

Missouri's Muskie Management Plan

2018-2027

Missouri Department of Conservation



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Approved by:

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EXECUTIVE SUMMARY

Missouri's Muskellunge (muskie) Program was initiated at Pomme de Terre Lake in 1966 to provide Missourians an opportunity to experience muskie angling within the state and to provide a trophy fishery for this top-level predator.

Fifty years after its inception, Missouri's muskie stocking and management program has become a great success. The program has grown to five lakes that are currently managed for muskies ([Table 1](#), [Figure 1](#)). In addition, four other small lakes were stocked and evaluated over the previous 20 years but were removed from the program due to inadequate habitat, high muskie mortality, and low angler success.

The goal of this muskie plan is to provide high-quality muskie angling opportunities in suitable, geographically distributed impoundments where more traditional Missouri fisheries will not be adversely affected and may be enhanced. The objectives and strategies outlined in this plan provide a framework to guide Missouri's muskie management and culture efforts. These objectives are evaluated annually with spring fyke netting surveys, and through the Show-Me Muskie Project, a statewide volunteer muskie angler catch reporting system.

This plan also serves as a tool to help communicate program direction to anglers. The success of Missouri's muskie program to date can be attributed to the interest of Missouri's muskie anglers, and their support of the cooperative efforts of hatchery and Fisheries Management personnel of the Missouri Department of Conservation (MDC).

INTRODUCTION

The goal of this plan is to provide a framework for developing and maintaining high-quality muskellunge (muskie) angling opportunities in suitable, geographically distributed impoundments where more traditional Missouri fisheries will not be adversely affected and may be enhanced.

The objectives and strategies outlined in this plan will guide Missouri's muskie management and culture efforts. Much of the muskie's life history information and historical background of muskie management efforts in Missouri can be found in our two previous muskie plans (Neuswanger et al. 1994, Boone et al. 2007).

History of Muskie Stocking and Culture in Missouri

Muskies were first stocked by MDC in 1966. Pomme de Terre Lake (7,820 acres) was stocked with 51,000 small fingerlings (1.5 to 2.0 inches) and approximately 1,500 large fingerlings (7.0 to 15.0 inches) ([Table 2](#)). The objective of the program was "to provide Missourians with a trophy fishery utilizing a predator that could prey upon large non-game fishes such as gizzard shad, carp, and various redhorses" (Dent 1986).

From 1981 to 2000, stocked muskies were 10 to 12 inches in length except for four years when smaller fingerlings (approximately 8 inches) were stocked. In the early years of the muskie program, Chesapeake and Blind Pony hatcheries were the primary sites for production of large muskie fingerlings in Missouri. In 1967 and 1968, 249 large fingerlings were reared at the Grand Glaize Hatchery (formerly owned and operated by Ameren/Union Electric) and released into Lake of the Ozarks (55,000 acres). One of these muskies was caught in 1981 at a length of 49.5 inches. It weighed 41 pounds, two ounces and is still the Missouri state record muskie. The record muskie was 14 years old (K. Richards, MDC, personal communication).

Pomme de Terre Lake supported Missouri's only significant muskie fishery until the mid-1980s. Despite a low mean annual stocking density of 0.35 large fingerlings per acre from 1983 through 1990, Pomme de Terre Lake muskie anglers caught one legal muskie (at that time greater than or equal to 30 inches) per 39 hours of effort from 1988 through 1992. This compared very favorably with reported mean catch rates from northern Wisconsin lakes (one per 71 hours) (Hanson 1986) and Minnesota waters (one per 91 hours) (Younk and Cook 1992) at that time.

In 1973, Pony Express Lake (240 acres) was first stocked with muskie. In 1983, the City of Kirksville's new water supply reservoir, Hazel Creek Lake, was stocked with 1,500 muskie fingerlings, which originated at the Linesville Fish Culture Station in Pennsylvania and were reared to 10 to 12 inches at Blind Pony Hatchery ([Table 3](#)). The lake opened to fishing in 1985 with a 42-inch minimum length limit (MLL); the highest in North America at that time.

A goal in the first muskie plan was to increase muskie fishing opportunities in small impoundments and to expand the geographic distribution of muskie fisheries in Missouri. The procedures and criteria listed in the plan were used to select small lakes for stocking (Neuswanger et al. 1994). From 1995 through 2001, six additional lakes were approved and stocked with muskies: Lake Girardeau, Fellows Lake, Henry Sever Lake, Binder Lake, Lower Taum Sauk Lake, and Busch Lake 35. Results from spring fyke netting and the Show-Me Muskie Project are used to evaluate populations in muskie program lakes. Based on these results, one of the older muskie program lakes (Pony Express Lake) and three of the newer lakes (Lake Girardeau, Binder Lake, and Lower Taum Sauk Lake) were removed from the muskie program.

Early attempts to use Missouri muskie as broodstock for the program date back to the late 1970s when biologists collected eggs from female muskies in Pomme de Terre Lake (R. Dent, MDC, personal communication). In April 1991, biologists were successful in collecting muskie broodstock by using large Wisconsin-style fyke nets in Hazel Creek Lake. Successful fertilization and hatching at Hunnewell Hatchery was followed by successful fingerling rearing at Chesapeake and Blind Pony hatcheries. Since coming online in 2000, all muskie production has been shifted to Lost Valley Hatchery. Currently, no muskies are spawned by Missouri hatcheries due to the cost of rearing fry and the findings of a recent genetic strain evaluation summarized later in this document. Only certified viral hemorrhagic septicemia (VHS) -free muskie are obtained from other state agencies with which MDC regularly trades fish.

Muskie Program Coordination

To accomplish one of the objectives in the first muskie plan, a Muskellunge Program Coordinator was appointed in 1996 (Neuswanger et al. 1994). Typically, the coordinator will have enough experience with muskie management and muskie fishing that he/she will be able to effectively communicate with muskie anglers and organized groups. Serving for a term of no less than three years, this individual coordinates muskie management strategies and communicates statewide muskie information to the public. This coordinator also oversees the Show-Me Muskie Project.

Show-Me Muskie Project

The Show-Me Muskie Project is a statewide volunteer muskie angler catch reporting system that began in 1996. It was initiated to gather catch data useful to Fisheries Management Biologists and to help evaluate our muskie program. Muskie anglers voluntarily keep records of their fishing results. Achieving our statewide average goal of catching a 36-inch or longer muskie every 20 to 40 hours of angling can be documented most efficiently by angler reports (Younk and Cook 1992).



Muskie anglers have been encouraged to participate in the Show-Me Muskie Project since its inception, and there are currently over 150 cooperators. Once each year, a newsletter is provided to all cooperators with updates on muskie culture and management, including annual results from the Show-Me Muskie Project. [Table 4](#) summarizes the results of the Show-Me Muskie Project. Much of the success of this program is due to the support of the Pomme de Terre Chapter of Muskies, Inc. and the participation of chapter members. An online reporting system will be available by 2018 to make participation in the project as convenient as possible.

Regulations

In January 1996, with the exception of Hazel Creek Lake, the statewide MLL for muskie was increased from 30 to 36 inches. On March 1, 2008, the 42-inch length limit on Hazel Creek Lake was replaced with the statewide 36-inch length limit. The statewide daily creel limit is one muskie per day.

Native Range and Habitat Considerations

Muskies are adapted to northern climates and are not native to Missouri. Being located at more southern latitudes than their native range, muskies in Missouri are subjected to regional environmental stressors. During summer months, it is likely that combinations of thermal stratification and high water temperatures constrain or eliminate quality muskie habitat in Missouri lakes. Previous studies have found that during the summer in lakes at southern latitudes, adult muskies typically seek water temperatures of about 78°F. Adult muskies prefer progressively lower water temperatures as their age and size increase. Thermal stratification occurs in Missouri lakes throughout the summer; a strong thermocline can develop at approximately 12 to 18 feet by June depending on the waterbody. Water temperatures are highest from late-June through mid-September, and dissolved oxygen concentration is often insufficient at depths where temperatures are optimal or preferred by muskies ([Figure 2](#)). Because their upper lethal limit is near 90°F, these conditions potentially create a thermally stressful environment for Missouri muskies, especially in waterbodies in the southern half of the state.

