MUSKELLUNGE MANAGEMENT PLAN

DEPARTMENT OF INLAND FISHERIES AND WILDLIFE
DIVISION OF FISHERIES AND HATCHERIES

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REGION A

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MUSKELLUNGE LIFE HISTORY

Description

Muskellunge, also referred to as musky and maskinonge are one of the Maine's largest freshwater fish, reaching weights in excess of 25 pounds. Musky are similar in appearance to other members of the Esocidae[1] Family found in Maine, which include northern pike and chain pickerel. Musky possess an elongate body form, a long flattened snout, large eyes high on the head, and a large mouth full of sharp teeth. Overall color and body markings are highly variable, but are distinctly different from those of northern pike, a closely resembling relative. Dark markings on a light background distinguish musky from northern pike, which have light markings against a dark background. A count of the sensory pores along the lower jaw is fairly reliable trait by which to differentiate musky from northern pike and chain pickerel. Generally musky possess 6 to 9 pair of sensory pores, where as northern pike usually have 5 pair and chain pickerel usually have 4 pair.

Distribution

Muskellunge occur in fresh waters of eastern North America. Their distribution extends from Quebec south to western Vermont, Tennesee, Minnesota, Wisconsin, western Ontario, and northward as far as southeastern Manitoba. Musky have also been introduced elsewhere in the United States, but not always with success.

Maine's population of muskellunge originated from an introductory stocking in Lac Frontiere by the Quebec Government around the late 1960's. Lac Frontiere lies at the headwaters of the Northwest Branch of the Saint John River, which provides a travel corridor for musky to access waters in Maine.

Habitat Requirements

Preferred habitat consists of warm, heavily vegetated lakes and slow moving rivers. Musky are very structure-oriented and except for the largest in the population are strongly associated with aquatic vegetation, timber, and stumps. Larger musky may be found in deeper water, which lacks dense growths of vegetation. Optimal water temperatures are reported to be 78°F, but musky can withstand temperatures as high as 90°F. Musky are also very tolerant of low summer oxygen conditions.

Reproduction

In Maine musky spawn in May, when water temperatures are approaching the upper 40's or 50's (^{o}F). Optimal spawning habitat consists of heavily vegetated areas, particularly those that have been flooded by 15 to 20 inches of water. The typically larger female pairs up with one or two smaller males. Nonadhesive eggs and sperm are simultaneously released over areas of vegetation. Immediately following this release the adults thrash their tails to spread the eggs. The act of spawning occurs at irregular intervals over a period of several days, as only a small numbers of eggs are released at any one time.

[1] Esocids are comprised of small to large elongate fish that occur within the northern hemisphere and include such species as, northern pike, muskellunge, chain pickerel, redfin pickerel, and grass pickerel.

Egg production is high and increases with the size of the female. On average, a female will produce 120,000 eggs, however, no more than a third may become fertile. Fertile eggs hatch in 8 to 14 days. Upon hatching the young remain inactive until the yolk sac has been absorbed, which takes about 10 days. The developing eggs and newly hatched fry are extended no parental care.

A number of factors affect spawning success. Newly hatched fry are very vulnerable to predation by fish, including perch, bass, northern pike, musky, sunfish, as well as a number of predaceous aquatic insects. Where northern pike and musky occur in the same water, they share similar spawning habitat, except that pike usually spawn much earlier than musky. The larger size pike fingerlings may feed heavily on smaller musky fry and this form of predation may significantly limit the development of a musky fishery. Furthermore, musky and northern pike can also breed with one another, producing “tiger muskellunge”. The resulting hybrid male is sterile, but some of the females can be fertile. Musky tend to prefer flooded areas to spawn, and even slight decreases in water levels may expose eggs, young, and even adult spawners, resulting in considerable mortalities.

Food Habits

Newly hatched musky fry feed on larger zooplankton until reaching a length of 1.5 inches, at which time fish become the principal forage for the remainder of their existence. Although musky are extremely selective regarding the size of the prey sought, species selection is less critical. Musky feed on a wide variety of forage fish including perch, suckers, larger minnow species, whitefish, alewives, shad, sunfish, catfish, and bass. However, crayfish, frogs, small rodents and waterfowl are also eaten.

