an average of 3.1/mile (n=12) since 2004.

    b. Fall Age-1 Recruitment
    Estimated age-1 walleye recruitment in Anvil Lake averaged 2.1/mile since 1990 (n = 25), ranging between 0.0/mile (1995, 1997, 2005, 2006, 2007, 2015, 2019,

2020, and 2021) and 17.9/mile (2000). Between 1990 and 2003, age-1 recruitment averaged 3.6/mile (n = 12), but has declined to an average of 0.5/mile (n=12) since 2004.

3. Historic Walleye Fisheries Management Strategies & Harvest Monitoring
    a. Angling Regulations
    The following table identifies angling regulations (length restrictions and daily bag limit) used in Anvil Lake since 1990.

Anvil Lake Regulation History		
Years	**Regulation**	**Bag Limit**
1990-1996	15" minimum length limit	3*
1997-2015	No minimum length limit, walleye 14"-18" may not be kept and only 1 fish over 18"	3*
2016-2017	15" minimum length limit, walleye 20"-24" may not be kept, only 1 walleye over 24"	3
2018	Catch and release only	0
2019-2021	15" minimum length limit, walleye 20"-24" may not be kept, only 1 walleye over 24"	3

*Bag Limits were adjusted annually under a sliding bag system based upon the level of tribal harvest that had occurred earlier within the given season. Bag limits were 3 in most cases, although some seasons had daily bag limits of 2 fish.

    b. Tribal Spearing Regulations (same as identified in Clear Lake)

    c. Stocking
    5,187 small-fingerling walleye were stocked in Anvil Lake in 1991. No walleye stocking occurred between 1990 and 2019. Small fingerling walleye stocking occurred in 2020 and 2021, when 14,464 and 13,174 walleye were stocked in each respective year.

    d. Harvest & Exploitation
        i. Angling
        Angling walleye harvest and adult exploitation has been estimated during one angling season (1991) in Anvil Lake since 1990. During the 1991 season, angling walleye harvest was 599 fish, and adult walleye exploitation was 2.8%.

        ii. Tribal
        Tribal walleye harvest by spearing or netting techniques has been censused every year in Anvil Lake since 1990. Annual tribal walleye harvest has averaged 90 fish, with a high of 247 (1993) and a low of 0 (1996, 2021). Tribal adult walleye exploitation has been estimated five times in Anvil Lake, averaging 5.1%, with a high of 8.2% (2015) and a low of 2.0% (1991).

        iii. Combined
        During 1991 in Anvil Lake, where combined walleye harvest and exploitation (including both angling and tribal components) could be determined, estimated walleye harvest was 687 fish, while adult walleye exploitation was estimated at 4.8%.

LAURA LAKE, VILAS COUNTY (see Appendix D)

1. Adult Walleye Population History
    a. Abundance & Density
    Adult walleye abundance and density in Laura Lake has been estimated six times since 1990. The average adult density was 4.2/acre. The highest density was estimated to be 6.2/acre (3,737 adult walleye) in 1994, while the lowest was 2.0/acre (1,214 adult walleye) in 2021. Between 1990 and 2006, adult density averaged 4.6/acre (n =4), ranging between 2.2 and 6.2/acre.

    b. Male: Female Sex Ratio
    The estimated adult walleye male: female sex ratio in Laura Lake averaged 5.1 males to every female during adult population assessments. The highest sex ratio was 8.4 (1995), while the lowest was 1.0 (2021).

    c. Size Structure
    The proportion of the adult walleye population estimated to be ≥ 15 inches in Laura Lake averaged 30% during adult population assessments. The lowest proportion was 11% (1994 and 2016), while the highest was 97% (2021).

    d. Year Class Distribution
    The number of adult year classes (measured during adult population estimate surveys) on Laura Lake has averaged 11 (high = 14, low = 8). On average, 2 (high = 3, low = 2) of those year classes were estimated to contribute significantly to the adult population (≥ 15% of the total survey catch). The number of male and female year classes have averaged 9 (high = 10, low = 8) and 9 (high = 11, low = 6), respectively.