Muskie Genetic Strain Evaluation

While MDC Fisheries Management Biologists have been pleased with the success of the muskie program, producing muskies that could attain lengths greater than 50 inches for anglers to catch would be a desirable improvement for the program. An evaluation was initiated in 2002 at Pomme de Terre and Fellows lakes to compare growth and survival of northern versus Kentucky strain muskie. All genetic strains of muskie stocked in Missouri prior to 2002 are considered “northern strain” muskies since their origins were from northern states in the US (Pennsylvania, Wisconsin, Michigan, Minnesota, North Dakota, and Iowa). Based on their geographic origin, some MDC staff thought Kentucky strain muskies may have been better adapted to southern latitudes. Due to relatively low capture rates of marked fish and highly variable growth among same-aged individuals, the available data at the project’s completion in 2013 was not adequate

for comparing differences in growth rates or survival between the northern and Kentucky strains. This project, however, provided some useful information about general growth trends of muskie in Missouri. On average, it took six years for a muskie to reach 36 inches long in Pomme de Terre Lake and five years for a muskie to reach the same size in Fellows Lake during this study. Expected growth rate differences between sexes were observed, with females reaching 36 inches around five years old and males reaching that same length in about six to eight years in Pomme de Terre Lake. In Fellows Lake, females reached 36 inches in three and a half to four years while it took males five to six years to reach that same length. This study also provided some insight into what anglers should expect from the muskie fisheries in Pomme de Terre and Fellows lakes. One of the main objectives of Missouri's Muskie Management Plan is to maintain density and size structure of muskie populations that result in a statewide average annual angler catch rate of one muskie at least 36 inches in length per 20 to 40 hours of fishing. Data suggest that growth rates in Pomme de Terre and Fellows lakes are adequate to provide the needed density and size structure of 36-inch fish to meet the angler catch rate objective. However, many Missouri muskie anglers often argue that 36 inches is not a significant trophy length and urge managers to set new goals for muskie lengths, often in the 45 to 50-inch range. Data collected in this study suggest that muskie growth rates in Missouri are not adequate to support those higher goals, with the average predicted time to reach 45 inches nearing the end of the life expectancy of a Missouri muskie, and the average predicted time to reach 50 inches surpassing the life expectancy of most muskies in the US (Fuller and Woods 2013).

CURRENT MUSKIE PROGRAM LAKES

Stocking and management activities for the five current muskie program lakes are summarized below. (Table 1, Figure 1)

Pomme de Terre Lake

As Missouri's first and largest lake managed for muskies, Pomme de Terre Lake remains the flagship of the Missouri muskie program.

From 1966 through 2016, a total of 248,792 muskie fry and fingerlings was stocked in Pomme de Terre Lake resulting in an average stocking rate of 4,976 fish per year. From 2008 through 2014, Pomme de Terre Lake was stocked under a "pulse" stocking regime as identified in Missouri's Muskie Management Plan (2008-2017). Under this regime, the stocking rate was 4,000 fingerlings per year in five out of every six years and then 6,000 to 8,000 fingerlings in one out of every six years for a six-year maximum stocking of 28,000 muskies. The two years that received the "pulse" stocking of 8,000 fingerlings were 2008 and 2014 (Table 2). After 2014, the "pulse" stocking regime was abandoned in an effort to allocate stocking equally on an annual basis to produce a more consistent muskie fishing opportunity for Pomme de Terre Lake anglers. Beginning in 2015, the annual stocking rate was adjusted to 4,700 fingerlings per year.



Terminology tip: Since 1996, MDC Fisheries Management Biologists have been using the large Wisconsin-style fyke nets to collect muskie each spring to monitor the relative abundance and size structure of each population

From 1996 through 2016, the spring fyke net catch rate ranged from 1.2 to 14.9 fish per fyke net day (FND) (Table 5). The 22-year average catch rate is 5.5 fish per FND. From 1996 through 2017, the Proportional Size Distribution (PSD36) ranged from 10 to 58 (Table 5); the 22-year average is 36. In 2017 the PSD36 was 47.

Terminology tip: Fisheries Management Biologists use a parameter called Proportional Size Distribution (PSD) to describe the proportion of fish collected during a population sample that are greater than a fixed minimum stock size and also greater than or equal to any particular size of interest (Zale et al. 2012). In general, fish smaller than the stock size are hard to collect and including them in PSD calculations could add a lot of unpredictable variability to the percentages. For muskie populations, the fixed stock size is 20 inches. In Missouri, a very common size of

interest is the statewide minimum length limit of 36 inches. The acronym PSD36 refers to the proportion of the muskies collected, which are at least 20 inches long that are also greater than or equal to 36 inches.

From 1996 to 2016, the fishing effort expended by our Show-Me Muskie Project cooperators to catch a legal-size muskie (≥ 36 inches) ranged from about 19 to 98 hours ([Table 4](#)). The 21-year average is 46 hours. Over the past 21 years, the objective of anglers catching one muskie at least 36 inches long per 20 – 40 hours of muskie fishing effort has been achieved nine times. Since the Show-Me Muskie Project began in 1996, more than 600 anglers have taken more than 4,200 trips, fished more than 24,000 hours, and caught more than 1,600 muskies. The 21-year average is 21 hours of angling effort to catch one muskie of any size. The average size muskie caught on Pomme de Terre Lake is 34.8 inches long.

Another strength of the muskie program at Pomme de Terre Lake has been the increase in voluntary catch-and-release of legal-sized muskies since stocking started. Angler surveys were conducted at Pomme de Terre Lake from 1966-2011. These surveys were roving creel surveys generally conducted on one of two arms of the lake. Surveys were conducted on an annual basis from 1966-1992. Since then, surveys were completed in 2004-2005 and 2010-2011. From 1977 to 1979, anglers released 34 percent of the legal muskies they caught. This increased to 78 percent from 1980 to 1983 after catch-and-release promotions by Fisheries Management Biologists and the local chapter of Muskies, Inc. Release rate for muskie was 80 to 96 percent in 1991 and 1992. No muskies were harvested in the 2004, 2010, or 2011 creel surveys. In 2005, one 42-inch muskie was harvested.

Brush pile or “fish attractor” construction has been an annual project on Pomme de Terre Lake since 1992. This has been a joint project of the U.S. Army Corps of Engineers, Muskies, Inc. volunteers, and MDC. A total of 41 brush piles are marked with large reflective signs on the shoreline to allow anglers to easily find them. Approximately 335 other unsigned brush piles have been constructed. Information concerning the location of brush piles at Pomme de Terre Lake can be found on the MDC website. Due to variable water levels, attempts to establish stands of native aquatic vegetation have not been successful.



Hazel Creek Lake

Muskies were first stocked in Hazel Creek Lake in 1983, and stocking has continued at a rate of approximately one fish per acre per year since 2005 ([Table 3](#)). Stocking in 2000 and 2001 included an evaluation to determine if larger fingerlings stocked in the spring (12 to 14 inches) would have higher survival rates than typical fall stockings (10 to 12 inches) as was found in three Wisconsin lakes by Margenau (1992).

The spring-stocked muskies at Hazel Creek Lake were freeze-branded to enable future identification. There were two size groups, and fish in each were branded in a distinct location ([Table 3](#)).



None of the muskies captured in spring 2004, 2005, or 2006 with fyke nets had recognizable freeze brands. Consideration of these results, plus results from a similar evaluation at Busch Lake 35, indicated no apparent benefit of spring stocking as compared to Missouri's standard fall stocking of muskies.

Hazel Creek Lake has consistently supported a quality muskie population, both in terms of numbers and size, since the mid-1980s. Catch rates from recent fyke netting surveys have been variable, ranging from 1.6 to 9.4 fish per FND since 2008 ([Table 5](#)). The catch rate of 9.4 fish in 2017 was third highest recorded since 1996. PSD36 has ranged from 11 to 67 from 2008 to 2017 including three consecutive years (2008 – 2010) in which it exceeded 60. Four of every ten muskies captured in 2010 were 40 inches in length or longer, but the proportion of this size-class has decreased to less than 10 percent since then ([Table 5](#)).

Show-Me Muskie Project results indicate a quality muskie fishery in Hazel Creek Lake ([Table 4](#)). From 1996 through 2001, angler catch rates and angler participation were quite high. Angler participation dropped significantly from 2002 through 2011, when only three anglers, on average, provided data for the project. From 2012 through 2016, anglers met the management objective of catching a muskie at least 36 inches long every 20 to 40 hours in three out of the five years. In 2016, anglers, on average, spent 25.2 hours fishing to catch a legal-sized muskie (≥ 36 inches). This was the lowest hourly catch rate since 2003 ([Table 4](#)).

Desirable aquatic vegetation remains sparse at Hazel Creek Lake. Periodic droughts, water withdrawals by the City of Kirksville, and common carp and grass carp are all contributing factors. American lotus coverage was notable in 2016; however, this species provides little benefit for sport fish.

Survival of large-leaf pondweed that was planted in two large exclosures in 2003 was poor, and by 2006 the exclosures were removed when no founder colonies of plants were observed outside the structures. During the summer of 2006, three locations, totaling 320 linear feet of shoreline, were planted with water willow. Although insignificant, a few water willow plants remain today in addition to sparse beds of American pondweed when water levels have remained stable.

Fellows Lake

Muskie stocking at Fellows Lake was initiated to meet program expansion objectives in the first muskie plan (Neuswanger et al. 1994). The lake was originally stocked with one muskie per acre in October 1996 (Table 6). The stocking rate was changed to three fish per acre in 1999 and 2002. Since 2004, the rate has been one muskie per acre per year. The lake has generated much muskie fishing excitement, and it even produced a fifty-one inch muskie in 2012.



Despite a mortality event in 2012 caused by a significant heat wave and drought, and worsened by a loss of water through the formation of a sinkhole in the lake, the muskie population in Fellows Lake is currently in very good condition (Table 5). From 2008 to 2016, fyke netting catch rates have ranged from 1.0 to 3.9 fish per FND. In 2017, Fellows Lake produced the highest catch rates since sampling began in 1999 (4.4 fish per FND). Since 2008, PSD36 has varied from 22 to 54. In 2017, the PSD36 was 44.