Age & Growth

Newly hatched fry experience very rapid growth and by fall of the first year have attained a length of 10 to 12 inches. Growth continues to be rapid within the first few years of life. The rate of growth in length decreases with the approach of sexual maturity, but gains in weight continue throughout life. Males and females mature at 3 to 5 years of age, although males are much smaller than females. In fact, females live longer, and are larger at any age than males. Larger trophy-size musky are most often females. Larger musky may experience poor growth and survival if forage fish of a certain size range are not available, despite the presence of abundant forage fish population.

The life expectancy of musky may approach 30 years, but most fisheries are comprised of 3 to 15 year olds. Musky are one of the largest game fish found in Maine. In 2001, a State record, 26.5-pound musky was caught in Glazier Lake.

MUSKELLUNGE MANAGEMENT HISTORY

Muskellunge have been introduced outside their native range of eastern North America because of their status as a prized trophy sportfish. Musky are known for their large size potential and tremendous fighting ability.

In other parts of the country where musky provide popular trophy fisheries, anglers may fish for musky to the exclusion of all other fisheries. Anglers often fish many days, weeks or even years before catching a musky. Low catch rates are common, particularly where moderate-to-high angler use exists, because musky generally do not become very abundant. For this same reason, musky are very vulnerable to being over-fished. Habitat degradation, poor reproductive success, and competition from other introduced species (including northern pike) have been blamed for declines in musky throughout its range. As a result, very restrictive harvest regulations, including large minimum length limits are common conservation measures. Stocking hatchery reared musky fingerlings is another common fishery enhancement practice.

Muskellunge are not native to Maine. The introduction of musky in Lac Frontiere by the Quebec Government in the 1960's enabled musky to migrate to Maine waters lying within the Saint John River drainage. Baker Lake was the first Maine water to develop a musky fishery in the early 80's. Additional populations have recently established in Glazier Lake, Fifth Saint John Pond, and Beau Lake.

Although musky fisheries are very vulnerable to over-exploitation, musky populations in Maine are not actively managed and receive no protection provided by length and bag limits. Relatively low angling pressure in the lightly populated upper Saint John region has minimized potential human impacts on developing musky fisheries.

Musky fisheries are not actively managed due to concerns that the presence of these large predators will jeopardize traditional fisheries for wild brook trout and landlocked salmon, particularly if musky establish in other waters within the region. Musky currently reside in a remote region of the state that supports some of the best fisheries for wild brook trout and landlocked salmon in the entire northeast. The concern over potential impacts to native fisheries has precluded the active management and enhancement of musky fisheries in this region of the state.

Musky are among the largest and strongest fighting fish in Maine. Successful fishing requires an understanding of musky behavior and some specialized fishing equipment. Muskies move very little, except to lash out at an unsuspecting prey, which is often carried to a protective area before swallowing. Because of this behavior still fishing with bait is usually not productive. Trolling large (up to 12 inches long!) plugs, spoons, spinner baits, lures, and natural baits (suckers) is one of the most effective fishing methods. Casting similar presentations along weed beds and stumps is also effective. It is reported that musky rarely pursue prey after a miss, so effective hook sets are critical for success. Musky flesh is white and flaky, and considered good table fare. It is recommended that the skin be removed before cooking, because the skin mucus imparts a "muddy" flavor.

PAST MANAGEMENT GOALS

The following management goal and objectives were identified for muskellunge in the 1986 Minor Sportfish Management Plan:

Goal: Limit populations to present distribution and abundance, and increase use.

Objective: No specific performance standards are considered necessary for the management. Unlimited harvest will be allowed and encouraged within the framework of general regulations.

In 1996 the Minor Sportfish Management Plan was updated, and included the following revised management goal and objectives for muskellunge:

Goal: Develop / clarify Department policy pertaining to the management on non-native esocids. This policy should be consistent with the management of other non-native species, and proactive with respect to addressing angler support for active management.

