Fishery Management Plan

Moose Lake
Sawyer County, Wisconsin

August, 2018

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FOREWORD AND ACKNOWLEDGMENTS

This is a long-term strategic plan that will guide our fishery management efforts on Moose Lake for many years to come. We believe our fishery management plans should be based upon a shared vision that is developed by combining broad-based survey information from statewide anglers and interactive input from local stakeholders. From those sources we determine user preferences in light of ecosystem capability. We believe the goals of a good plan must reflect the shared vision between users and managers; and measurable objectives must be set so we know whether selected strategies are succeeding or failing. We believe in making good tries and learning from failure. Part of that process involves amending strategic plans (like this document) when failure dictates that we either develop more realistic objectives or change our strategies to achieve reasonable objectives. This plan should be updated as needed in the decades that follow.

We call this a "long-term strategic plan" because the goals and objectives are relatively timeless, and because we possess neither the wisdom nor the authority to commit DNR or partner resources to a specific operational schedule of funding and action. Each year will bring its own fiscal constraints and operational priorities, so we must remain flexible in our implementation of proposed actions. We will do our best to justify actions we believe necessary to realize our shared vision to DNR leaders and the general public as time and circumstances permit. We promise only to consult this plan at least once annually as we allocate our time and resources to the many important projects before us.

We want to thank the Moose Lake Improvement Association and Mr. Jim Onarheim (Fish Committee Chair) for hosting our local stakeholder visioning session at the Round Lake Town Hall on May 20, 2006. Their continued support for this process and this plan has given us the energy and enthusiasm needed to aggressively pursue implementation and to expand this process to other lakes in Sawyer County and the Upper Chippewa Basin.

We also want to thank the 40 local stakeholders who gave up an entire Saturday evening in order to help us develop the vision that forms the backbone of this plan. We are very pleased to incorporate their input at this appropriate stage in the planning process; and we look forward to their continued support for the actions we believe will be necessary to achieve the shared vision. We can settle for nothing less in an area where the quality of fishing means so much to our livelihoods and our quality of life.

-- Max Wolter, Frank Pratt, and Dave Neuswanger

BACKGROUND

Habitat Characteristics and Productivity

Moose Lake has 1,703 surface acres, a maximum depth of 21 feet, 35.2 miles of shoreline and 82 islands totaling 64 acres of land area. (Table 1). Three major inlets flow into Moose Lake including the Little Moose River entering from the Northeast, the Moose River entering from the East, and the West Fork of the Chippewa River which enters from North. The total watershed area is 182,401 acres and the land type is predominantly forested with very little human development or agriculture. The outlet of Moose Lake is the continuation of the West Fork of the Chippewa River which flows through a gated dam with a 10-foot head. There is no power production at the Moose Lake dam, rather the reservoir is operated as water storage for downstream power production by Xcel Energy. The shoreline is heavily wooded with a mix of deciduous and coniferous species.

Bottom substrates in Moose Lake include considerable amounts of rock and gravel with extensive areas of muck, particularly in deep water. There is abundant littoral woody habitat in the form of stumps, trees, and flooded timber that is estimated to be continuous and at "natural levels" on 37% of the shoreline that has remained undeveloped and unaltered (Miskowiak 2010**)**. Moose Lake has considerably more littoral woody habitat than most other lakes in the area because of relatively low shoreline development. Fish cribs have been added to the few deepwater (>15') areas of the lake on several occasions. There is no direct evidence suggesting this approach his increased production of smallmouth bass, perch, and black crappie which were project objectives at one point.

Water clarity is low because of the tannin stained water that flows into the lake from the low-lying marshes upstream. Secchi disk visibility is typically around two feet. The dark water of Moose Lake is a major factor structuring the fish population in the lake. Alkalinity ranges between 20 and 46 ppm (Table 1). The lake does not stratify and is oxygenated throughout the water column.

Water level management regimes have changed through time. Winter drawdowns of up to 8 feet deep had been conducted in the past. The current winter drawdown is around 5 feet. Muskellunge and walleye reproduction are thought to benefit from compaction and oxidation of sediment that occurs as a result of the annual drawdown. However, entrainment of muskellunge and other species through the dam is an unquantified but likely important factor structuring the Moose Lake fish community.

Table 1. Most current limnological parameters for Moose Lake.

Limnological Parameter	**Absolute or Mean Value (range if known)**
Physical Characteristics	
Surface Area	1,703 acres
Volume	13,113 acre-feet
Water Level Elevation	1374.0 feet above mean sea level
Maximum Depth	21 feet
Mean Depth	Listed as 8', but varies based on water level
Littoral Zone	99% of lake area <20 feet deep
Shoreline Distance	35.2 miles
Watershed Area (direct drainage)	14,838 acres
Watershed Area (indirect drainage)	182,401 acres

Chemistry and Primary Productivity	
Total Alkalinity	24 mg/l (range 20-46 ppm)
pH	7.0-7.2
Specific Conductance	80 micromhos/cm
Total Phosphorus	0.043 mg/l (range 0.016 to 0.045)
Chlorophyll *a* (July)	4.49 µg/l (range 2.18 to 43.20)
Total Nitrogen	1.42 mg/l
Secchi Disk Visibility	2.5 feet (range 2-3 feet)
Trophic State Index	Ranges from 50-58 (classed as slightly eutrophic)

Human Development and Public Access

In 1980 there were 8-10 functioning resorts on the lake. That number has dwindled to two (as of 2018). Sixteen miles of shoreline (32% of total) are owned by the US Forest Service. Thirty-two miles of shoreline (63% of total) are privately owned. Xcel Energy and the State of Wisconsin also own small portions of the shoreline. An observation survey documented 692 shoreline structures on Moose Lake (13.8 structures per mile, or 1 per 380 feet) which is a relatively low density of development in comparison to many other northern Wisconsin lakes (Miskowiak 2010).

Historical Perspective on the Fishery

Moose Lake has always been known to have a high-density walleye (*Sander vitreus*) population with slow growth. Historical growth rate analyses found that it took walleye 5-7 years to grow to 15 inches in Moose Lake (northern Wisconsin average is ~4.5 years). Because of these growth characteristics, walleye in Moose Lake were exempted from the statewide minimum length limit in 2005, this exemption is still in effect today (with a modification to that regulation added in 2015 that limits harvest of walleye over 14 inches to one per angler per day).

The muskellunge (*Esox masquinongy*) population in Moose Lake is thought to be very pure genetically since little stocking has happened. Moose was considered as a potential broodstock location for WDNR hatchery production but that idea was abandoned based on the slow growth of these fish. The population has always been self-sustaining and consistently produces year classes. The forage base for muskellunge in Moose Lake is largely made up of riverine species such as sucker and redhorse species. It is considered an "action" muskellunge fishery with very high catch rates of around 1 fish per 13 hours of angling effort (average for Wisconsin is 1 fish per 34 hours of angling). The minimum length limit was increased from 34 inches to 40 inches in 2003 and that regulation remains in effect. Muskellunge harvest is low to non-existent in recent years.