Show-Me Muskie Project results indicate that our cooperators began fishing and catching muskie in Fellows Lake in 2001 (Table 4). It took an average of 13.5 hours to catch a muskie of any size in 2001, and no muskies were caught that exceeded 36 inches. From the period of 2002-2005, the hours to catch a muskie at least 36 inches steadily increased from 10.0 to 33.3 hours. Except for 2008, when it took an average of 50.4 hours to catch a muskie 36 inches or longer, Fellows Lake has annually met or exceeded the objective of producing an angler catch rate of at least one 36-inch muskie for every 20 to 40 hours of fishing.

Numerous brush piles have been constructed by MDC staff at Fellows Lake. Efforts are made annually to replenish and expand these structures. Information concerning the location of brush piles at Fellows Lake can be accessed from the statewide fish attractor map on the MDC website.

Henry Sever Lake

This lake was originally stocked with muskie in 1996, 1999, and 2002 at a rate of three fingerlings per acre ([Table 7](#)). In 2005, the rate was changed to one muskie per acre per year. Henry Sever Lake was removed from the muskie program during 2010 and 2011 due to a perceived lack of interest by anglers, but was reinstated as a surplus lake in late 2011. A surplus lake does not receive an annual stocking commitment and is only stocked if surplus (extra) fish are available that year after all other commitment lakes have been stocked. Surplus stockings occurred in 2012, 2014, and 2016.

Fyke netting indicated that a good muskie population developed initially until numerous muskie escaped over the spillway during a heavy spring rain in 2001 ([Table 5](#)). Catch rates decreased from 1.8 per FND in 2001 to 0.8 per FND in 2002. Catch rates in 2003 and 2004 were even lower. The 2005 and 2006 fyke net results were encouraging because the catch rate increased to 3.5 and 5.7 fish per FND, respectively, with most of the fish apparently from the 2002 year class. PSD36 was zero from 2002 to 2004. It increased in 2005 to 5 and again in 2006 to 24, indicating that the population was recovering. Since 2008, fyke netting catch rates ranged from 2.1 to 4.4 fish per FND, and PSD36 varied from 22 to 53.

Very few muskie fishing trips at Henry Sever Lake were reported by Show-Me Project cooperators prior to 2008; however, the reported number of trips and muskie caught has increased considerably since 2008. Show-Me Project cooperators reported 120 trips and caught 73 fish during 2016 ([Table 4](#)). From 2010 through 2016, Henry Sever Lake met the objective of producing an angler catch rate of at least one 36-inch muskie for every 20 to 40 hours of fishing only once.

Grass carp also left the lake over the spillway during spring 2001. Since then, water clarity has improved and some aquatic vegetation has begun to grow. A spillway barrier to reduce escapement of muskie was installed in 2007.

Lake 35, August A. Busch Conservation Area



Busch Lake 35 was initially stocked in October 2001 with 93 fingerlings followed by 112 yearlings in spring 2002 ([Table 8](#)). No more fish were stocked until 2005 when the stocking rate was changed to one muskie per acre per year. Supply problems in 2013 and 2015 reduced stocking by over 50 percent; however, these shortfalls were abated in May 2016 when 119 muskies averaging 15 inches long were stocked. The total number of muskie stocked at Busch Lake 35 from 2001 through 2016 is 956.

Fyke netting was initiated in 2004 and demonstrated a good initial fishery before muskie catch rates and size structure decreased after 2009 ([Table 5](#)). Prior to 2010, the average muskie catch rate was 1.9 per FND. During 2012 to 2017 samples, the average catch rate dropped to 0.7 per FND and was 0.5 per FND in 2017.

Prior to 2010 (excluding the 2004 sample which was only three years after initial stocking), PSD averaged 90 and was 100 in 2005 and 2007. During the 2012-17 samples, PSD averaged only 75 and was 83 in 2017. PSD36 quickly ascended to a high of 59 in 2007 and averaged 41 during 2007 to 2009. During the 2012 to 2017 samples, PSD36 was 0 on two occasions, but was 50 in 2017 ([Table 5](#)). Male relative weight values are good, ranging from 84 to 106, but 2017 provided the lowest value (84).

Few Show-Me Muskie Project cooperators have reported fishing Busch Lake 35 ([Table 4](#)). Only 102 fishing trips have been recorded by 30 muskie anglers during 2003 to 2016. On average, it takes muskie anglers 21.3 hours to encounter a muskie and almost 25 hours to catch one. The average length of muskies caught by anglers was 29.1 inches. Only four muskies larger than 36 inches have been reported – all during 2007. Additionally, 2007 was the only year Busch Lake 35 satisfied the angler catch rate objective of at least one 36-inch muskie per 20 to 40 hours fished. Muskie catches continue to primarily be incidental to other fishing activity or made by muskie anglers who have not yet become participants in the Show-Me Muskie Project.

Acting upon muskie angler requests, a johnboat and oars was provided for muskie angler use beginning in late-fall 2014. After the commercial concessionaire who provides rental boats closes for the winter, the boat is provided free of charge and remains until ice develops.

Escapement of muskies from Busch Lake 35 has been a continuing concern due to its combined primary/emergency spillway design. Heavy spring rains in 2008, 2010, 2011, 2014, and 2017 provided extended escapement opportunities with flows up to 18 inches deep over the spillway. Various spillway fish passage barriers were considered in 2005, but all were found to be cost prohibitive.

Overall, Busch Lake 35 has very good habitat. Coontail, American pondweed, curly leaf pondweed, and large leaf pondweed typically cover up to 80 percent of the lake by mid-summer. Spot treatments with herbicide proved inadequate, resulting in the stocking of grass carp (six per acre) in 2013. Numerous brush pile projects have improved deep-water habitat in the lake. Most recently, 1,450 Christmas trees were placed off the dam and large hardwood trees were hinged in 2015. Nonetheless, due to high temperatures and low dissolved oxygen concentrations during lake stratification, Busch Lake 35 muskies are likely stressed and forced to deal with limited suitable habitat during summer.

Suitable water temperatures (<80°F) and dissolved oxygen concentrations (>4 mg/L) are limited, if not absent, during portions of July and August. The summer thermocline depth averaged 10 feet and was only about 18 inches wide. Dissolved oxygen concentrations quickly dropped below four mg/L just below the thermocline. In addition, July water temperatures above the thermocline approached the reported lethal limit (90°F) for muskies. Therefore, suitable muskie habitat may be greatly limited in summer and could be limiting the Busch Lake 35 muskie population.

CULTURE AND HATCHERY OPERATIONS

Historically, most of MDC's warm-water fish hatcheries have contributed to the muskie program. In the early years of the program, fry or eggs were obtained from outside of Missouri and reared to stocking size in Missouri hatcheries. Starting in 1991, muskie broodstock were collected from Missouri's program lakes for spawning and rearing of fingerlings at Hunnewell, Chesapeake, or Blind Pony hatcheries. During that period, our independence in muskie fingerling production grew, though we still relied on states such as Iowa, Indiana, and Kentucky during periods of production shortages or special evaluations. Opening in 2000, Lost Valley Hatchery (LVH) became the primary hatchery involved with spawning and raising muskie fingerlings.

Prior to 2007, Missouri broodstock were collected during standardized fyke netting surveys in late March or early April from Pomme de Terre and Fellows lakes. Flowing females were used for egg production. Eggs and semen were taken from the broodstock on-site, and the broodstock were then released. Fingerlings were raised intensively (in tanks or raceways) up to 3.5 to 4.0 inches on dry artificial feed and placed in ponds for further grow-out on fathead minnows. The target stocking density was 4,000 3.5 to 4-inch fish per half-acre rearing pond. For the production of 5,800, 12- to 14-inch fingerlings in non-pulse stocking years, three, half-acre ponds were needed, and the muskie were fed at least 8,500 to 9,000 pounds of live fathead minnows. To raise 9,800 fingerlings during the pulse stocking years, an additional two, half-acre ponds were needed, which was an added demand on the hatchery system. Currently, MDC has no plans to allocate additional hatchery rearing space for muskie production due to cost and space requirements for other species. Therefore, it is unlikely that the muskie program can be

expanded to any substantial degree beyond the current total acreage of lakes in the muskie program.



Since 2007, LVH has received all muskies from the Iowa Department of Natural Resources-Spirit Lake Hatchery. These fish are shipped to LVH once they are four-inches long. Typically, fish are received in July and are reared on live forage until the end of October when they reach the minimum desired stocking size of twelve inches. This is done as a fish trade where Missouri provides Iowa with channel catfish fingerlings in exchange for the muskies. Iowa muskie will be used until that state can no longer supply them, or biosecurity becomes an issue. If this happens, we would start spawning our own fish again.

Avian piscivores, primarily great blue herons, can reduce yields of hatchery-reared fish (Glahn et al. 1999a, Glahn et al. 1999b, Glahn et al. 2000). MDC began covering half-acre rearing ponds dedicated to the muskie program with avian predator netting to decrease predation. The netting has been successful in reducing bird predation on small muskies and their forage. The initial nets were donated by the Shawnee Muskie Hunters and Pomme de Terre chapters of Muskies, Inc. in 2001, with additional donations coming from the Pomme de Terre Chapter of Muskies Inc. in recent years.