Objectives:

(1) Identify fishery management concerns associated with the presence muskellunge in Maine and develop a study plan designed to investigate and address identified concerns;

(2) Develop criteria to: (a) determine the management position that will be taken by the Department in response to illegal muskellunge introductions (e.g., unlimited harvest of musky will be allowed and encouraged where their presence adversely affects regionally significant sport fisheries); (b) address angler support for Department initiated introductory stocking programs; and (c) develop specific performance standards necessary to support active management efforts.

The 1996 goal and objectives have not been realized, due primarily to the following factors:

1) The management of non-native species, like musky, is controversial and it is difficult to obtain consensus from the public and within the Department regarding the direction that should be taken by the Department in formulating policy.
2) The task of developing appropriate policy and implementing management objectives has not been identified as a priority, given the many other resource issues facing the Department;
3) There is an increasing reliance upon Regional staff to develop and implement statewide management plans, and Regional staff is finding it difficult to manage an increasing workload.

OPPORTUNITY

Muskellunge are currently present in four lakes, which have a combined surface area of 5,024 acres (Table 1 & Figure 1). Known populations are presently restricted to the upper Saint John River drainage, within Somerset and Aroostook Counties.

The current distribution of muskellunge is confined to the two northern-most Fisheries Management Regions. In 1985, musky were only known to occur in Administrative Fisheries Management Region E, but have since expanded to Region G (Figure 2).

Since 1985, musky have established in three new waters, which represents a 4-fold increase in the number of musky waters, and a 308% increase (3,793 acres) in associated lake surface area. The expanded distribution of musky has resulted from natural movement and migration within the Saint John Drainage. Introductory musky stockings have not been undertaken by the MDIFW to expand angling opportunities.

TABLE 1. Musky Occurrence in Lakes by Fisheries Management Region for Years 1985 & 2000

REGION	TOTAL OCCURRENCE		PRINCIPAL FISHERIES		ON-GOING INTRODUCTIONS	
	NUMBER OF LAKES	ACRES OF LAKES	NUMBER OF LAKES	ACRES OF LAKES	NUMBER OF LAKES	ACRES OF LAKES
YEAR 1985						
A	0	0	0	0	0	0
B	0	0	0	0	0	0
C	0	0	0	0	0	0
D	0	0	0	0	0	0
E	1	1,231	0	0	0	0
F	0	0	0	0	0	0
G	0	0	0	0	0	0
STATE	**1**	**1,231**	**0**	**0**	**0**	**0**
YEAR 2000						
A	0	0	0	0	0	0
B	0	0	0	0	0	0
C	0	0	0	0	0	0
D	0	0	0	0	0	0
E	2	1,901	2	0	0	0
F	0	0	0	1,901	0	0
G	2	3,123	1	1,1200	0	0
STATE	**4**	**5,024**	**3**	**3,021**	**0**	**0**

Muskellunge presently provide principal fisheries in three (75%) of the four waters where they occur, representing a combined area of 3,021 acres, or 60% of available lake surface area where musky occur (Table 1). A principal fishery has not developed in Beau Lake, and this is at least partially attributed to the fact that it is a relatively new developing population. Principal fisheries for musky have increased by three waters since 1985, occurring in the two Fisheries Management Regions where they are present. The lake surface area associated with these waters is 3,021 acres. Prior to 1985, there were no principal fisheries for musky.