Black crappie (*Pomoxis nigromaculatus*) growth has been above average but year class production has been inconsistent, as would be expected in a dynamic system with fluctuating water levels, a large river influence, and dense predator populations. Habitat for crappie in the form of shallow water woody cover is abundant. Black crappie were occasionally transferred into Moose Lake from other nearby lakes to supplement natural recruitment. That program is no longer in effect due to concerns related to relocating fish. A 10-daily bag limit for panfish was put in effect in 2001 to reduce harvest of crappie and other panfish species that do not have consistent or strong recruitment in Moose Lake.

Northern pike (*Esox lucius*) were not present in Moose Lake until recently, although the exact date of northern pike introduction is unknown. Northern Pike are more prevalent in

waterbodies upstream (Lower Clam Lake) and that may have been how northern pike got to Moose Lake. But despite their presence in the watershed, northern pike density in Moose Lake is extremely low. In fact, a northern pike has never been captured as a part of the DNR survey. However, hybridization between pike and musky (tiger muskellunge) in Moose Lake has been observed.

Smallmouth bass (*Micropterus dolomieu*) are common in Moose Lake as well as the inflowing rivers. Smallmouth are thought to move between the lake and rivers seasonally, though little is known specifically about smallmouth movement in the system. Largemouth bass (*Micropterus salmoides*) are much less common but can attain good size.

Other species present include yellow perch (*Perca flavescens*), bluegill (*Lepomis macrochyrus*) rock bass (*Ambloplites rupestris*), pumpkinseed (*Lepomis gibbosus*), black bullhead (*Ameiurus melas*), yellow bullhead (*Ameiurus natalis*), and brown bullhead (*Ameiurus nebulosus*), white sucker (*Catostomus commersonii*), silver redhorse (*Moxostoma anisurum*), golden redhorse (*Moxostoma erythrurum),* greater redhorse (*Moxostoma valenciennesi),* and shorthead redhorse (*Moxostoma macrolepidotum),* burbot (*Lota lota*), trout perch (*Percopsis omiscomaycus*), common shiner (*Luxilus cornutus*), and creek chub (Semotilus atromaculatus). Sucker species make up a considerable amount of the biomass in Moose Lake.

Stocking in Moose Lake has included walleye fry (1930's and 1940's), muskellunge fry (1930's and 1940's), largemouth bass fingerlings (1930's and 1940's) and sucker fry. Despite public pressure to do otherwise, in 1961 the recommendation was to no longer stock walleye or muskellunge because these populations were dense, slow growing, and reproducing at an adequate level. No stocking of either species has occurred since that time. A small number of bluegill were stocked in 2014 by a private group interested in boosting panfishing opportunities in the lake. Those stocked fish were fin clipped for follow-up evaluations of stocking success.

Yellow perch were stocked extensively between 1978 and 1990 to diversify the forage base in an attempt to increase walleye growth rates. Yellow perch are still present in Moose Lake but the intended effect of increasing walleye growth was not realized. Bluegill are present and reproduce in Moose Lake but have never been abundant. Field transfers of bluegill into Moose Lake from nearby lakes with slow growth were conducted regularly in the past and were both popular and purportedly successful. In 2015, a batch of 5,100 bluegill transferred into Moose from Ghost Lake (upstream) were fin clipped for follow-up evaluations of stocking success. Growth rates of transferred bluegill were always believed to improve once these fish were in Moose Lake. As discussed later in this plan, recent bluegill stocking and transfer efforts have had limited success. These types of direct transfers are time and labor intensive and are only possible under specific circumstances.

Fishing pressure was estimated to be 9.2 hours per acre during the open water season in 1975 and was very similar when estimated again in 1995-96 (10 hours per acre). This amount of angling pressure is relatively low for the area (20-30 hours per acre are commonly observed). Very little tribal spearing takes place on Moose Lake as a result of the dark water color.

Aquatic Community Overview

Submergent aquatic vegetation is limited in Moose Lake due to the dark color of the water. Species present include longleaf pondweed (*Potamogeton nodosus*), variable pondweed (*Potamogeton gramineus*), ribbon-leaf pondweed (*Potamogeton epihydrus*), clasping-leaf pondweed (*Potamogeton perfoliatus*), and slender naiad (*Najas flexilis*). Emergent vegetation is

somewhat more common and includes broad leaf cattail (*Typha latifolia*), narrow leaf cattail (*Typha angustifolia*, invasive), wild rice (*Zizania* spp.), common arrowhead (*Sagittaria latifolia*), water horsetail (*Equisetum fluviatile*), sedges (*Cyperaceae* spp.), bulrushes (*Typha* spp.), sweetflag (*Acorus calamus*), and floating leaf bur reed (*Sparganium angustifolium*). Algal growth is limited in the dark water of Moose Lake and there are no issues with blue-green algae species.

Aquatic macroinvertebrates include many species of mayflies, dragonflies, caddisflies, diptera larvae, and amphipods. Hatches of mayflies can be very large and have a considerable effect on the fishing and most likely also the food chain.

A Vision for the Moose Lake Fishery

On May 20, 2006, DNR representatives Frank Pratt and Dave Neuswanger met with approximately 40 local stakeholders who were willing to volunteer their time to help develop a long-term vision for the fishery of Moose Lake in Sawyer County. Objectives of the meeting were to prioritize species of interest, and then to identify for those species the relative importance of numbers versus size and catch versus harvest. Attention was then focused on identifying the desired conditions (goals and objectives) that appear in this plan. Goals and objectives statements for walleye, black crappie, muskellunge and bluegill were developed by consensus of local stakeholders in consultation with Frank Pratt, who served as technical advisor to the group on what was possible. However, little attention was given to methods for achieving goals and objectives (management strategies such as harvest regulations, fish stockings, and habitat preservation or enhancement). It was understood and generally agreed that professional fishery managers would select the most appropriate strategies once goals and objectives had been developed with help from local stakeholders and adjusted to incorporate the capacity of Moose Lake to produce what is desired.

Detailed results of the visioning session appear in the Appendix. Walleye were the species of greatest sport fishing interest among local stakeholders in the Moose Lake fishery (Table A1). Though characterized in times past as a harvest-oriented "numbers" fishery for mostly small fish, visioning session participants desired an improved balance between numbers and sizes; and they were willing to forego maximum harvest opportunity in exchange for improved population size structure (Table A2). Several participants expressed concern that the few walleye living long enough to attain a length of 13 inches were being harvested (no length limit currently) before reaching a quality size of 15 inches. Almost nobody wanted a "trophy" walleye fishery at Moose Lake, but stakeholder desires for improved balance are reflected in the goals and objectives, which call for moderate numbers of walleye but a higher proportion of quality-size fish.