2. Juvenile Walleye Recruitment History
    a. Fall Age-0 Recruitment
    Estimated age-0 walleye recruitment in Laura Lake averaged 36.2/mile since 1990 (n = 23), ranging between 0.0/mile (2000, 2016, 2017, 2018, and 2019) and 136.5/mile (1994). Between 1990 and 2006, age-0 recruitment averaged 48.6/mile (n = 17) but has declined to an average of 1.1/mile (n = 6) since 2016. There were no fall walleye recruitment surveys between 2007 and 2015 because the public boat landing was inaccessible due to extreme low water.

    b. Fall Age-1 Recruitment
    Estimated age-1 walleye recruitment in Laura Lake averaged 17.1/mile since 1990 (n = 23) ranging between 0.0/mile (2016, 2018, 2019, and 2020) and 104.6/mile (2004). Between 1990 and 2006, age-1 recruitment averaged 22.8/mile (n = 17) but has declined to an average of 0.7/mile (n = 6) since 2016.

3. Historic Walleye Fisheries Management Strategies & Harvest Monitoring
    a. Angling Regulations

The following table identifies angling regulations (length restrictions and daily bag limit) used in Laura Lake since 1990:

Laura Lake Regulation History		
Years	**Regulation**	**Bag Limit**
1990-1996	No minimum length limit	3*
1997-2014	No minimum length limit but only 1 walleye over 14"	3*
2015-present	No minimum length limit but only 1 walleye over 14"	3

*Bag Limits were adjusted annually under a sliding bag system based upon the level of tribal harvest that had occurred earlier within the given season. Bag limits were 3 in most cases, although some seasons had daily bag limits of 2 fish.

b. Tribal Spearing Regulations (same as identified in Clear Lake)

c. Stocking

13,872 small-fingerling walleye were stocked in Laura Lake in 1997. No walleye stocking occurred between 1990 and 2019. Small fingerling walleye stocking occurred in 2020 and 2021, when 21,380 and 21,955 walleye were stocked in each respective year. In addition to the 2021 small fingerling walleye stocking, 2,000 extended growth fingerling walleye were stocked.

d. Harvest & Exploitation

i. Angling

Angling walleye harvest and adult exploitation has been estimated during four angling seasons in Laura Lake since 1990. Angling walleye harvest averaged 624 fish, with a high of 1,456 (1994) and a low of 89 (2016). Angling adult walleye exploitation averaged 7.4%, with a high of 19.7% (1994) and a low of 0.7% (2016).

ii. Tribal

Tribal walleye harvest by spearing or netting techniques has been censused every year in Laura Lake since 1990. Annual tribal walleye harvest averaged 154 fish, with a high of 370 (2017) and a low of 50 (2021). Tribal adult walleye exploitation has been estimated five times in Laura Lake, averaging 5.7%, with a high of 7.8% (1995) and a low of 3.3% (1994).

iii. Combined

During the four years in Laura Lake where combined walleye harvest and exploitation (including both angling and tribal components) could be determined, estimated walleye harvest averaged 624 fish (high of 1,581 in 1994, low of 209 in 2016). The combined adult walleye exploitation estimated during those same four years averaged 12.7% (high of 23.1% in 1994, low of 5.1% in 2016).

SECTION 6: LAKE-SPECIFIC HABITAT, AQUATIC PLANT MANAGEMENT & INVASIVE SPECIES

The following lake-specific descriptions represent a brief overview of the ecosystem characteristics that influence overall lake health and the associated fisheries. See Appendices E (Habitat Evaluations and Potential Actions) and F (Climate Vulnerability) for more information related to habitat and environmental considerations within these four lakes.