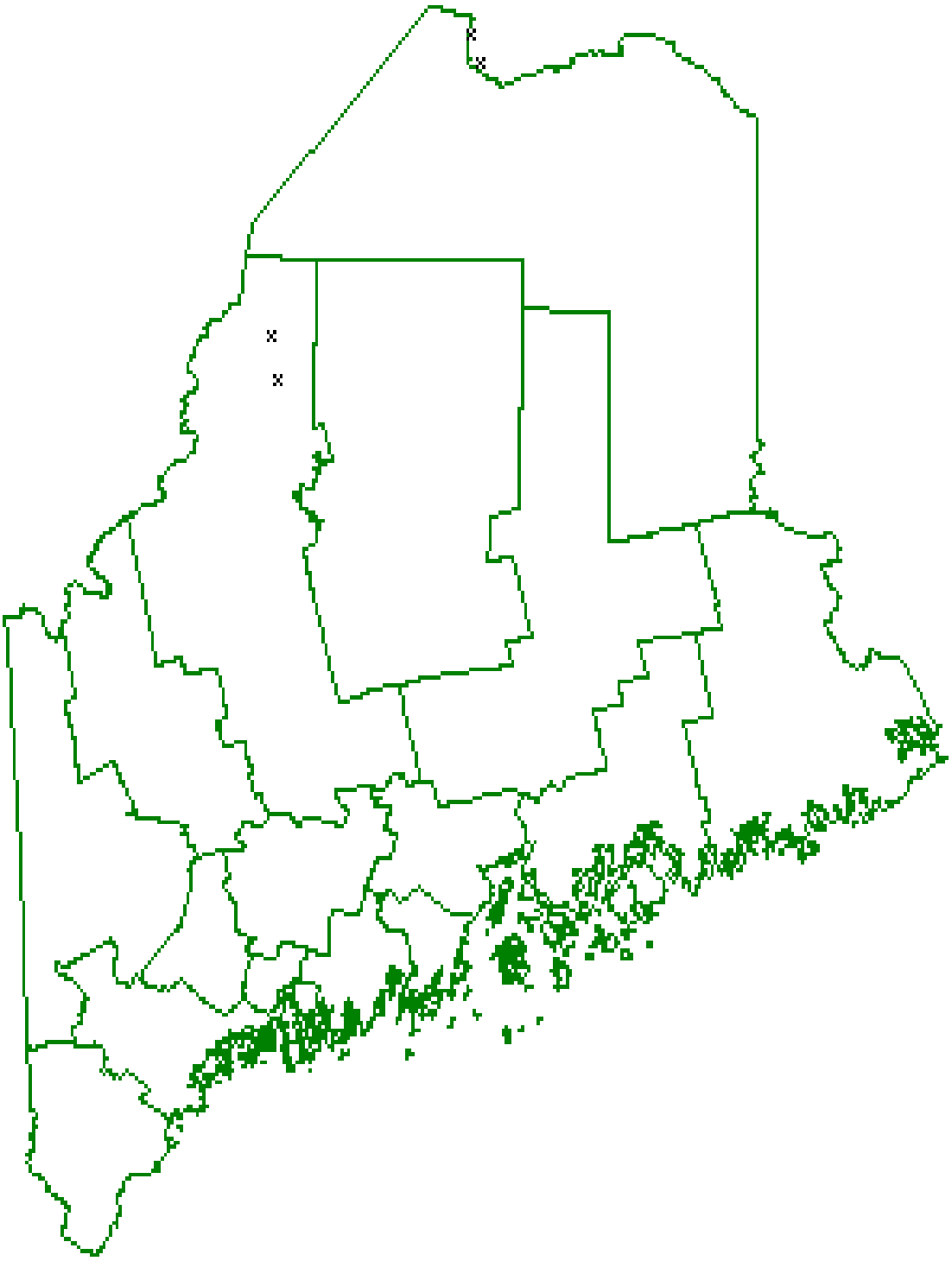

FIGURE 1. DISTRIBUTION OF MUSKELLUNGE IN MAINE

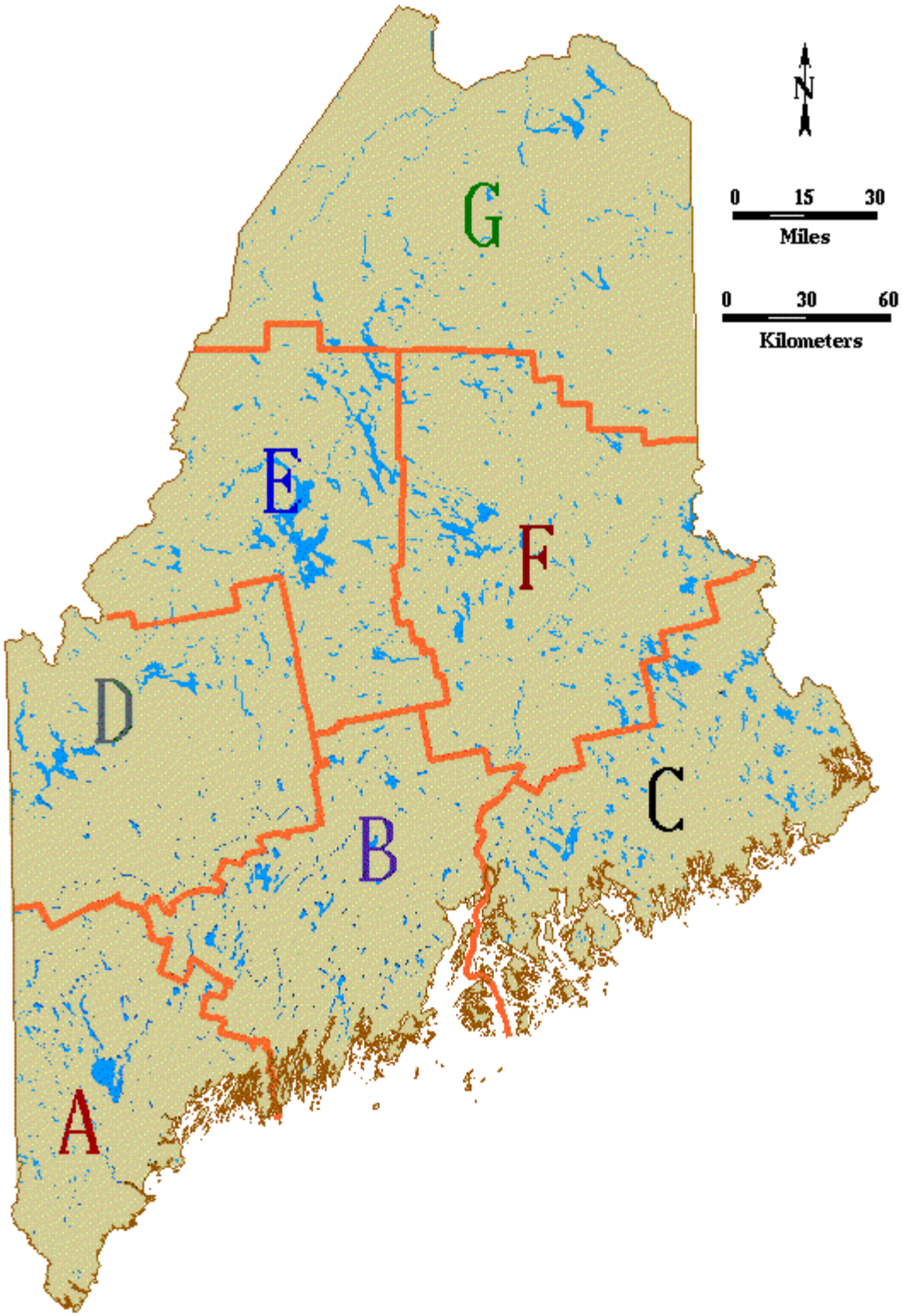

FIGURE 2. ADMINISTRATIVE FISHERIES MANAGEMENT REGIONS FOR THE MAINE DEPARTMENT OF INLAND FISHERIES AND WILDLIFE

Except for their remote setting, the waters that support principal fisheries for musky are quite dissimilar. Baker Lake and Fifth Saint John Pond are considered mesotrophic and have a maximum depth of 33 feet. Large populations of suckers, fallfish, and yellow perch dominated the fishery prior to the arrival of musky. A few wild brook trout are also present in Baker Lake. Glazier Lake is strongly oligotrophic, with a maximum depth that exceeds 100 feet. Although other fish species typical of the region are present, lake trout dominate the Glacier Lake fishery. The characteristics of both lakes are shared by many other lakes and ponds throughout the state, thereby providing additional potential opportunities for the creation of new self-sustaining musky fisheries. However, serious concerns regarding potential impacts to existing fisheries, particularly more traditional coldwater fisheries, would likely limit future introductions that might be contemplated by the Department. Another concern related to the range expansion of muskellunge is the creation of new “donor” sources that could facilitate unauthorized introductions to waters where existing management programs could be jeopardized.