As in most area lakes, black crappies were second only to walleyes in importance to local Moose Lake stakeholders (Table A1). Visioning session participants strongly favored a balance between numbers and sizes of crappie, and they were willing to forego maximum sustainable harvest in order to achieve that balance (Table A2). Several participants recalled a time when "buckets of slab crappies up to 16 inches and longer" could be caught at Moose Lake. But the consensus in 2006 was that the Moose Lake crappie population has been seriously over-harvested in recent years. Likely reasons include the advent of modern fishing technology, year-round effort targeting fish concentrated by a relatively small number of cribs, and potential illegal harvest activity. Though we did not dwell upon potential strategies to correct these problems, some participants advocated prohibition or increased restriction on the harvest of crappie during the winter months. Stakeholders seemed willing to support strategies that might restore and maintain moderate numbers of crappie with moderate proportions of 10- and 12-inch fish.

Muskellunge were important to local Moose Lake stakeholders (Table A1). The vast majority of visioning session participants preferred to release the muskies they catch, and there was far more interest in improving size structure than in maintaining a strictly "numbers" fishery (Table A2). Goals and objectives reflect reasonable angler desires for moderate numbers and improved size structure of muskellunge, including an objective to have some fish of trophy size (50 inches and longer). It is doubtful that these objectives can be achieved without changing regulations governing the size of fish harvested and the methods by which live bait may be used to catch muskellunge.

Bluegill were surprisingly important to local Moose Lake stakeholders (Table A1), considering their low overall abundance in the lake. The relatively open niche for bluegill in Moose Lake has resulted in apparent satisfactory growth of transferred fish, creating quality-size fish and generating significant interest in sustaining a bluegill fishery. As with crappie, visioning session participants preferred a balance between numbers and sizes of bluegill (Table A2), but there was a significant faction (25%) who desired maximum sustainable harvest of bluegill in a lake where young bluegill have not survived well due to habitat limitations (winter drawdowns and few macrophytes). We do not believe we can sustain a bluegill fishery and maximize bluegill harvest in a recruitment-limited situation, especially when stakeholders want 5-15% of all bluegill to be 8 inches and longer.

Smallmouth bass were of moderate importance to local Moose Lake stakeholders (Table A1). The vast majority of visioning session participants were inclined to release most or all of the smallmouth bass they caught, and there was slightly more interest in size than in numbers (Table A2). The visioning session was beginning to run long (four hours) by the time we got around to developing goals and objectives for smallmouth bass. Participants were getting tired. With friendly good humor, they left us with the take-home message to "not screw it up" (the smallmouth bass population), indicating satisfaction with the existing fishery and a willingness to trust our judgment in characterizing and maintaining it. We developed goals and objectives that we believe reflect current uncertainties and the preferences of a majority of stakeholders.

Yellow perch, largemouth bass, and rock bass were of limited interest to local Moose Lake stakeholders, but there was insufficient time and interest to develop individual objectives for those species. Yellow perch, of course, are important to walleye as prey; so anything that might be done to improve the production of young perch might benefit the high-priority walleye fishery.

Overall, this was a very positive session in which everyone, including DNR representatives, learned a great deal. We are confident that we can develop strategies that reflect the preferences and desires of local stakeholders and other anglers who visit the area.

WALLEYE

GOAL 1: A walleye population of moderate density with a low to moderate proportion of quality-size fish.

Objective 1.1: 2-4 adult walleye per acre in spring population estimates

Objective 1.2: Of all walleye 10 inches and longer captured by fyke netting in early spring, 15-25% should be 15 inches or longer (PSD = 15-25%).

Walleye Status and Management Strategies:

Walleye

Captured 3.6 per net-night ≥ 10 inches	
Quality Size ≥ 15"	21%
Preferred Size ≥ 20"	10%

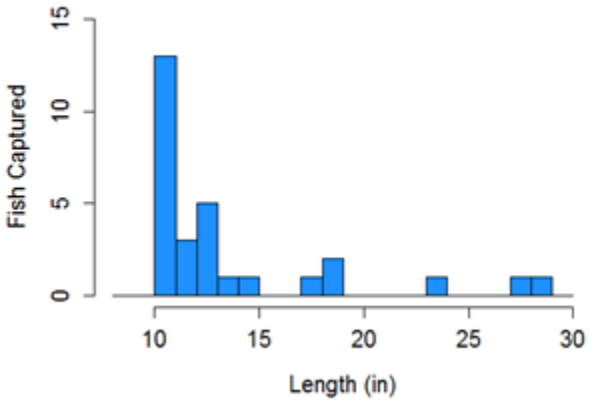

Figure 1. Walleye capture summary from a 2013 netting survey in Moose Lake.

A current walleye population estimate is not available for Moose Lake and so we do not have data to conclude whether Objective 1.1 is being met at this point in time. The most recent population estimate was conducted in 1995 and found 2.8 adults per acre. However, angler reports presently indicate a dense walleye population that has not changed from historical levels. In addition, recruitment of walleye continues to be adequate (8.1 young of year per mile in 2012 despite poor electrofishing conditions). In Moose Lake, walleye abundance has never been limiting and so we expect Objective 1.1 to consistently be met when we evaluate the walleye population through our spring surveys.

Achieving the desired size of walleye may be more difficult. Early surveys of Moose Lake found a higher average size and a greater proportion of walleye over 15 inches than recent surveys (Table 1). The 2013 netting survey did find a large enough proportion of the adult walleye population was over 15 inches (21%) to meet size objectives established in this plan (1.2, Figure 1). However, surveys over the last couple decades have shown a population with low size structure to be more of the norm. Even in the 2013 survey, many of the spawning adult walleye captured were only 10-12 inches of length and are not highly desirable to anglers. Strategies to improve and maintain size structure should be sought.

Table 1. Historical records of walleye captured in DNR surveys, including number measured and two metrics of size structure.

Survey Year	Number of Adults Measured	Average Length (inches)	PSD/RSD15*
1949	124	15.6	63
1967	107	14.6	41
1995	944	13.0	14
2009	93	12.9	11
2013	31	13.3	21

* PSD/RSD15 is the proportion of the adult walleye population over 15 inches.

One of the most important questions to answer when considering whether alternative fishing regulations may improve size structure of walleye in Moose Lake is if the current size structure is the result of slow growth or high angler harvest of fish that reach bigger sizes. A 2013 analysis of walleye growth rate revealed that, like in the past, walleye in Moose Lake are growing slowly (Figure 2). Both males and females were determined to be well below the average length for their age in this part of the state. In particular, the growth of males slows considerably after they achieve 10 inches in length which happens at about age-3.

Figure 2. Walleye average growth rates in Moose Lake determined from spine ages and back calculated lengths of fish captured in 2013. The average growth rate for northern Wisconsin is also shown.