In September 2000, anglers at Pomme de Terre Lake notified MDC of herons feeding on recently stocked 10- to 12-inch muskie fingerlings. Fisheries staff inspected the site and found approximately 50 dead muskie fingerlings, most with obvious injuries caused by herons. As a result, a decision was made to stock larger muskie fingerlings (12 to 14 inches) late in October and to stock them late in the day to reduce heron and bass predation. Increasing the size of fingerlings at stocking should decrease vulnerability to predation by largemouth bass and enhance survival of newly stocked fingerlings (Carline et al. 1986; Hanson 1986; Szendrey and Wahl 1996; McKeown et al. 1999). Increasing the size of stocked muskies by approximately two inches increased production costs and hatchery space needed, because it required approximately 4,000 additional pounds of minnows annually.

The evaluation of the Kentucky strain of muskies at Pomme de Terre and Fellows lakes added complexity and expense to muskie production from 2002 to 2006. The hope was that this strategy would enhance the quality of Missouri's muskie fisheries by determining the genetic strain with the best performance. For the strain evaluation, LVH obtained fertilized eggs from the Kentucky Department of Fish and Wildlife Resources about three weeks after the normal spawning time for Missouri muskie. The strains were kept separate in the hatchery and had different growth rates and feeding behaviors. Freeze branding or marking of fingerlings was used to provide identification of the strains when recaptured years later. [Tables 2](#) and [6](#) include the distribution of Kentucky strain muskies.

In addition to freeze brands and coded wire tags, another method of marking muskies has been investigated and used in conjunction with physical marks and tags. From 2001 to 2006 a small sample of tissue was removed from stocked fish that represent several stocking sources (states) and year classes. The intention was to document any easily identifiable genetic differences among stockings if physical markers or tags are not identifiable on muskie when they are captured as large, old fish. For year classes and sources that had distinguishing DNA markers, a tissue sample could be removed without injuring the muskie and be used to identify its origin. These natural genetic markers varied by hatchery stock depending on broodstock selection and representation of offspring in fish received by Missouri. Distinct genetic markers were found to identify the 2001 and 2002 Kentucky strain fish versus the fish stocked from Missouri sources those years.

Two options for increasing the growth potential and maximum size of muskies in Missouri have been considered. One would involve increasing the ratio of females to males produced and stocked. It has been shown that the sex ratios of some species, such as trout, can be altered by subjecting the fertilized eggs to short-term temperature shock (Thorgaard et al. 1981; Galbreath and Samples 2000). Females grow faster and larger than males. Therefore, the average and maximum size of caught fish could be increased by having a higher percentage of females in Missouri lakes. Heidinger et al. (2002) attempted unsuccessfully to produce all-female muskie progeny. Another option may be the production of genetically altered triploid muskie fingerlings. These muskies would be mostly sterile and would therefore direct energy normally consumed by reproduction into growth. Both options would affect our Missouri broodstock source lakes if successful. Thus, provisions for maintaining broodstock quality and availability would have to be developed if either of these options were pursued.

LOOKING TO THE FUTURE

The success of Missouri's muskie program can largely be attributed to the interest of Missouri's muskie anglers and their support of the cooperative efforts of hatchery and Fisheries Management personnel of the Missouri Department of Conservation. It is essential to maintain and enhance this support, cooperative spirit, and communication.

The following objectives and strategies will guide Missouri's muskie management and culture efforts. This plan will also serve as a tool to help communicate program direction to anglers.

GOAL

To provide high-quality muskie angling opportunities in suitable, geographically-distributed impoundments where more traditional Missouri fisheries will not be adversely affected and may be enhanced.

Objective I: Produce and/or acquire 12-inch minimum muskie fingerlings to meet stocking objectives.

Strategies:

- Acquire muskie fingerlings from surrounding states through fish trades, with priority given to the Iowa Department of Natural Resources (Spirit Lake and Rathbun fish hatcheries) when fish are available.
- Use Pomme de Terre and Fellows lakes as potential sources of Missouri broodstock for hatchery production in years when eggs or fingerlings are not supplied by other states.
- Collect Missouri broodstock and fertilize eggs on-site; release broodstock at the collection site, if needed.
- Evaluate stocking densities in hatchery ponds to increase the number of muskies raised per acre while achieving minimum stocking size.

Objective II: In the fall, stock 12-inch minimum muskie fingerlings in program lakes.

Strategies:

- Annually stock one muskie fingerling per acre in lakes under 1,000 acres (Hazel Creek Lake, Fellows Lake, and Busch Lake 35).
- Annually stock 0.65 muskie fingerlings per acre in lakes over 1,000 acres (Pomme de Terre Lake).
- Provide supplementary angling opportunities at Henry Sever Lake by only stocking surplus muskie fingerlings when available (up to one per acre annually).

- If necessary, adjust stocking rates based on data collected through evaluation methods outlined in Objectives III and IV (catch rates, population size structure, growth, relative weight, and angler success)

Objective III: Maintain an annual statewide average angler catch rate of one muskie at least 36 inches long per 20 to 40 hours of muskie fishing effort, as reported by Show-Me Muskie Project cooperators.

Strategies (regulations):

- Maintain the statewide minimum length limit of 36 inches.
- Maintain the statewide daily creel limit of one muskie.

Strategies (assessment):

- Continue to use Show-Me Muskie Project results to assess angler catch rates.
 - ✓ Encourage current cooperators to remain active.
 - ✓ Create an online reporting system for members to enter their angling data.
 - ✓ Recruit additional cooperators at all program lakes through promotional signage.
 - ✓ Share annual summary of Show-Me Muskie Project results with all cooperators.

Objective IV: Evaluate muskie populations in program lakes through fyke net surveys.

Strategies:

- Each lake with an annual stocking commitment will be surveyed at least every other spring with Wisconsin-style fyke nets.
- Assessments will be conducted annually during periods of special management or regulation evaluations.
- The muskie population at Henry Sever Lake should be surveyed at the discretion of Fisheries regional staff and the Fisheries Division Management Team.
- Parameters to be monitored will include: average number of muskie caught per fyke net per day (number per FND); PSD30, PSD36 and PSD40; and in many cases, male relative weight (Wr). Individual lake sampling objectives are below. Henry Sever is a surplus only lake, and therefore no sampling objectives have been developed.
 - ✓ Pomme de Terre Lake
 - Total Catch Rate: objective range is 3.4-7.6 fish per FND
 - PSD30: objective range is 85–100
 - PSD36: objective range is 25–45
 - PSD 40: objective range is 5-15

- Wr: objective range is 90-100
- ✓ Fellows Lake
 - Total Catch Rate: objective range is 2.1-3.2 fish per FND
 - PSD30: objective range is 80–100
 - PSD36: objective range is 25–45
 - PSD 40: objective range is 10-20
 - Wr: objective range is 90-100
- ✓ Hazel Creek Lake
 - Total Catch Rate: objective range is 3.7-6.8 fish per FND
 - PSD30: objective range is 95-100
 - PSD36: objective range is 30-55
 - PSD40: objective range is 10-20
 - Wr: objective range is 90-100
- ✓ Busch Lake 35
 - Total Catch Rate: objective range 1.1-1.4 fish per FND
 - PSD30: objective range is 60-100
 - PSD 36: objective range is 15-25
 - PSD 40: objective range is 2-4
 - Wr: objective range is 90-100
- If new muskie lakes are added to the program, they will be sampled beginning the fourth year after the initial stocking.

Terminology tip: Many Fisheries Management Biologists use a parameter called relative weight to describe the “well-being” or body condition of fish collected during population sampling. Measures of body condition are typically based on a comparison of each individual fish to the “standard weight” of a fish of the same species and length as described by Anderson and Neumann (1996). In theory, relative weights equal or slightly greater than 100 are optimal.

Objective V: Evaluate opportunities to establish new muskie fishing opportunities IF any of the current muskie program lakes are dropped from the program.

Strategies:

- Proposed lakes must meet most of these criteria:
 - ✓ Appropriate geographic distance and position relative to other Missouri muskie lakes.
 - ✓ Low likelihood of dissolved oxygen or water temperature regimes that might threaten muskie survival or hinder their growth for prolonged periods of time (summer dissolved oxygen concentration must exceed 5 mg per liter at water

temperatures less than 90° F in order for muskie to survive and less than 85° F for them to grow at adequate rates.)

- ✓ Water transparency (Secchi disk) almost always 24 inches or greater. This will facilitate muskie growth and maximize angler enjoyment of muskie encounters.
- ✓ Gizzard shad present (primary prey for age-1-and-older muskies).
- ✓ Availability of other preferred prey, such as brook silversides, golden shiner, common carp, or redhorse suckers.
- ✓ Substantial areas of submerged and emergent aquatic plants, flooded timber, and brush piles.
- ✓ A barrier to emigration via the outlet structure or emergency spillway; or watershed characteristics such that the frequency and magnitude of flushing flows are very low (suggested ratio 15 to1 or less, preferably with a tower outlet, but no greater than 20 to1 without a barrier, which will retain age-3-and-older fish)
- ✓ Not subject to inundation by a nearby stream.

Objective VI: Monitor and improve aquatic habitat in program lakes.