There are no length or bag limit restrictions to conserve existing musky fisheries. All four musky waters in Maine are open to fishing during the open water fishing season, but only Beau and Glacier are open during the ice fishing seasons. The winter closures at Baker and Fifth Saint John Pond were not initiated to protect musky.

Baker Lake angler survey results indicate that muskellunge have increased the opportunity to catch a sportfish in that water. Musky have also provided better fishing throughout the open water season than was historically provided by brook trout, the lake’s only other gamefish. In addition, musky have provided an opportunity to catch larger fish than traditional fisheries were providing

DEMAND

Information provided in this section on angler effort, catch, harvest, and angler preferences were obtained from two sources: statewide angler questionnaire surveys and water specific angler creel surveys. Statewide angler surveys are conducted periodically by sending written questionnaires to randomly selected anglers. Questionnaire surveys rely on many assumptions, and while useful in assessing trends are generally considered less accurate than creel surveys, which collect information specific to an individual water by interviewing anglers engaged in fishing.

Relatively little information exists on Maine's newly developed muskellunge fisheries. In 1987, anglers first discovered the Baker Lake fishery, and in 1996 adventurous anglers began catching musky in Fifth Saint John Pond. It has only been within the last year of so that the Glazier Lake musky fishery developed. It is not surprising that the 1999 open water statewide angler survey indicated that muskellunge were targeted the least of any Maine sportfish. Although, approximately 12% of all surveyed anglers indicated it was very important to have an opportunity catch musky in Maine. Anglers also indicated it was more important to catch a musky than it was to catch cusk, whitefish, yellow perch, and black crappie.

Angler use and effort estimates derived from the 1999 open water questionnaire survey indicate that summer use on Region E musky lakes was 1,235 angler trips (+/- 817 trips), or about 1 angler per acre. Because musky fishing is a new sport in Maine, there is little historical information to evaluate long-term trends in use or effort. Although, voluntary angler data collected at Baker Lake between 1990 and 2000 indicates that angler use has remained relatively steady, ranging between 652 and 553 angler trips per year. The low summer effort (0.48 to 0.58 angler days per acre) at Baker Lake is probably largely due to the lake's remote location. Voluntary angling data at Fifth Saint John Pond indicates considerably lower use since that fishery was discovered in 1996. Anecdotal information obtained by the Ashland Regional Fisheries Headquarters indicates angler use on Glacier Lake has very recently increased in response to the musky fishery.

Available use information suggests that there is a limited demand for musky fishing. Angler use on musky waters is expected to increase as public knowledge regarding this new large sportfish increases. However, the relatively remote location of existing fisheries will likely continue to limit angler interest. Increased popularity of this new fishery may also lead to illegal stocking by the public to create additional musky fishing opportunities in other areas of the state. In addition, the Department will likely experience increased public pressure to "deal" with the problem of illegal introductions, as well as to take a more active role in the management of existing musky populations.

FISHING QUALITY

Data available to assess the quality of Maine's musky fisheries is primarily limited to information contained in the 1999 open water questionnaire survey and the results of an annual open-water voluntary angler survey at Baker Lake. Furthermore, fish quality performance objectives were not developed for musky in the 1996 update of the Minor Sportfish Management Plan. As a result, changes in the fishery are described in the absence of standards for evaluation.