In 2015, walleye regulations on Moose Lake were slightly modified with the hopes of delivering more consistent quality size (in line with Objective 1.2). The new regulation maintains a "no minimum" length limit for walleye in Moose Lake, but allows harvest of only one walleye over 14 inches. This regulation offers slightly more protection to larger adults and pushes some harvest towards smaller walleye. Over time, this regulation may drive improvements in the size structure of Moose Lake walleye while still allowing a considerable amount of harvest. However, anglers should not expect dramatic results given the slow growth of the population.

There is a low-density population of small perch in Moose Lake that could serve as a good forage base for large walleye (Figure 3). In fact, the presence of perch in the 6-8 inch range may explain why some walleye in Moose Lake are able to "break out" from the modal size of 10-13 inches and reach bigger sizes (Figure 1). Any walleye that gets large enough to start utilizing adult perch as a food source may have the ability to increase growth rate somewhat. Promoting perch recruitment and abundance could be a viable strategy to increase walleye growth rates. But this has been attempted in the past and was not measurably successful.

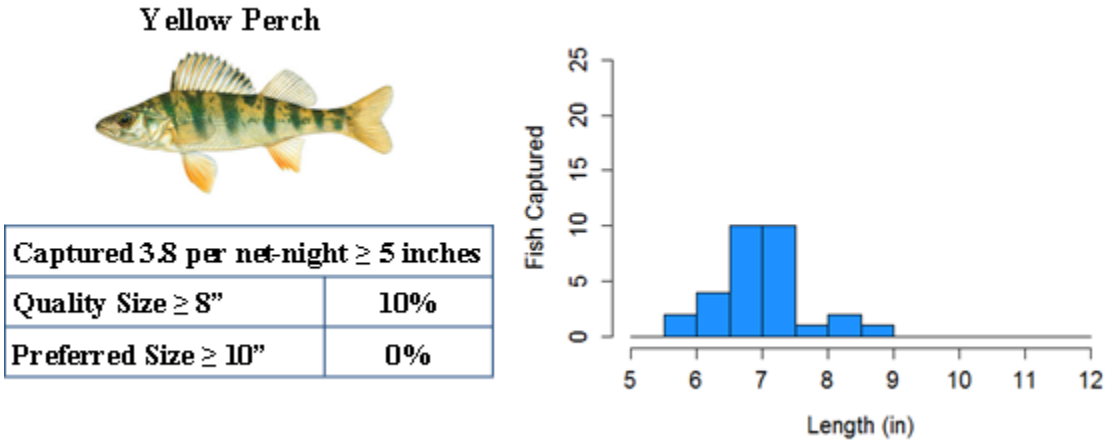

Figure 3. Yellow perch capture summary from a 2013 netting survey in Moose Lake.

One positive note on the Moose Lake walleye population is that this lake is in a very good position to remain a walleye dominated fishery even while many other lakes in the area are experiencing declines in walleye recruitment (Gostiaux 2016) and are becoming dominated by largemouth bass. The riverine habitat, dark water, and lack of aquatic vegetation in Moose Lake all favor walleye over largemouth bass. Maintaining walleye as the dominant predator will not only help achieve abundance and size objectives for walleye, but will help deliver quality size structure of crappie.

BLACK CRAPPIE

GOAL 2: A black crappie population of moderate density with moderate proportions of preferred- and memorable-size fish.

Objective 2.1: A late spring fyke net capture rate of 10-20 black crappie 5 inches and longer per net-night.

Objective 2.2: Of all black crappie 5 inches and longer captured by fyke netting in late spring or mid fall, 20-40% should be 10 inches or longer (RSD_{10}= 20-40%) and 5-10% should be 12 inches or longer (RSD_{12}=5-10%).

Black Crappie Status and Management Strategies:

Historically, Moose Lake has always had good size structure for crappie with a healthy proportion of the population over 10 inches in length appearing in virtually all surveys going back to 1946. The most recent survey data for crappie in Moose Lake (Figure 4) shows that the population currently meets both abundance (2.1) and size (2.2) objectives (only 4% were over 12

inches making the second part of objective 2.2 *close* to being met). Therefore, management actions should strive to maintain the population in its current state.

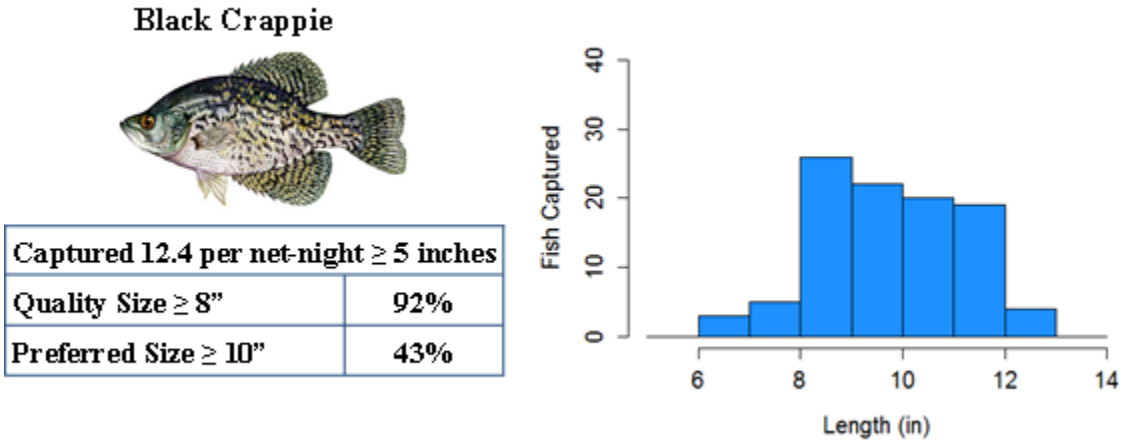

Figure 4. Black crappie capture summary from a 2013 netting survey in Moose Lake.

The reduced daily bag limit for crappie appears to be delivering the intended result of better size structure and should be maintained. The relatively dense population of walleye keeps individual year classes from becoming overly abundant thereby allowing fast growth (Figure 5). Habitat additions do not appear to be necessary. In fact, existing cribs are thought to concentrate fish and make them vulnerable to high rates of harvest, particularly in winter months.