Strategies:

- Pomme de Terre Lake:
 - ✓ Annually monitor June-September water temperature and dissolved oxygen profiles on the lake.
 - ✓ Continue to construct brush piles and hinge-cut shoreline trees to improve fish habitat utilizing MDC resources, U.S. Army Corps of Engineers contributions, outside grant funding, and Muskies, Inc. volunteers.
 - ✓ Continue to work with the U.S. Army Corps of Engineers to refine water level management recommendations to promote increased fish productivity.
- Fellows Lake:
 - ✓ Annually monitor June-September water temperature and dissolved oxygen profiles on the lake.
 - ✓ Replenish existing brush piles on an 8- to 10-year cycle.
 - ✓ Hinge cut trees in selected locations in cooperation with City Utilities of Springfield.
- Hazel Creek Lake:
 - ✓ Monitor and improve the natural expansion of American pondweed and other species of aquatic macrophytes.
 - ✓ Promote bow fishing for grass carp and common carp.
 - ✓ Remove all grass carp sampled during normal management activities.
- Henry Sever Lake
 - ✓ Monitor and improve aquatic vegetation annually.
 - ✓ Replenish existing brush piles as needed.
- Busch Lake 35
 - ✓ Monitor and manage aquatic vegetation, as needed.

- ✓ Replenish existing brush piles and add new woody structure, as needed.
- ✓ Monitor and improve (June-September) dissolved oxygen and temperature profiles.
- ✓ Explore the possibility of improving hypolimnetic dissolved oxygen concentrations through use of hypolimnetic aeration.

Objective VII: Communicate with anglers to ensure awareness of muskie fishing opportunities in Missouri.

Strategies:

- Continue to assign MDC staff to the three-year term of Muskie Program Coordinator to communicate statewide muskie information to the public.
- Inform the public of Missouri muskie fishing opportunities through periodic news releases, television and radio interviews, and magazine articles (including the *Missouri Conservationist*).
- Managers of muskie lakes and hatcheries should capitalize on opportunities to invite reporters to do stories on muskie management and culture operations.
- Periodically update MDC's muskie brochure to reflect the status of Missouri muskie fisheries.
- Encourage Muskies, Inc. and similar angler groups to assist MDC in educating anglers about muskie fishing statewide.
- Notify Muskies, Inc. of scheduled sampling and stocking to occur on program lakes.
- Post and maintain signage about proper catch-and-release techniques and the Show-Me Muskie Project at all program lakes.
- Fisheries Management Biologists will provide an annual update to the Muskie Program Coordinator, which will include spring fyke-netting results and other information, which will be posted MDC's muskie web page and included in the annual Show-Me Muskie Project newsletter.

Objective VIII: Implement this plan through effective program coordination and sustaining internal and external partnerships.

Strategies:

- The Muskie Program Coordinator will lead a Muskie Work Group comprised of MDC hatchery staff, Fisheries Management Biologists, and Fisheries administrators involved in muskie management and will conduct muskie coordination meetings as needed to discuss management, stocking, culture, and other activities and opportunities.
- The Muskie Program Coordinator will be MDC's liaison with Muskies, Inc., Show-Me Muskie Project cooperators, and other muskie anglers. Local Fisheries Management Biologists will be the primary contacts for their respective lakes.

- The coordinator will promote the Show-Me Muskie Project, summarize the results, and distribute information annually to the Muskie Work Group and cooperators.
- The coordinator will serve as the MDC representative at meetings of the Esocid Technical Committee of the North Central Division of the American Fisheries Society.

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[Table 1.](#) General information for current Missouri muskie lakes.

Lake	Surface Acres	Minimum Length Limit (in)	County Location	Year Initially Stocked	Boat/Outboard Motor Restrictions
Pomme de Terre	7820	36	Hickory and Polk	1966	None
Hazel Creek	530	36	Adair	1983	Trolling motor only
Fellows	820	36	Green	1996	40 HP maximum
Henry Sever	158	36	Knox	1996	Greater than 10 HP at no wake
Busch Lake 35	62	36	St. Charles	2001	Rental boats only

[Table 2.](#) Muskie stocking history for Pomme de Terre Lake.

Year Stocked	Month	Number	No./Acre	Size (in)	Strain/Origin	Freeze Brand Location
2016	October	4,707	0.6	12-14	Wisconsin strain from Iowa	
2015	October	4,702	0.6	12-14	Wisconsin strain from Iowa	
2014	October	8,263	1.0	12-14	Wisconsin strain from Iowa	
2013	November	1,468	0.2	9-11	Wisconsin strain from Indiana	
2012	September	4,635	0.6	12-14	Wisconsin strain from Iowa	
2011	October	3,929	0.5	12-14	Wisconsin strain from Iowa	
2010	October	4,000	0.5	12-14	Wisconsin strain from Iowa	
2009	September	4,000	0.5	12-14	Wisconsin strain from Iowa	
2008	October	8,015	1.0	12-14	Wisconsin strain from Iowa	
2007	October	4,675	0.8	12-14	Wisconsin Strain from Iowa	
2006	October	2,490	0.3	10-12	Wisconsin strain from Iowa	L/PEL
2006	October	3,000	0.4	10-12	Kentucky	R/PEL
2006*	February	2,034	0.3	11-12	Indiana	
2005	November	2,760	0.4	10	Indiana	
2005	October	2,682	0.3	10-12	Iowa	
2004	October	2,040	0.3	10-12	Iowa	
2003	October	2,825	0.4	12-14	Missouri--Fellows Lake	L/DOR
2003	October	1,175	0.2	12-14	Kentucky	R/DOR
2002	October	3,075	0.4	10-12	Missouri--Pomme de Terre	L/PEC
2002	October	3,000	0.4	10-12	Kentucky	R/PEC
2001	October	2,428	0.3	12-14	MO-Fellows/Pomme de Terre	
2000	October	10,611	1.4	10-12	Missouri--Pomme de Terre	
1999	October	5,253	0.7	10-12	Missouri--Hazel Creek Lake	
1999	March	166	0.02	12-14	Missouri--Hazel Creek Lake	
1998	October	853	0.1	2-4	Missouri--Pomme de Terre	
1998	October	2,210	0.3	10-12	Missouri--Pomme de Terre	
1997	November	3,205	0.4	8-10	Missouri--Hazel Creek Lake	
1997	October	2,585	0.4	10-12	Missouri--Hazel Creek Lake	
1996	October	7,000	0.9	10-12	Iowa--Spirit Lake	
1995	October	2,813	0.4	12-14	Missouri--Pomme de Terre	
1994	October	604	0.1	6-8	Iowa	
1994	October	4,247	0.5	8-11	Missouri	
1994	October	1,209	0.2	10-12	Missouri	

Table 2. continued

1993	October	212	0.03	10-12	Minnesota--Leech Lake strain
1993	October	1,764	0.2	12-14	MO--Hazel Creek and Pomme
1992	November	1,413	0.2	12-14	Missouri--Hazel Creek Lake
1992	October	441	0.1	10-12	Missouri--Hazel Creek Lake
1992	October	3,029	0.4	12-14	Missouri--Hazel Creek Lake
1992	September	1,676	0.2	12-14	Missouri--Hazel Creek Lake
1992	September	56	0.01	10-12	Missouri--Hazel Creek Lake
1992**	Spring	969	0.1	10-12	Minnesota--Forest Lake
1991	October	1,120	0.1	10-12	MO--Hazel Creek and Pomme
1991	October	1,440	0.2	12-14	MO--Hazel Creek and Pomme
1990	October	2,788	0.4	10-12	Wisconsin
1990	October	1,212	0.2	10-12	Minnesota--Leech Lake strain
1989	October	1,143	0.1	12-14	Minnesota--Leech Lake strain
1989	October	4,879	0.6	12-14	Wisconsin/Kentucky
1988	October	646	0.1	10-12	Pennsylvania/North Dakota
1987	N/A	0			
1986	October	3,817	0.49	8-14	Unknown
1985	October	961	0.1	10-12	Unknown
1984	October	3,627	0.5	10-12	Unknown
1983	October	2,575	0.3	10-12	Unknown
1982	October	1,676	0.2	10-12	Unknown
1981	October	835	0.1	12-14	Unknown
1980	October	150	0.02	12-14	Unknown
1979	September	1,186	0.2	11-13	Unknown
1978	October	3,365	0.4	12-15	Unknown
1977	October	2,393	0.3	10-12	Unknown
1976	September	500	0.1	12-14	Bear Lake Fish Hatchery
1976	September	750	0.1	6-12	Valley City National Hatchery
1975	Unknown	298	0.04	9-11	Unknown
1974	Unknown	223	0.03	9-11	Unknown
1973	N/A	0			
1972	September	420	0.1	8-10	Unknown
1971	N/A	0			

Table 2. continued

1970	Unknown	298	0.04	9-11	Unknown	
1969	Unknown	11,200	1.4	Fry	Unknown	
1969	September	370	0.05	9-11	Unknown	
1968	June	7,711	1.0	Fry	Unknown	
1968	March	798	0.1	9-11	Unknown	
1967	Unknown	12,850	1.6	Fry	Unknown	
1967	Unknown	835	0.1	7-15	Unknown	
1966	Unknown	51,000	6.5	Fry	Unknown	
1966	Unknown	1,507	0.2	7-15	Unknown	

L/PEL - left side, above pelvic fin

R/DOR - right side, between dorsal fin and tail

L/PEC - left side, near tip of pectoral fin, behind gill cover

R/PEC - right side, near tip of pectoral fin, behind gill cover

* Held over from 2005 at Chesapeake Hatchery and stocked in 2006

** Held over from 1991 at Blind Pony Hatchery and stocked in 1992

[Table 3.](#) Muskie stocking history for Hazel Creek Lake.