The Baker Lake muskellunge fishery gained popularity in 1987, when this fishery became the focus of a voluntary angler survey. Between 1990 and 2000, Baker Lake musky have more or less consistently averaged between 28 and 34 inches long, weighing between 5 and 9 pounds. Daily angler catch rates averaged 0.27 musky per angler day, and 0.15, for musky that exceeded 30 inches long. Between 1987 and 1990 there was a decline in the proportion of larger musky (greater than 40 inches long) in the catch, as well as an initial decline in angler catch rates. However, throughout the 1990's there were no further significant changes in the size of the catch, and the catch rates actually improved slightly. A strong catch and release ethic has limited exploitation, thereby maintaining the quality of the fishery. However, if demand and exploitation increases on this unregulated resource, a decline in size quality and catch rates may occur.

MUSKELLUNGE GOALS AND OBJECTIVES
2001-2016

STATEWIDE GOAL

Limit muskellunge populations and fishing opportunities to their present distribution and diminish their influence where popular traditional fisheries are threatened.

STATEWIDE OBJECTIVES

1. Reduce the impact of existing populations of muskellunge on traditional sport fisheries where practical and possible.
2. No management strategies will be adopted to maintain or enhance existing or future populations of muskellunge in Maine.
3. No further expansion of the species' range in Maine.

Capability: Suitable habitat for muskellunge is generally not limiting in Maine. Existing muskellunge waters and many others throughout Maine provide an abundance of high quality spawning, nursery and adult habitat for muskellunge. Habitat suitability and forage availability for muskellunge are expected to remain suitable or even improve on some waters as the range and abundance of potential forage fish and aquatic vegetation increase from unwelcome introductions. The Saint John River provides a migratory pathway for muskellunge to freely access other suitable waters within the drainage.

Feasibility: Where muskellunge threaten existing popular fisheries there may be few socially acceptable eradication and control measures available to protect and/or restore affected fisheries. Muskellunge are reported to be very vulnerable to overexploitation, and as a result musky harvest incentives could "control" unwanted populations, where angler use is high. However, it may be difficult to achieve angler cooperation with regulations intended to reduce the size and abundance of the large adults prized by musky anglers. Since most anglers who fish northern Maine pursue native salmonids and relatively few target musky, there would likely be considerable support for control of the spread and amelioration of the effects of muskellunge in this area of our state. Although current trends suggest stable use, in the future, illegal stocking of muskellunge may increase their distribution and threat if the popularity of this trophy fishery increases. Preventing the natural movement of muskellunge to salmonid waters within the existing river drainage may require installation of costly barrier dams.

Desirability: The need to protect traditional and native fisheries exceeds the current demands to provide enhanced angling opportunities for muskellunge. Angler survey questionnaires have indicated the angling public is very concerned about the potential effect of non-native introductions on native populations. In addition, some strong advocates for native fish species do not support the concept of actively managing non-native fisheries including muskellunge.

Consequences: The quality of existing muskellunge fisheries could diminish in the absence of protective regulations if angler use and harvest increases. However, the remote location of existing muskellunge populations will likely limit future use and exploitation of this fishery resource. Lack of a DIFW sponsored control program designed to prevent the spread of muskellunge into new habitat and/or control the ecological impact of existing populations of muskies on established fish populations may be construed as tacit acceptance of illegal introductions of muskellunge on the part of DIFW.

MUSKELLUNGE MANAGEMENT PROBLEMS AND STRATEGIES

PROBLEM 1. The Fisheries Division lacks sufficient staff and funding to adequately address muskellunge management research needs.

Strategy a. Seek public support for sufficient staff and resources to accomplish the plan's objectives.

PROBLEM 2. The interactions and response of fish communities found in typical Maine lakes to introduced populations of muskellunge are not well known.

Strategy a. Undertake an extensive literature review on interactions, as well as information regarding musky fishery manipulation strategies (i.e., suppress population size, enhance size quality, etc.)

Strategy b. Assess short and long term changes in fish communities in response to new introductions of muskellunge.

Strategy c. Seek support from universities to investigate selected key research issues.

PROBLEM 3. Muskellunge may freely access other waters within the Saint John River drainage and threaten quality salmonid fisheries.

Strategy a. Construct fish barrier dams where effective and practical.

Strategy b. Identify a source of funding to support barrier dam construction and related planning.