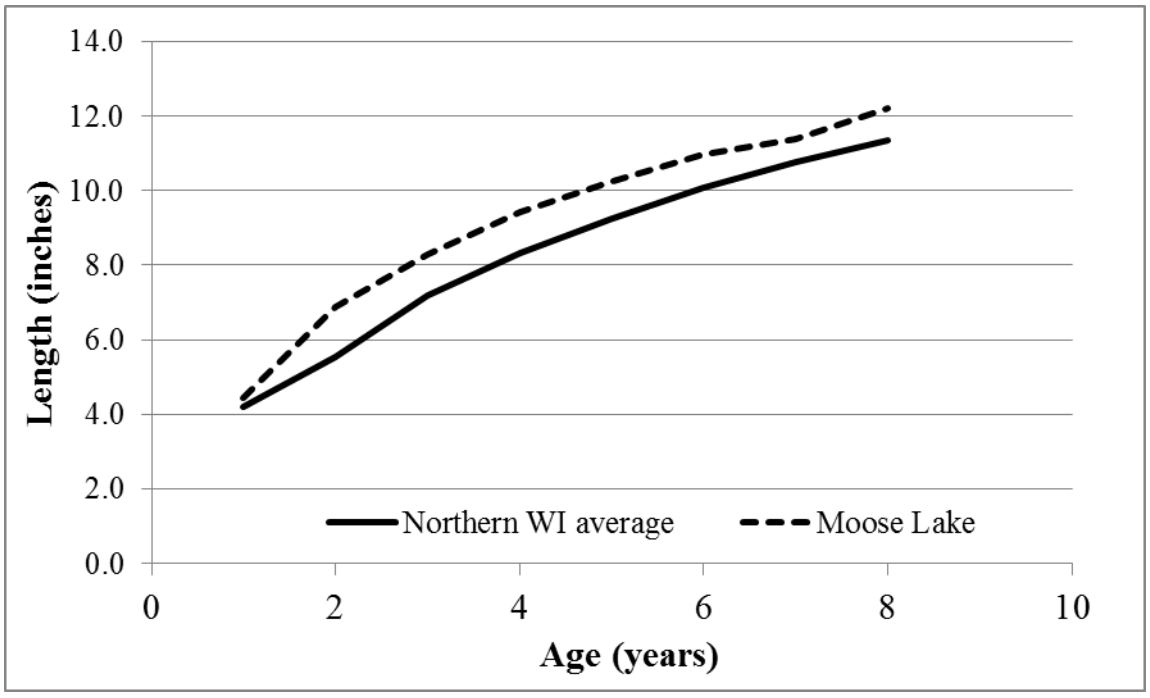

Figure 5. Black crappie average growth rates in Moose Lake determined from scale ages and back calculated lengths of fish captured in 2013. A comparison to the average growth rate for the area is also shown.

If crappie recruitment becomes highly inconsistent, changes in water level management may be recommended as a strategy to improve recruitment consistency. Small overwinter

drawdowns and high water levels in the spring during spawning are conditions that have been shown to improve crappie recruitment (Beam 1983). However, achievement of these conditions is dependent on many factors including cooperation of the company that controls the dam (Xcel Energy) and support from shoreline owners that currently enjoy the winter drawdown.

MUSKELLUNGE

GOAL 3: A muskellunge population of moderate to high density with a moderate to high proportion of memorable-size fish and a low proportion of trophy-size fish.

Objective 3.1: 0.6 to 0.8 adult muskellunge per acre in spring population estimates

Objective 3.2: Of all muskellunge 20 inches and longer captured by fyke netting in early spring, 10-20% should be 42 inches or longer (RSD_{42} = 10-20%).

Muskellunge Status and Management Strategies:

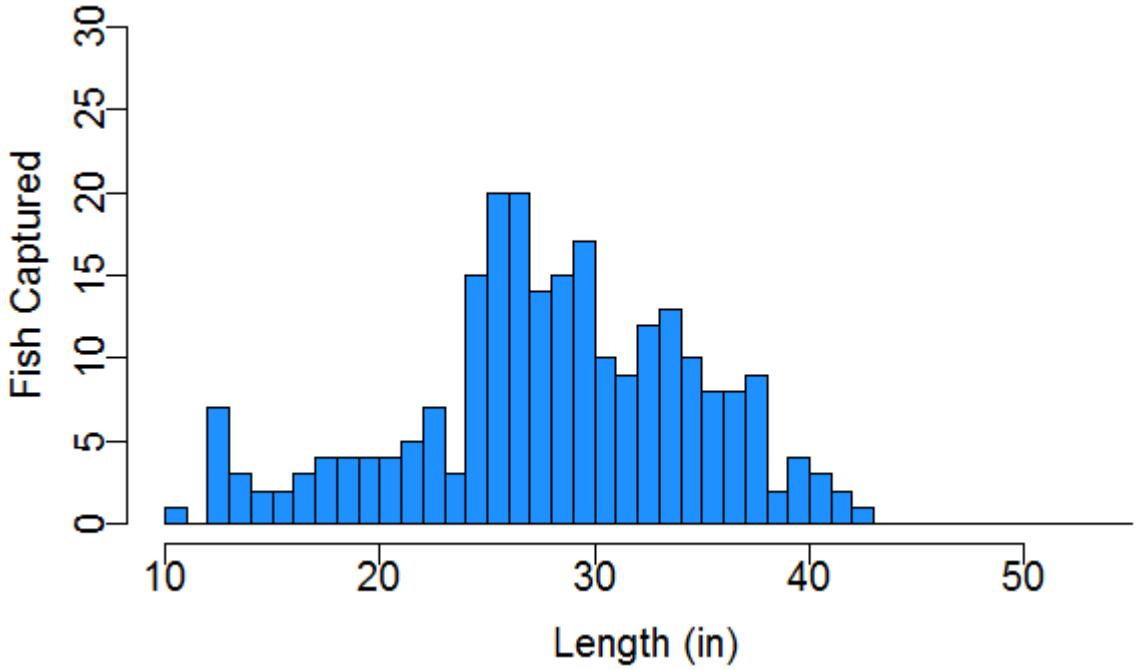

Figure 6. All muskellunge captured in netting surveys of Moose Lake between 1949-2017 (9 surveys, totaling 241 fish).

Moose Lake has always been known to have a dense population of muskellunge that is dominated by smaller bodied individuals (Figure 6). Dombeck et al. (1984) studied spawning habitat in several muskellunge lakes in the Midwest, including Moose Lake. Spawning habitat in Moose Lake was found to be excellent, especially in comparison to many other lakes. As a result, natural recruitment of muskellunge in Moose Lake is sufficient to maintain the population and no stocking has occurred for several decades. Like smallmouth, muskellunge in this system benefit from having access to a variety of river and lake habitats to meet their needs seasonally. The forage base for muskellunge is excellent with many different species of sucker present in both the lake and connecting rivers. As such, it is unclear if the small size structure of Moose Lake is a result of density leading to competition for food which translates into slow growth, or, whether early maturation and small maximum body size is a natural characteristic of this population. One

hypothesis is that the dark water of Moose Lake considerably limits the foraging success of muskellunge (a primarily sight feeding fish) which could have positively selected for slow growth, early maturation, and smaller adult body size. Regardless of the specific cause of the current size structure of muskellunge in Moose Lake, achieving even the modest size structure objectives (3.2) in this plan may be difficult. The current minimum length limit of 40 inches is unlikely to have any change on harvest which is very low or non-existent for both tribal and sport fishing. Therefore, we have no expectation that the population will respond to further changes in the minimum length limit. If density of muskellunge is the limiting factor for growth, then harvesting some smaller muskellunge could improve size structure. It is unlikely that such a concept would ever be put into practice as it would be very unpopular with the musky fishing community and has not been accepted by anglers on other area lakes when attempted. Reducing catch and release fishing mortality may be a viable option to preserve the large fish present in the lake. Educational efforts related to the proper handling of muskellunge and some of the inherent risks of live bait fishing are warranted. Utilizing local guides as champions of this approach may be more effective than hearing the same message from the DNR.