Date	Number	No./Acre	Size (in)	Strain/Origin	Freeze Brand Location
Sept. 2016	530	1.0	≥ 12	Wisconsin strain from Iowa	
Oct. 2015	530	1.0	10-12	Wisconsin strain from Iowa	
Oct. 2014	516	1.0	≥ 12	Wisconsin strain from Iowa	
Sept. 2014	364	0.7	≥ 12	Wisconsin strain from Iowa	
Nov. 2013	194	0.4	10-12	Wisconsin strain from Indiana	
Sept. 2012	530	1.0	≥ 12	Wisconsin strain from Iowa	
Oct. 2011	530	1.0	≥ 12	Wisconsin strain from Iowa	
Oct. 2010	530	1.0	≥ 12	Wisconsin strain from Iowa	
Oct. 2009	530	1.0	≥ 12	Wisconsin strain from Iowa	
Oct. 2008	530	1.0	≥ 12	Wisconsin strain from Iowa	
Oct. 2007	530	1.0	≥ 12	Wisconsin strain from Iowa	
Oct. 2006	530	1.0	10-12	Wisconsin strain from Iowa	
Oct. 2005	530	1.0	10-12	Iowa	
Mar. 2001	207	0.4	11.9	Missouri-Fellows Lake	L/Anal fin
Mar. 2001	169	0.3	13.3	Missouri-Fellows Lake	R/PEC
Oct. 2000	684	1.3	10-12	Missouri-Pomme de Terre Lake	
Oct. 1996	530	1.0	10-12	Missouri-Hazel Creek Lake	
Oct. 1995	530	1.0	12-14	Missouri-Hazel Creek Lake	
Apr. 1992	530	1.0	10-12	Minnesota-Leech Lake strain	
Oct. 1990	200	0.4	10-12	Pennsylvania-Linesville Fish Culture Station	
Oct. 1990	330	0.6	12-14	Minnesota-Leech Lake strain	
Oct. 1983	1,500	2.8	10-12	Pennsylvania-Linesville Fish Culture Station	

L - Left side

R/PEC - right side, near tip of pectoral fin, behind gill cover

[Table 4.](#) Show-Me Muskie Project Results.

Lake	No. of Trips	No. of Anglers	Total Hours	No. of Encounters	Hrs. per Encounter	No. Caught	Hrs. per Catch	No. Caught >36"	Hrs. per Catch >36"
Pomme de Terre									
1996	162	?	1035	97	10.7	33	31.4	20	51.8
1997	113	12	719	115	6.3	43	16.7	25	28.8
1998	50	7	294	17	17.3	5	58.8	3	98.0
1999	53	13	368	32	11.5	15	24.5	7	52.6
2000	205	39	1201	67	17.9	43	27.9	24	50.0
2001	138	25	812	83	9.8	33	24.6	17	47.8
2002	221	27	1419	199	7.1	72	19.7	18	78.8
2003	294	50	1616	364	4.4	102	15.8	20	80.8
2004	407	54	2181	622	3.5	278	7.8	94	23.2
2005	348	38	2048	414	4.9	177	11.6	65	31.5
2006	319	38	1,786	395	4.5	165	10.8	92	19.4
2007	238	28	1,278	124	10.3	60	21.3	36	35.5
2008	161	20	885	77	11.5	27	32.8	13	68.1
2009	181	18	1,073	148	7.2	56	19.2	42	25.5
2010	122	25	735	70	10.5	18	40.8	10	73.5
2011	201	17	1,139	159	7.2	68	16.7	24	47.4
2012	142	33	788	156	5.1	59	13.4	17	46.4
2013	218	56	1,262	261	4.8	133	9.5	42	30.0
2014	231	58	1,285	333	3.9	121	10.6	48	26.7
2015	220	41	1,164	224	5.2	91	12.8	56	20.8
2016	169	9	934	164	5.7	39	24.0	23	40.6
Hazel Creek									
1996	99	?	768	219	3.5	94	8.2	55	14.0
1997	130	16	941	174	5.4	55	17.1	39	24.1
1998	58	7	485	64	7.6	34	14.3	27	18.0
1999	72	9	562	50	11.2	46	12.2	35	16.1
2000	107	13	810	109	7.4	57	14.2	50	16.2
2001	26	7	220	36	6.1	27	8.1	27	8.1
2002	23	7	151	15	10.1	8	18.9	7	21.6

Table 4. continued

2003	17	7	87	6	14.5	5	17.4	4	21.8
2004	31	5	153	30	5.1	11	13.9	4	38.3
2005	17	5	102	12	8.5	1	102.0	0	N/A
2006	15	8	104	12	8.7	1	104.0	1	104.0
2007	19	6	106	9	11.7	6	17.6	4	26.4
2008	16	5	90	6	14.9	4	22.4	3	29.8
2009	13	5	76	10	7.6	2	37.8	2	37.8
2010	29	15	166	14	11.8	7	23.7	1	166.0
2011	48	10	291	43	6.8	25	11.6	3	97.0
2012	80	21	558	79	7.1	43	13.0	16	34.9
2013	104	18	694	77	9.0	39	17.8	15	46.2
2014	102	10	655	94	7.0	41	16.0	21	31.2
2015	97	22	644.5	69	9.3	46	14	15	43
2016	90	24	603	105	5.7	53	11.4	24	25.2
Fellows									
2000	0	0	0	0	N/A	0	N/A	0	N/A
2001	6	5	27	3	9.0	4	13.5	0	N/A
2002	18	6	110	25	4.4	14	7.9	11	10.0
2003	47	12	259	41	6.3	22	11.8	15	17.3
2004	45	9	284	39	7.3	27	10.5	11	25.8
2005	85	9	366	52	7.0	22	16.6	11	33.3
2006	111	12	555	66	8.4	49	11.3	35	15.8
2007	129	8	621	45	13.8	18	34.5	9	69.0
2008	70	4	404	19	21.2	15	26.9	8	50.4
2009	56	7	304	37	8.2	40	7.6	17	17.9
2010	94	7	462	97	4.8	51	9.1	19	24.2
2011	103	8	533	119	4.5	59	9.0	35	15.3
2012	78	4	443	179	2.5	45	9.8	21	21.1
2013	68	9	335	55	6.1	23	14.5	10	33.5
2014	78	9	411	92	4.5	35	11.7	19	21.6
2015	27	7	148	36	4.1	12	12.3	7	21.1
2016	7	2	41	5	8.2	7	5.9	3	13.8
Henry Sever									
2000	3	2	15	0	N/A	0	N/A	0	N/A

Table 4. continued

2001	5	4	33	0	N/A	1	33.0	0	N/A
2002	0	0	0	0	N/A	0	N/A	0	N/A
2003	6	4	31.5	1	31.5	0	N/A	0	N/A
2004	2	1	9	1	9.0	0	N/A	0	N/A
2005	0	0	0	0	N/A	0	N/A	0	N/A
2006	0	0	0	0	N/A	0	N/A	0	N/A
2007	1	1	5	0	N/A	0	N/A	0	N/A
2008	0	0	0	0	N/A	0	N/A	0	N/A
2009	8	3	41	2	20.5	0	N/A	0	N/A
2010	29	4	163	11	14.8	6	27.2	1	163.0
2011	63	13	409	36	11.3	26	15.7	13	25.5
2012	77	16	488	23	21.0	15	32.3	9	53.8
2013	30	6	155.5	3	51.8	2	77.8	2	77.8
2014	41	7	192	27	7.1	12	16.0	3	64.0
2015	80	15	475.5	34	14	44	10.8	11	43.2
2016	120	24	796.5	66	12.1	73	10.9	10	79.7
Busch Lake 35									
2002	0	0	0	0	N/A	0	N/A	0	N/A
2003	1	1	4	0	N/A	0	N/A	0	N/A
2004	20	3	81	4	20.3	1	81.0	0	N/A
2005	8	3	44	2	21.8	2	21.8	0	N/A
2006	5	3	28	1	27.5	0	N/A	0	N/A
2007	20	7	73	8	9.1	9	8.1	4	18.3
2008	0	0	0	0	N/A	0	N/A	0	N/A
2009	12	3	38	3	12.5	2	18.8	0	N/A
2010	12	4	59	1	58.5	0	N/A	0	N/A
2011	2	1	15	1	15.0	1	15.0	0	N/A
2012	0	0	0	0	N/A	0	N/A	0	N/A
2013	7	2	38	7	5.4	2	19.0	0	N/A
2014	0	0	0	0	N/A	0	N/A	0	N/A
2015	3	1	16.8	1	16.8	2	8.4	0	N/A
2016	5	1	14	0	N/A	0	N/A	0	N/A

[Table 5.](#) Muskie Sampling (Fyke Nets) Results.