CLEAR LAKE, ONEIDA COUNTY

Clear Lake is an 846-acre, oligotrophic, seepage lake with very clear water, and mean and maximum depths of 31 and 95 feet, respectively. Substrate materials in Clear Lake are predominately sand and rock/gravel. Clear Lake is classified as a complex two-story lake, with sufficient oxygen and thermal conditions present to support warm-, cool-, and cold-water fisheries, including walleye (Rypel et al. 2019). Clear Lake has a watershed (all of the land surrounding a lake that contributes rainfall and snowmelt to the lake) and shoreland (land along the lake shore) with very low amounts of estimated disturbance (approx. 0-1%; Midwest Glacial Lakes Partnership (MGLP) Conservation Planner). The majority of the shoreland is under public ownership by the State of Wisconsin and is a part of the Northern Highland-American Legion State Forest. There are currently no aquatic plant management (APM) applications pertaining to Clear Lake, and identified aquatic invasive species (AIS) in the lake consist of Chinese mystery snail and freshwater jellyfish.

KATHERINE LAKE, ONEIDA COUNTY

Katherine Lake is a 590-acre, mesotrophic, seepage lake with very clear water, and mean and maximum depths of 16 and 30 feet, respectively. Substrate materials in Katherine Lake are predominately sand and rock/gravel. Katherine Lake is classified as a complex cool clear lake supportive of walleye (Rypel et al. 2019). Katherine Lake has a watershed and shoreland with low amounts of estimated disturbance (approx. 9%; MGLP Conservation Planner). The majority of the shoreland is privately owned. There are currently no APM applications pertaining to Katherine Lake, and identified AIS in the lake consist of banded and Chinese mystery snails and purple loosestrife.

ANVIL LAKE, VILAS COUNTY

Anvil Lake is a 398-acre, mesotrophic, seepage lake with moderately clear water, and mean and maximum depths of 19 and 32 feet, respectively. Substrate materials in Anvil Lake are predominately sand and gravel. Anvil Lake is classified as a complex cool clear lake supportive of walleye (Rypel et al. 2019). Anvil Lake has a watershed and shoreland with low amounts of estimated disturbance (approx. 5-9%; MGLP Conservation Planner). The majority of the shoreland is privately owned. There is one APM application pertaining to Anvil Lake for chemical treatment of Eurasian watermilfoil (EWM; since

2018 the Anvil lake association has tried to control EWM via diver assisted suction harvesting). Identified AIS in the lake consist of banded and Chinese mystery snails, curly-leaf pondweed, EWM and rusty crayfish.

LAURA LAKE, VILAS COUNTY

Laura Lake is a 599-acre, oligotrophic, seepage lake with moderately clear water, and a maximum depth of 43 feet (no mean depth reported). Substrate materials in Laura Lake are predominately sand and rock/gravel. Laura Lake is classified as a complex cool clear lake supportive of walleye (Rypel et al. 2019). Laura Lake has a watershed and shoreland with low amounts of estimated disturbance (approx. 4-6%; MGLP Conservation Planner). The majority of the shoreland is under public ownership by the State of Wisconsin and is a part of the Northern Highland-American Legion State Forest. There are currently no APM applications pertaining to Laura Lake, and identified AIS in the lake consist of banded mystery snail and non-native phragmites.

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APPENDICIES

Appendix A. Clear Lake, Oneida County. History of walleye population survey statistics, stockings, angler and tribal harvest records, since 1990.

Year	Adult Density (No./acre)	Estimated Male:Female Sex Ratio	Adults ≥ 15 inches (%)	Adult Year Class Distribution^	Age-0 Recruitment (No./mile)	Age-1 Recruitment (No./mile)	Walleye Stocking*	Estimated Angler Harvest	Estimated Angler Exploitation (%)	Tribal Harvest	Estimated Tribal Exploitation (%)
1990	2.3	3.1	42	11, 3	0.1	4.9		479	5.3	126	6.4
1991					15.3	0.0				84	
1992					3.2	3.2				109	
1993					0.1	1.0				153	
1994					NA	NA				172	
1995					20.6	4.6				180	
1996	3.7	2.6	58	12, 3	1.3	2.5		596	10.9	269	8.7
1997					1.2	0.8				141	
1998					8.4	0.7				129	
1999					6.2	3.6				179	
2000	3.8	2.8	55	12, 2	5.6	4.3		364	9.1	182	5.6
2001					3.8	0.7				154	
2002					13.6	3.0				132	
2003					5.4	1.4				182	
2004					17.0	1.3				187	
2005	2.5	3.5	54	13, 3	7.8	0.9		226	2.6	179	8.5
2006					4.8	0.4				102	
2007					1.9	1.0				87	
2008					4.6	2.3				179	
2009					1.2	1.3				175	
2010					4.5	0.4				179	
2011					3.2	0.7				181	
2012	2.2	2.7	55	8, 3	4.3	0.3				271	14.3
2013					1.9	0.5				163	
2014					0.7	0.6				208	
2015					1.4	0.2				182	
2016					1.4	0.0				298	
2017	1.0	2.1	87	10, 2	0.1	0.2	29,626 SF			169	20.9
2018					0.4	0.1	30,544 SF			106	
2019					0.1	0.4	8,728 LF			51	
2020					0.4	0.4	4,352 LF	50[a]	NA	238	
2021					0.4	0.2	9,588 LF			73	
Averages	**2.6**	**2.8**	**59**	**11, 3**	**4.5**	**1.3**		**416**	**7.0**	**163**	**10.7**