It is also possible that we may need to accept that the small bodied fish present in Moose Lake are a unique and natural characteristic of the fishery and large fish may continue to be rare regardless of management actions or angler behavior. This type of fishery still has merit and provides a great setting for introducing youth to the sport of muskellunge fishing. The Youth Conservation Alliance and Muskies Inc. recently moved their "Youth Musky Hunt" events to Moose Lake for this very reason and catch rates during the event have been high.

BLUEGILL

GOAL 4: A bluegill population of low to moderate density with a moderate proportion of preferred-size fish.

Objective 4.1: Currently we lack an effective method to assess the relative abundance of bluegill in Moose Lake. Until an assessment method is chosen, we will consider a late spring fyke netting capture rate of 5-10 bluegill 3 inches and longer to be somewhat indicative of the desired low-moderate density.

Objective 4.2: Of all bluegill 3 inches and longer (stock size) captured by electrofishing in late spring, 5-15% should be 8 inches or longer (RSD_8 = 5-15%).

Bluegill Status and Management Strategies:

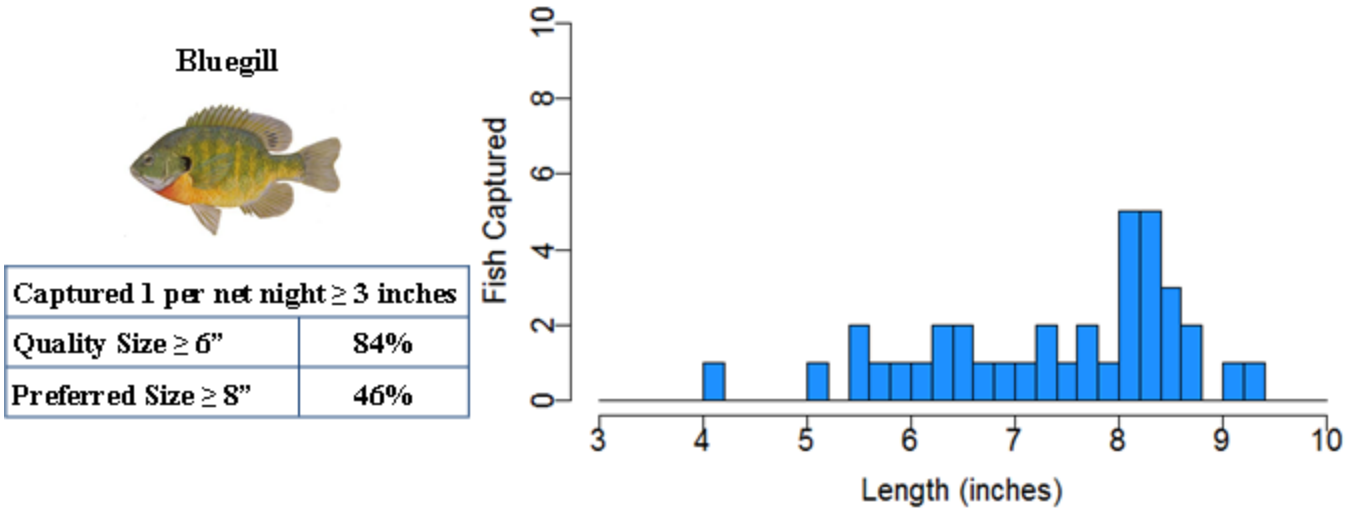

Figure 7. Bluegill captured in a late spring fyke netting survey of Moose Lake in 2017 specifically targeting panfish.

Historical data on the bluegill population in Moose Lake is extremely limited. Prior to 2016, only *20* total bluegill were recorded to be captured as a part of DNR fisheries surveys (more bluegill may have been captured, but were not recorded). A 1995 angler creel survey further highlighted the rarity of bluegill in Moose Lake. The average catch rate for bluegill was 1 per 5.4 hours of angling. That number is vastly higher than other lakes in the area (1 fish per 0.25 hours of angling is common). Netting efforts in 2016 and 2017 specifically targeted panfish with timing and net locations that should have been ideal to capture both bluegill and black crappie turned up low catch rate of bluegill, with just a few dozen fish captured in each year despite considerable effort (Figure 7).

Likely because of their low density, bluegill in Moose Lake appear to grow well, reaching 8 inches at a faster rate than average for northern Wisconsin (Figure 8). The 2017 netting effort found a significant proportion (46%) of captured bluegill to be 8 inches or longer.