Lake	Effort (No. FND)	Total Caught	Catch Rate (No./FND)	PSD30	PSD36	PSD 40
Pomme de Terre						
1996	89	212	2.4	98	37	13
1997	62	276	4.5	91	41	11
1998	9	59	6.6	90	42	7
1999	29	77	2.7	91	39	5
2000	67	132	2.0	94	39	11
2001	73	198	2.7	94	49	21
2002	61	150	2.5	67	34	11
2003	73	292	4.0	49	12	5
2004	20	219	11.0	85	10	1
2005	8	138	14.9	94	15	2
2006	14	148	10.6	97	25	4
2007	19	145	7.6	99	43	7
2008	20	139	6.9	99	50	16
2009	30	107	3.6	100	58	22
2010	27	122	4.5	90	53	22
2011	30	73	2.4	66	26	11
2012	20	23	1.2	100	37	5
2013	30	209	7.0	84	25	3
2014	30	161	5.4	92	31	5
2015	20	203	10.2	95	36	14
2016	30	101	3.4	100	42	14
2017	23	79	3.4	87	47	15
Hazel Creek						
1996	12	63	5.2	98	33	16
1997	4	27	6.8	100	56	22
1998	6	67	11.2	100	64	18
1999	4	38	9.5	100	55	18
2000	NS	NS	NS	NS	NS	NS
2001	8	22	2.8	100	36	14
2002	8	34	4.3	94	47	18
2003	4	15	3.7	60	40	13
2004	8	32	4.0	63	25	19

2005	4	27	6.8	100	48	11
2006	8	51	6.4	100	57	12
2007	NS	NS	NS	NS	NS	NS
2008	24	38	1.6	100	61	18
2009	24	46	1.9	100	67	28
2010	12	50	4.2	100	66	40
2011	NS	NS	NS	NS	NS	NS
2012	10	37	3.7	95	11	5
2013	4	32	8.0	81	41	9
2014	7	33	4.7	94	30	9
2015	NS	NS	NS	NS	NS	NS
2016	8	21	2.6	100	14	0
2017	10	94	9.4	71	31	4
Fellows						
2000	24	82	3.4	100	36	1
2001	48	90	1.9	94	51	4
2002	42	137	3.3	72	36	14
2003	45	93	2.1	96	27	14
2004	24	52	2.2	96	44	21
2005	20	19	1.0	63	21	16
2006	28	84	3.0	100	31	14
2007	25	89	3.6	100	52	17
2008	20	41	2.0	100	54	10
2009	28	64	2.4	94	52	11
2010	25	90	3.6	83	41	15
2011	28	61	2.2	93	38	17
2012	24	94	3.9	87	26	9
2013	28	46	1.6	82	22	4
2014	28	74	2.6	93	28	10
2015	21	63	3.0	95	40	19
2016	28	27	1.0	100	39	19
2017	25	110	4.4	92.7	44	19
Lake 35, Busch C.A.						
2004	12	24	2.0	17	0	0
2005	13	27	2.1	100	7	0
2006	16	27	1.7	96	19	0
2007	16	22	1.4	100	59	0

2008	16	50	3.1	61	25	2
2009	16	21	1.3	95	40	15
2010	NS	NS	NS	NS	NS	NS
2011	NS	NS	NS	NS	NS	NS
2012	20	13	0.7	85	0	0
2013	NS	NS	NS	NS	NS	NS
2014	10	9	0.9	56	11	11
2015	10	9	0.9	78	0	0
2016	NS	NS	NS	NS	NS	NS
2017	11	6	0.5	83	50	0
Henry Sever						
2000	28	15	0.5	100	0	0
2001	12	21	1.8	90	0	0
2002	12	10	0.8	90	0	0
2003	8	5	0.6	100	0	0
2004	7	2	0.3	100	0	0
2005	9	22	2.4	41	5	5
2006	14	80	5.7	98	24	4
2007	12	31	2.6	100	21	3
2008	11	26	2.4	69	23	0
2009	9	25	2.8	100	52	<1
2010	NS	NS	NS	NS	NS	NS
2011	NS	NS	NS	NS	NS	NS
2012	NS	NS	NS	NS	NS	NS
2013	8	35	4.4	100	53	11
2014	NS	NS	NS	NS	NS	NS
2015	NS	NS	NS	NS	NS	NS
2016	7	24	3.4	100	33	4
2017	15	32	2.1	40	22	9

NS - No sample

No./FND - average number of muskies caught per fyke net per day.

PSD - proportion of the muskies collected which are at least 20 inches long that are also greater than or equal to 30 inches.

PSD36 and PSD 40 - proportion of the muskies collected which are at least 20 inches long that are also greater than or equal to 36 or 40 inches.

[Table 6.](#) Muskie stocking history for Fellows Lake.

Date	Number	No./Acre	Size (in)	Strain/Origin	Type of Mark/Tag	Mark/Tag Location
Oct. 2016	526	0.6	12-14	Wisconsin Strain from Iowa		
Oct. 2015	820	1.0	12-14	Wisconsin Strain from Iowa		
Oct. 2014	1,486	1.8	12-14	Wisconsin Strain from Iowa		
Nov. 2013	300	0.4	12-14	Wisconsin Strain from Indiana		
Sept. 2012	820	1.0	12-14	Wisconsin Strain from Iowa		
Oct. 2011	820	1.0	12-14	Wisconsin Strain from Iowa		
Oct. 2010	820	1.0	12-14	Wisconsin Strain from Iowa		
Oct. 2009	820	1.0	12-14	Wisconsin Strain from Iowa		
Oct. 2008	820	1.0	12-14	Wisconsin Strain from Iowa		
Oct. 2007	820	1.0	12-14	Wisconsin Strain from Iowa		
Oct. 2006	410	0.5	10-12	Wisconsin strain from Iowa	FB	L/PEL
Oct. 2006	410	0.5	10-12	Kentucky	FB	R/PEL
Oct. 2005	550	0.7	10-12	Kentucky	WC	L/Cheek
Oct. 2005	550	0.7	10-12	Iowa	WC	Anal fin
Oct. 2004	350	0.4	10-12	Iowa		
Nov. 2004	380	0.5	11.7-13.5	Kentucky	WC	R/Cheek
Oct. 2002	2,590	3.2	10-12	Missouri-Fellows Lake		
Oct. 2002	400	0.5	10-12	Kentucky	FB	R/PEC
Oct. 1999	2,460	3.0	10-12	Missouri-Hazel Creek Lake		
Oct. 1996	820	1.0	11-14	Missouri-Hazel Creek Lake		

FB- Freeze Brand

WC- Wire Coded Tag

L/PEL- left side, above pelvic fin

R/PEL- right side, above pelvic fin

R/PEC- right side, near tip of pectoral fin, behind gill cover

[Table 7.](#) Muskie stocking history for Henry Sever Lake.

Date	Number	No./Acre	Size (in)	Strain/Origin
May 2016	125	0.8	12-14	Wisconsin Strain from Iowa
Oct. 2014	318	2	12-14	Wisconsin Strain from Iowa
Sept. 2012	159	1	12-14	Wisconsin Strain from Iowa
Oct. 2009	107	0.7	12-14	Wisconsin Strain from Iowa
Oct. 2008	158	1	12-14	Wisconsin Strain from Iowa
Oct. 2007	158	1	12-14	Wisconsin Strain from Iowa
Oct. 2006	38	0.2	10-12	Wisconsin strain from Iowa
May 2006	127	0.8	11-12	Indiana
Oct. 2005	158	1.0	10-12	Iowa
Oct. 2002	474	3.0	10-12	Missouri-Fellows Lake
Oct. 1999	474	3.0	10-12	Missouri-Hazel Creek Lake
Oct. 1996	474	3.0	10-12	Missouri-Hazel Creek Lake