Adult Year Class Distribution^: # of adult year classes present in aged subsample, # of adult year classes comprising ≥ 15% of estimated total catch

Walleye Stocking*: SF = small-fingerling; LF = large-fingerling

[a]Estimated angler harvest in 2020 did not include harvest estimates for May and June due to Covid19 precautions that precluded angler interviews (excluded from average); A population estimate was also not conducted in 2020 which prevented an estimate of angler exploitation (NA)

Appendix B. Katherine Lake, Oneida County. History of walleye population survey statistics, stockings, angler and tribal harvest records, since 1990.

Year	Adult Density (No./acre)	Estimated Male:Female Sex Ratio[A]	Adults ≥ 15 inches (%)	Adult Year Class Distribution^	Age-0 Recruitment (No./mile)	Age-1 Recruitment (No./mile)	Walleye Stocking*	Estimated Angler Harvest	Estimated Angler Exploitation (%)	Tribal Harvest	Estimated Tribal Exploitation (%)
1990					8.8	8.0				84	
1991	1.5	71.9	2	NA	38.0	1.5				81	9.2
1992					9.3	9.4				56	
1993	4.0	3.6	19	13, 2	34.8	6.2		543	9.4	50	2.1
1994					151.7	9.3				168	
1995					65.9	19.7				132	
1996					13.4	15.3				145	
1997					42.7	9.3				127	
1998					60.5	14.0				120	
1999					NA	NA				125	
2000					11.7	5.1				129	
2001	6.4	9.1	10	11, 2	16.1	2.8		630	7.1	127	3.4
2002					42.2	6.4				184	
2003					18.5	17.8				157	
2004					57.2	10.2				133	
2005					53.6	2.9				126	
2006					40.8	12.1				127	
2007					77.1	6.9				123	
2008	9.8	3.3	8	8, 3	15.2	10.7				127	2.2
2009					5.7	6.6				547	
2010					7.3	6.5				362	
2011					3.7	2.2				126	
2012					11.5	0.4				124	
2013					4.2	5.0				179	
2014					0.0	1.1				127	
2015	5.0	5.5	5	8, 3	0.0	0.0				203	6.8
2016					0.9	0.0				256	
2017					1.4	0.0	18,323 SF			326	
2018	2.7	2.2	49	13, 2	0.4	0.4	18,338 SF			228	14.4
2019					1.0	0.0	5,233 LF			214	
2020					0.8	2.7				109	
2021	1.9	2.5	63	9,2	1.0	0.1	5,512 LF			225	20.1
Averages	**4.5**	**4.4**	**22**	**10, 2**	**25.7**	**6.2**		**587**	**8.2**	**167**	**8.3**

Sex Ratio[A]: 1991 estimate excluded from average

Adult Year Class Distribution^: # of adult year classes present in aged subsample, # of adult year classes comprising ≥ 15% of estimated total catch

Walleye Stocking*: SF = small-fingerling; LF = large-fingerling

Appendix C. Anvil Lake, Vilas County. History of walleye population survey statistics, stockings, angler and tribal harvest records, since 1990.