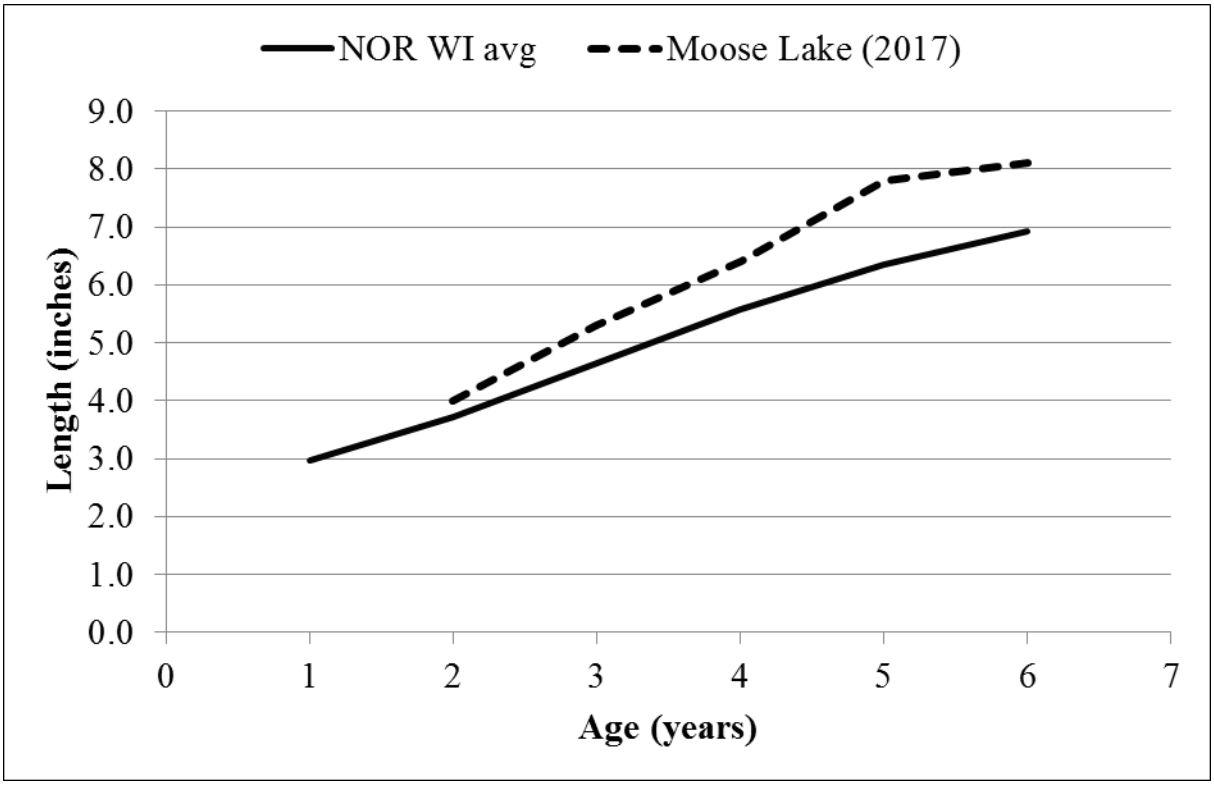

Figure 8. Bluegill average growth rates in Moose Lake determined from scale ages of fish captured in 2017. A comparison to the average growth rate for the area is also shown.

Because of the appealing potential to grow big bluegill in Moose Lake, several efforts have been made by both the public and DNR to increase bluegill abundance through stocking or field transfers. Early field transfer efforts involved capturing bluegill from small lakes in the Winter area (Black Dan, Island) with abundant bluegill populations and trucking them to Moose Lake. The field transfer program relied on considerable volunteer effort, primarily by members of the Moose Lake Improvement Association. Those efforts were deemed to be successful by Moose Lake locals, but were never formally evaluated by the DNR. The ability to continue field transfer of fish was greatly limited in 2006 by VHS rules, and transfers were ceased.

In response to continued interest in increasing bluegill abundance, a new initiative was undertaken in 2014. A private group on Moose Lake secured funding and permits to stock 3,000 bluegill from a private hatchery. The DNR worked with this group to clip the left ventral fin on 2,000 of the 3,000 fish (1,000 were deemed too small to clip). The following year, a field transfer was conducted that brought an estimated 5,100 fish from Ghost Lake (upstream waterbodies are currently the only viable option for a simple field transfer). The fish from Ghost Lake were given the opposite (right ventral) fin clip. Transferred fish were stocked into Moose Lake at various locations.

During a pair of follow-up surveys in 2016 and 2017 all bluegill captured were examined for fin clips (Photo 1). In the 2016 survey, only 10 of 44 bluegill had a right ventral clip, indicating they were the product of the Ghost Lake transfer in 2015. In the 2017 survey, only 9 of 37 bluegill had a ventral fin clip (8 right ventral clips from Ghost Lake, 1 left ventral clip from the private stocking event). In both survey years, the proportion of clipped fish was around 20-25%, indicating that the combined stocking and field transfer efforts had minimal impacts on total population abundance. Considering the significant cost and time investment involved, we conclude, based on these results, that stocking and field transfer efforts are not a cost-effective means to significantly

improve the bluegill fishery in Moose Lake. Other strategies should be explored to achieve Objective 4.1. The good news is that these survey efforts determined there is at least a modest amount of natural bluegill recruitment happening in Moose Lake (~75% of bluegill appearing in these surveys were determined to be natural born in Moose Lake or made their way into the lake on their own) and the existence of a bluegill fishery is not entirely dependent on stocking.

Photo 1. A bluegill captured in Moose Lake in a 2016 netting effort. The right ventral fish (top fin in the photo) was clipped and is now partially regrown, indicating that the fish was stocked into Moose Lake in 2015 as a part of a field transfer from Ghost Lake.

While bluegill can reproduce successfully in Moose Lake, the population is likely to remain at a low density due to a variety of unique factors acting against bluegill recruitment. Dark water, a dense predator population, limited aquatic macrophytes, and annual winter drawdowns are all major limiting factors for bluegill. Most of these factors are unlikely to change in the future. Therefore, this Plan aims to outline what can be reasonably expected of the bluegill fishery in Moose Lake. A low-density population with good size structure is a realistic goal under current conditions. If conditions change and bluegill recruitment appears to increase, the goal and objectives for bluegill in this Plan can be revisited.

SMALLMOUTH BASS

GOAL 5: A smallmouth bass population of moderate density with a high proportion of memorable-size fish.

Objective 5.1: Angling catch rates for adult smallmouth bass (7-inch and longer) of 0.2 per hour of targeting angling effort (or 1 fish per 5 hours of effort), as measured with DNR creel surveys or volunteer creel surveys.

Objective 5.2: 5-15% of all smallmouth bass caught by anglers and recorded in DNR creel surveys or volunteer creel surveys should be 17 inches or longer.

Smallmouth Bass Status and Management Strategies:

The Moose Lake smallmouth bass population is unique because of the access fish have to both river (West Fork of the Chippewa River and the Moose River) and lake habitats. We suspect that smallmouth in Moose Lake use different habitat types seasonally to meet their foraging, spawning, and overwintering needs. While this diversity allows for a dynamic smallmouth fishery, it poses major challenges when trying to assess the population in Moose Lake. Additionally, electrofishing, which is our primary gear for sampling bass, is not very effective in Moose Lake as a result of dark water, navigational hazards, and possible use of the inflowing rivers for spawning. A 2013 electrofishing survey had minimal success sampling smallmouth bass in Moose Lake, capturing only 6 adult smallmouth. In fact, of the 11 DNR electrofishing surveys of Moose Lake going back to 1961, only once was there more than 10 smallmouth captured (44 smallmouth were captured in a huge 1995 survey effort, Figure 9). We do not feel the number of fish captured during our electrofishing efforts is representative of the Moose Lake smallmouth population, rather it is a reflection of how difficult it is to electrofish this lake. Going forward, electrofishing may not be the best method for assessing smallmouth bass in Moose Lake. Angling data (either through creel surveys or a designed angler diary program) may be a more effective means to monitor trends in the smallmouth bass population of Moose Lake. As such, we recommend using angling catch rate to assess Objectives 5.1 and 5.2 established in this Plan. Target catch rates for smallmouth established in Objective 5.1 are based on angler catch rates in other popular smallmouth bass fisheries in the Hayward area (Grindstone Lake, Round Lake). Those interpreting this plan need to understand that target catch rates are an average across all anglers and angler skill levels. More experienced anglers are likely to experience higher catch rates while more novice anglers will experience lower catch rates.