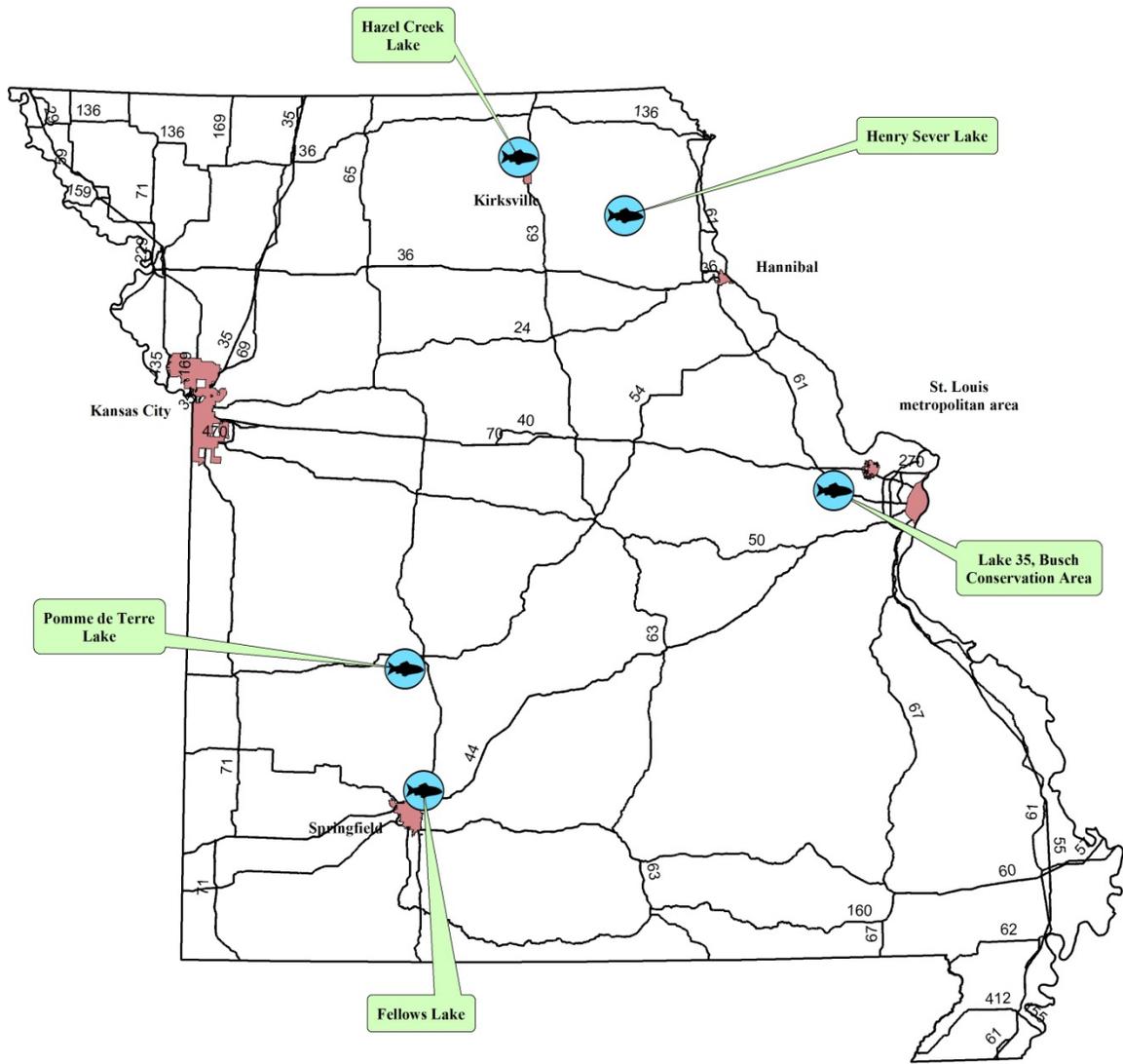
[Table 8.](#) Muskie stocking history for Busch Lake 35.

Date	Number	No./Acre	Size (in)	Strain/Origin	Type of Mark/Tag	Mark/Tag Location
May 2016	119	1.9	15"	Iowa		
Oct 2015	32	0.5	12-14"	Iowa		
Oct 2014	64	1.0	12-14"	Iowa		
Nov 2013	24	0.4	10-12"	Iowa		
Sept 2012	64	1.0	10-12"	Iowa		
Oct 2011	64	1.0	>12"	Iowa		
Oct 2010	64	1.0	>12"	Iowa		
Oct 2009	64	1.0	12-14"	Iowa		
Oct 2008	64	1.0	12-14"	Iowa		
Oct 2007	64	1.0	12-14"	Iowa		
May 2006	64	1.0	12-14	Indiana		
Oct. 2005	64	1.0	10-12	Iowa		
Mar. 2002	112	1.8	12-14	Missouri-Fellows Lake	FB&WC	R/Vent
Oct. 2001	93	1.5	12-14	Missouri-Fellows Lake		

FB- Freeze Brand

WC- Wire Coded Tag

R- Right side



[Figure 1](#). Map of muskie program lakes in Missouri

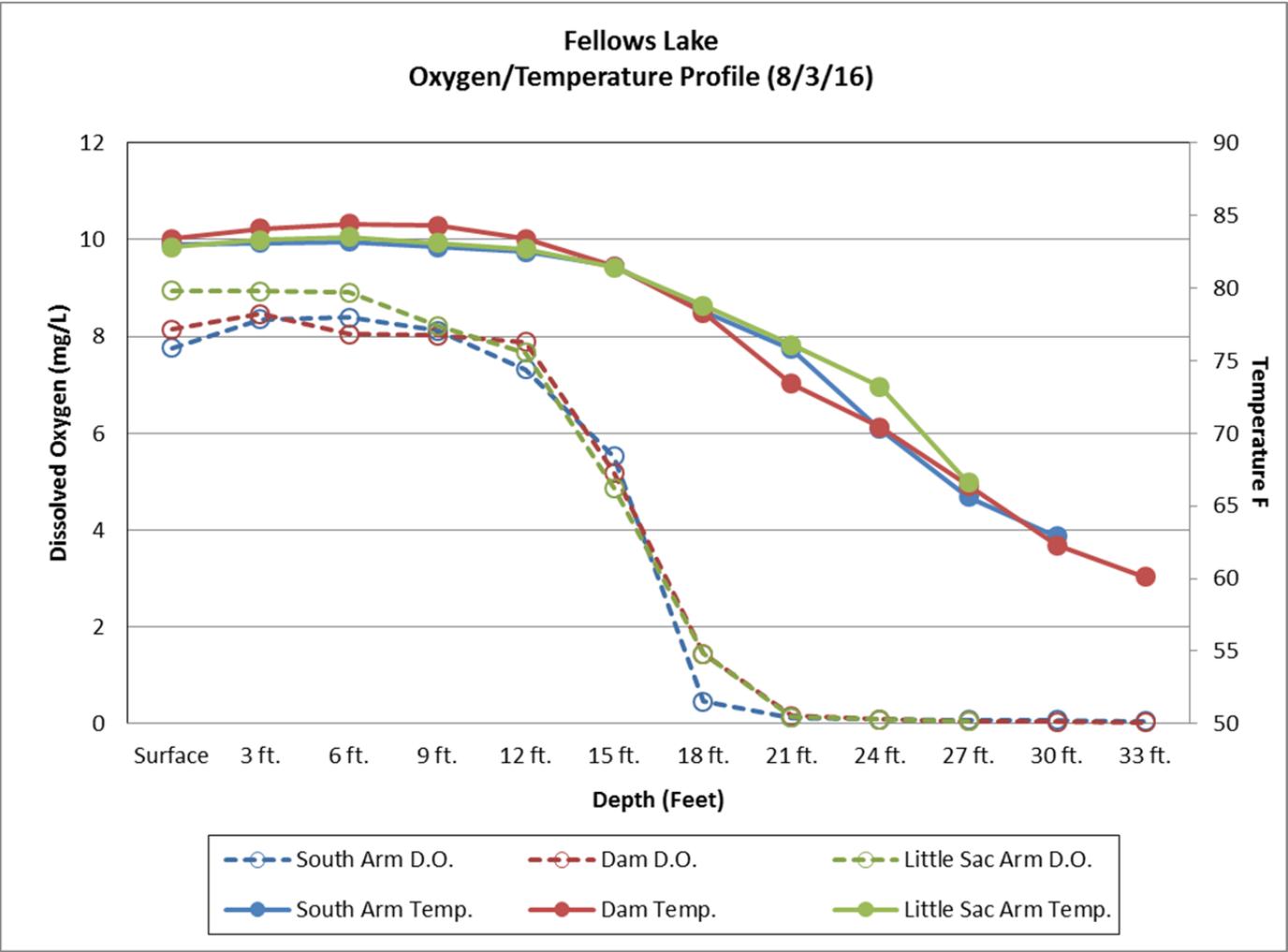


Figure 2. August 2016 Fellows Lake temperature/dissolved oxygen profile.

Appendix A.

Standardized Fyke Net Specifications Wisconsin DNR – Upper Chippewa Basin February 2008

Two 4-foot by 6-foot frames of solid, 1/2-inch diameter cold-rolled steel, spaced ~38 inches (~36 meshes) apart

Three 4-foot-diameter fiberglass hoops spaced ~30 inches (~26 meshes) apart and ~36 inches (~32 meshes) from second frame

#15 knotted nylon netting with 3/4-inch bar mesh in trap and lead, tied to frames and hoops with #21 twine

All cut pieces of nylon mesh burned at every cut to prevent unraveling

One funnel directed rearward of first hoop with 7-inch square throat held firmly open by 4 cords of #36 twine Diagonal side winklers attached to second frame 7 inches away from point of attachment of perpendicular center winkler, leaving a 7-inch aperture for fish to enter on either side of center

Cod end of net with 1-2 inch loops to allow easy passage of 1/4-inch nylon draw cord

75-foot lead 4 feet high with PVC sponge or hard foam floats-SB3 (2-1/2" x 1-1/2") spaced 3 feet apart along the top, and 2-ounce lead weights spaced 20 inches apart along the bottom

Draw cord, float line, and lead line all of 1/4-inch braided nylon with all ends burned to prevent unraveling

Dave Neuswanger, Fisheries Team Leader, Hayward In Consultation With Advanced Fisheries Technicians Jim Cox (Mercer), Russ Warwick (Hayward), and Greg Rublee & Jason Folstad (Park Falls) February 8, 2008