Strategy c. Employ other control measures such as chemical reclamation, netting and regulations as practical.

PROBLEM 4. Although there have been no confirmed reports of illegally stocked muskellunge, their presence in Maine creates a local source that potentially provides a source of fish for unauthorized stockings that could threaten important native trout and salmon fisheries. Once a musky population is established; eradication and suppression efforts are often difficult, usually expensive and frequently not effective.

Strategy a. There is a need to draw more media attention to this issue as a prevention measure, including highly publicized violations and convictions of people found guilty of an illegal introduction.

Strategy b. Continue to work with the Warden Service to intensify their focus on illegal fish stockings.

Strategy c. Intensify educational and outreach efforts regarding the problems of illegal fish stocking, including a larger section of the law book devoted to this topic.

Strategy d. Require the completion of a fishing ethics program before issuing an adult fishing license.

Strategy e. Avoid implementing management strategies that would enhance the sport fishery attributes of any existing or future population of muskellunge in Maine.

APPENDIX A

WARMWATER WORKING GROUP INPUT

WARMWATER WORKING GROUP
MUSKELLUNGE MEETING SUMMARY
JANUARY 24, 2002

Issues:

- ✓ Have muskellunge impacted salmonid fisheries?
- ✓ What is the potential for further expansion of the species' range?
- ✓ Muskies are a valuable resource for the state because of their uniqueness, size and the special setting in which they are found.

Goals and Objectives:

No further expansion of the species' range in Maine.

Fishing quality:

- Divided report BUT opposed to proactive management.
- Maintain the setting of the primary fishery, i.e. Baker Lake.

PRIORITIZED MUSKELLUNGE MANAGEMENT OBJECTIVES, WARMWATER GROUP

DESCRIPTION OF STATEWIDE OBJECTIVES	RANK
Prevent the spread of muskellunge in Maine (within and outside of the drainage in which the species now occurs)	1
Reduce the impact of existing populations of muskellunge on traditional sport fisheries	2
Reduce angler interest in current muskellunge sport fisheries.	3

PRIORITIZED MUSKELLUNGE MANAGEMENT PROBLEMS

DESCRIPTION OF MANAGEMENT PROBLEMS	FISHERIES	WARMWATER GROUP	FINAL RANKING
Existing populations of muskellunge provide a local source of fish for unauthorized stockings in other waters.	4	1	1
Muskellunge may freely access other waters within the Saint John River drainage and threaten quality salmonid fisheries	1	2	2
The interactions and response of fish communities found in typical Maine lakes to introduced populations of muskellunge are not well known.	4	3	3
The Fisheries Division lacks sufficient staff and funding to adequately address muskellunge management research needs.	3	4	4
Effective eradication or suppression of established musky populations is often difficult, expensive and ineffective.	1	5	5

CONCEPT PLAN FOR IMPLEMENTATION OF MUSKELLUNGE MANAGEMENT OBJECTIVES (2001-2016)

PRIORITIZED MUSKELLUNGE MANAGEMENT OBJECTIVES		Region A Contribution			Region B Contribution			Region C Contribution			Region D Contribution			Region E Contribution			Region F Contribution			Region G Contribution			Statewide Totals		
DESCRIPTION OF STATEWIDE MANAGEMENT OBJECTIVES	**Rank**	**Exst**	**Prop**	**Dfct**	**Exst**	**Prop**	**Dfct**	**Exst**	**Prop**	**Dfct**	**Exst**	**Prop**	**Dfct**	**Exst**	**Prop**	**Dfct**	**Exst**	**Prop**	**Dfct**	**Exst**	**Prop**	**Dfct**	**Exst**	**Prop**	**Dfct**
Prevent the spread of muskellunge in Maine (within and outside of the drainage in which the species now occurs)	1																								
Reduce the impact of existing populations of muskellunge on traditional sport fisheries	2																								
Reduce angler interest in current muskellunge sport fisheries.	3																								

Exst = Existing;
Prop = Proposed;
Dfct = Deficit (Proposed – Existing).