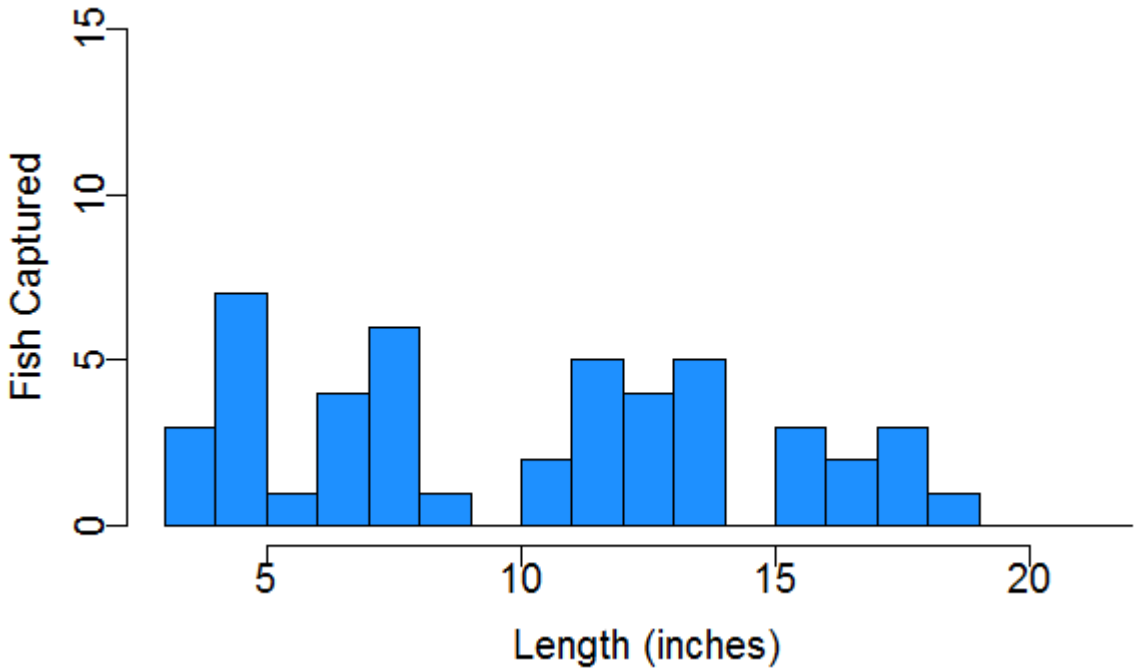

Figure 9. Smallmouth bass capture summary from a 1995 electrofishing survey in Moose Lake.

The use of angling data to measure the quality of smallmouth bass fishing in Moose Lake offers some advantages (more direct measure of angler satisfaction, more efficient than DNR electrofishing), but also poses challenges. It is unlikely that DNR creel surveys will become more common on Moose Lake in the future due to high cost and limited staff. A volunteer angler diary program that tracks angling effort (hours) along with numbers and sizes of fish caught may be a more attractive method. A similar volunteer creel program has been a successful method for tracking smallmouth bass fishing quality on rivers in the Hayward area (Wolter and Neuswanger 2016). As a part of the implementation of this plan, DNR will work with reliable anglers to establish an annual diary program that can be used to track Objectives 5.1 and 5.2.

The main sentiment expressed by stakeholders during the visioning session was that the Moose Lake smallmouth fishery remains at its current high-quality level. Therefore, any changes in fishing regulations should be as restrictive or more restrictive than those currently in place (statewide 14" minimum length limit). Recruitment of smallmouth bass is not thought to be a limiting factor, so management actions should focus on maximizing adult survival and growth to achieve objectives 5.1 and 5.2. More restrictive regulations for both black bass species could be a viable option to deliver larger smallmouth bass in Moose Lake without the risk of "flipping" the lake into a largemouth bass dominated fishery.

GENERAL FISH COMMUNITY

GOAL 6: A diverse native fish community that fluctuates in species composition but generally experiences no net loss of native fish species and provides adequate forage for sport fish populations.

Objective 6.1: No loss of native fish or other aquatic species either in the lake or in the tributary streams, as documented by periodic baseline monitoring surveys.

Objective 6.2: Adequate forage, as reflected by satisfactory growth rates and condition factors of sport fish populations managed under Goals 1-5.

General Ecosystem Status and Management Strategies:

Adequate year-round water quality is vital to maintain sport fish populations with acceptable growth rates and size structures.

Introduction of invasive exotic species should be discouraged by the Moose Lake Improvement Association via direct communications to their membership and appropriate signing at local businesses and public access areas.

Support for good shoreland management along privately-owned shorelines would help to prevent excessive input of nutrients. Maintaining wild shorelines and wide buffer strips between managed lawns and the lake will be helpful in achieving the goals and objectives of this plan. Minimizing the input of phosphorus and nitrogen from lawns or faulty septic systems will minimize nuisance plant growth and the ultimate decay of those plants that depletes oxygen and kills fish. Wild shorelines can exist on well-managed private properties as well as public lands.

APPENDIX

Results of Visioning Session for Local Stakeholders in the Fishery of Moose Lake in Sawyer County

Date: May 20, 2006
Time: 7:00 p.m. to 11:00 p.m.
Place: Round Lake Town Hall
Facilitator: Dave Neuswanger, Fisheries Supervisor, Upper Chippewa Basin, WDNR
Technical Advisor: Frank Pratt, Senior Fisheries Biologist, Sawyer County, WDNR
Profile of 40 Participants (more than one affiliation possible per person):

Lakeside Landowners – 40
Area Anglers – 0
Fishing Guides – 3
Business Owners – 6 (representing all the major resorts)
Others – 0

Table A1. Levels of sport fishing interest among visioning session participants in Moose Lake fish species nominated for consideration.

Fish Species Nominated	Level of Participant Fishing Interest			
	High	Medium	Low	None
Walleye	34	2	1	0
Black Crappie	25	10	3	1
Muskellunge	15	14	7	3
Bluegill	13	16	8	1
Smallmouth Bass	8	14	16	2
Yellow Perch	3	9	24	4
Largemouth Bass	0	3	18	12
Rock Bass	0	0	20	17

Table A2. Preferences for numbers versus size and catch versus harvest among visioning session participants for fish species perceived to be most important in Moose Lake.

Important Fish Species	Preference for Numbers versus Size			Preference for Catch-and-Release versus Harvest		
	Emphasis on Number over Size	Prefer Balance	Emphasis on Size over Number	Emphasis on Catch and Release	Prefer Balance	Emphasis on Maximum Sustainable Harvest
Walleye	0	39	1	4	32	4
Black Crappie	1	39	0	0	38	2
Muskellunge	0	14	17	37	2	1
Bluegill	6	33	1	0	30	10
Smallmouth Bass	7	19	13	34	6	0

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