Year	Adult Density (No./acre)	Estimated Male:Female Sex Ratio	Adults ≥ 15 inches (%)	Adult Year Class Distribution^	Age-0 Recruitment (No./mile)	Age-1 Recruitment (No./mile)	Walleye Stocking*	Estimated Angler Harvest	Estimated Angler Exploitation (%)	Tribal Harvest	Estimated Tribal Exploitation (%)
1990					4.4	7.3				53	
1991	11.2	20.3	13	NA	25.0	0.8	5,187 SF	599	2.8	88	2.0
1992					13.5	4.4				107	
1993					9.8	1.3				247	
1994					19.2	2.3				77	
1995					45.2	0.0				82	
1996					0.6	4.8				0	
1997					20.8	0.0				81	
1998					20.8	0.8				84	
1999					NA	NA				83	
2000					12.1	17.9				71	
2001					52.9	2.1				86	
2002					12.1	4.6				87	
2003					5.0	0.4				86	
2004					0.2	3.5				87	
2005					0.0	0.0				82	
2006	4.7	5.9	55	9, 3	1.8	0.0				84	4.5
2007	5.5	2.7	78	7, 3	7.1	0.0				91	4.2
2008					NA	NA				106	
2009					NA	NA				72	
2010					6.5	0.9				82	
2011					NA	NA				88	
2012					NA	NA				85	
2013					NA	NA				2	
2014					NA	NA				139	
2015	2.7	6.5	93	7, 4	6.7	0.0				88	8.2
2016					0.4	0.4				147	
2017	2.8	2.1	96	9, 2	4.8	0.2				74	6.7
2018					0.0	0.4				159	
2019					0.0	0.0				76	
2020					4.3	0.0	14,464 SF			174	
2021	0.9	1.4	99	6,3	5.6	0.0	13,174 SF			0	
Averages	**4.6**	**6.5**	**72**	**8, 3**	**11.2**	**2.1**		**599**	**2.8**	**90**	**5.1**

Adult Year Class Distribution^: # of adult year classes present in aged subsample, # of adult year classes comprising ≥ 15% of estimated total catch

Walleye Stocking*: SF = small-fingerling; LF = large-fingerling

Appendix D. Laura Lake, Vilas County. History of walleye population survey statistics, stockings, angler and tribal harvest records, since 1990.

Year	Adult Density (No./acre)	Estimated Male:Female Sex Ratio	Adults ≥ 15 inches (%)	Adult Year Class Distribution^	Age-0 Recruitment (No./mile)	Age-1 Recruitment (No./mile)	Walleye Stocking*	Estimated Angler Harvest	Estimated Angler Exploitation (%)	Tribal Harvest	Estimated Tribal Exploitation (%)
1990					9.2	24.4				259	
1991					11.4	0.9				175	
1992					2.3	14.4				128	
1993					10.6	2.9				132	
1994	6.2	3.8	11	10, 2	136.5	2.7		1456	19.7	125	3.3
1995	5.9	8.4	14	10, 3	78.3	24.4		497	5.9	274	7.8
1996					31.5	38.1				329	
1997					122.9	24.2	13,872 SF			148	
1998	4.0	5.4	20	14, 2	44.6	8.3		452	3.5	131	5.4
1999					18.3	14.4				115	
2000					0.0	3.8				102	
2001					48.8	1.9				123	
2002					62.9	4.0				90	
2003					107.5	47.3				134	
2004					7.9	104.6				135	
2005	2.2	6.6	27	8, 2	104.0	35.5				97	7.3
2006					30.0	36.9				63	
2007					NA	NA				55	
2008					NA	NA				127	
2009					NA	NA				124	
2010					NA	NA				198	
2011					NA	NA				130	
2012					NA	NA				122	
2013					NA	NA				182	
2014					NA	NA				108	
2015					NA	NA				207	
2016	4.6	5.3	11	12, 3	0.0	0.0		89	0.7	120	4.4
2017					0.0	0.2				370	
2018					0.0	0.0				187	
2019					0.0	0.0				230	
2020					5.2	0.0	21,380 SF			145	
2021	2.0	1.0	97	12, 2	1.2	4.2	21,955 SF; 2,000 LF			50	4.1
Averages	**4.2**	**5.1**	**30**	**11, 2**	**36.2**	**17.1**		**624**	**7.4**	**154**	**5.4**

Adult Year Class Distribution^: # of adult year classes present in aged subsample, # of adult year classes comprising ≥ 15% of estimated total catch

Walleye Stocking*: SF = small-fingerling; LF = large-fingerling

Appendix E. Habitat Evaluations and Potential Actions

GLIFWC will evaluate the shoreland habitat in each lake and the watershed. Key habitat components for evaluation will include potential walleye and yellow perch spawning habitat, riparian zone buffers, coarse woody habitat, water levels, aquatic vegetation, sediment cores, water temperature, and clarity (some of these components will be monitored over time). If areas for habitat improvement are identified during this assessment, cooperative efforts to make the necessary habitat improvements will be considered.

Shoreland and watershed conservation and protection efforts should be implemented based on an inventory of existing and potential stressors to the lake and target the highest-value opportunities. For shorelands, examples of protection include acquisition, easement, zoning, invasive species prevention, and monitoring. Examples of rehabilitation include bioengineered shorelands, large woody habitat, and aquatic vegetation plantings. Examples of mitigation include no-mow zones, sewage management, and erosion control. For watersheds, examples of protection include acquisition, easement, zoning, and monitoring. In some cases, critical habitats or land may have been degraded. Examples of rehabilitation include reforestation, creation of vegetated buffer strips, and building engineered wetlands or stormwater retention ponds. Examples of mitigation include using best practices for fish passage on road-stream crossings, erosion control measures, and minimizing sewage and runoff. Protection, rehabilitation, and mitigation strategies should be developed after consultation with stakeholders and on-site surveys have been completed. For details on individual lakes, please visit The Midwest Glacial Lakes Partnership Conservation Planner at http://ifrshiny.seas.umich.edu/mglp.

Appendix F. Climate Vulnerability

Water temperature is an important variable determining how suitable a lake is for different fish species. The MGLP used projected climate scenarios to predict future water temperatures for lakes throughout the region. Suitability models were run to estimate whether representative warm-water (e.g., bluegill (agwadaashi)), cool-water (e.g., northern pike and walleye), and cold-water (e.g., cisco (odoonibiins), burbot (mizay), and lake trout (namegos)) fishes are likely to be present in 2018 and 2050. Similarly, Read et al. 2016 generated predictions of species dominance largemouth bass or walleye in these lakes under future conditions for two time periods, 2040-2064 and 2065-2089. The table below summarizes these findings and the likelihood these lakes will be refuges for walleye in the future. Building resilience and/or eliminating other stressors is likely the best way to reduce the effects of a changing climate on fish communities – see Appendix E on habitat.

Lake	Species Suitability (2018)	Species Suitability (2050)	Probability of Species Dominance (2040-2064)	Probability of Species Dominance (2065-2089)	Vulnerability to Climate Change	Refuge for Walleye Under Future Conditions
Clear	Warm-water, Cool-water, and Cold-water Species	Warm-water and Cool-water Species	High largemouth bass abundance >49%, naturally reproducing walleye populations <49%	High largemouth bass abundance >49%, naturally reproducing walleye populations <49%	High	Unlikely
Katherine	Warm-water, Cool-water, and Cold-water Species	Warm-water and Cool-water Species	Naturally reproducing walleye populations >49%, high largemouth bass abundance >49% probability	Naturally reproducing walleye populations >49%, high largemouth bass abundance >49%	High	Likely
Anvil	Warm-water, Cool-water, and Cold-water Species	Warm-water and Cool-water Species	High largemouth bass abundance >49%, naturally reproducing walleye populations <49%	High largemouth bass abundance >49%,naturally reproducing walleye populations <49%	High	Unlikely
Laura	Warm-water, Cool-water, and Cold-water Species	Warm-water and Cool-water Species	Naturally reproducing walleye populations >49%, high largemouth bass abundance <49%	Naturally reproducing walleye populations >49%, high largemouth bass abundance >49%	High	Likely