BURBOT MANAGEMENT PLAN

DEPARTMENT OF INLAND FISHERIES AND WILDLIFE
DIVISION OF FISHERIES AND HATCHERIES

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BURBOT LIFE HISTORY

The burbot, Lota lota (Linnaeus), is a unique member of the cod family. It is the only species in the family, which spends its entire life in fresh water. However, the burbot is similar to its marine relatives in that its distribution is circumpolar. It can be found in cool, fresh waters throughout northern Europe, Asia and North America. In North America its range extends as far south as the northern tier of States across the United States. In Maine, the burbot is commonly known as the cusk, although in other areas it is also called the ling, eelpout, loche and lawyer.

Unlike the salmonids and Maine's other coldwater species, the burbot is not noted for its grace and beauty. The body is elongate, almost eel-shaped, with long, soft-rayed dorsal and anal fins that meet a rounded tail. Although it is smooth and slimy to the touch, the skin is embedded with very small, cycloid scales. The head of the burbot is broad and somewhat flattened. It has a large mouth containing several rows of small teeth on the jaws. A single, whisker-like barbell protrudes from the tip of the chin. There are no obvious external differences between males and females.

In general, adults are olive brown to dark brown on the back and sides. This background is overlaid with distinctive patterns of dark brown or black markings and spots. The belly is creamish in color. Habitat conditions probably influence the coloration, as the color often varies among, and sometimes even within, waters.

The burbot is a coldwater fish, typically inhabiting larger, deep lakes. However, throughout its range it is also found in small, shallow lakes and ponds, as well as in larger rivers and small streams. In lakes and ponds supporting principal fisheries, the burbot prefers the deep, cooler areas during the summer months. It shares the deep habitat with lake trout, whitefish, and sculpin. All require cold well-oxygenated (in excess of 4 ppm) water. The optimum temperature range for burbot is 60-65 degrees and 74 degrees appears to be its upper limit. In the spring and fall the burbot will move into shallow water along the shore. During the winter it is especially active at all depths under the ice. Young of the year are frequently found along rocky shores and sometimes in weedy areas of tributary streams.

Life history studies of the burbot were conducted on Moosehead Lake during the winter of 1986. A sample of 60 burbot (Obrey 1986, unpublished) was examined to determine age and growth characteristics, food habits, age and size at maturity, and spawning dates. For the purpose of this plan, it shall be assumed that the general characteristics of the Moosehead Lake burbot population are typical of the majority of the State's burbot populations. Since 1986 additional burbot have been sampled from Moosehead Lake.

Throughout its entire world range the burbot spawns from November to May, and in Canada from January to March. Evidence in Maine indicates early-to-mid February as the spawning time, which makes the burbot Maine's only freshwater species known to spawn principally in the winter under the ice. Spawning occurs at night, most commonly over shoals, at depths of from 3 to 15 feet. Burbot have also been known to move into rivers to spawn. Spawning substrate consists of sand, gravel and small stones. A current is usually present at the site, which keeps the area free of sediment.

Males arrive first at the spawning site. Once the females arrive, the actual spawning period lasts about one week. No nests are prepared. During the Moosehead Lake study, Obrey captured gravid females on the night of February 7. The next sampling date was February 17 at

which time all specimens were either spent or immature. The eggs, each about 1.0 mm in diameter, are broadcast into the water where they are fertilized. The burbot has a tremendous reproductive potential. Individual females often produce hundreds of thousands of eggs, and the larger females (over 25 inches long) can produce over 1 million eggs. The eggs are released into the water column and remain suspended for a short time. Gradually they sink and settle on to the bottom between spaces in the rock and gravel. They are not adhesive. After spawning, the adults leave the area, and therefore provide no care for the young when they hatch. Eggs spawned in February hatch in the spring, probably in April. There is evidence indicating that in northern populations some adults skip spawning on some years.

The Moosehead Lake sample (Table 1) contains specimens of all age classes from 2 to 13 years old. The range in length of the sample is 8.0 inches (age 2) to 30.6 inches (age 13). The Moosehead Lake burbot exhibit a rapid growth rate during the first two years, reaching a mean length of 9.6 inches by the end of their second year and a mean length of 12.0 inches by the end of their third year. By the end of their third year they reach just over 50% of the total length that they would attain by age 10. The majority of the sample had reached sexual maturity by the end of their fourth year, at which time a dramatic decrease in annual length increments occurred. The annual growth increment for ages 0 to 3 was 4.0 inches; for ages 4 to 13 the mean annual increment was 1.5 inches. It has been observed that mature females are significantly longer than males for the same age.

During October trapnetting at First Roach Pond in 1992 and 1993 205 burbot ranging in length from 12.6 inches to 30.5 inches were jaw tagged with numbered tags. By October 2001, 56 of the tagged burbot were recaptured in subsequent trapping operations. Thirty-nine were recaptured once; 13 twice; 3 three times; 1 four times. Based on these returns, the mean annual increment of the First Roach Pond burbot of adult size is 0.7 inches. Unlike Moosehead Lake, First Roach Pond is not open to ice fishing. Therefore the exploitation of burbot is very low. There is a limited ice out fishery for burbot that may account for a few hundred pounds of harvest. First Roach Pond is 3,270 acres. Most likely the burbot harvest does not exceed 0.1 pound per acre per year. At such a low harvest rate, the burbot in First Roach Pond may have attained a maximum size for the available forage causing the growth rate to be slower than that of a lake where the population is exploited at a higher rate.

Canadian age and growth studies indicate that burbot over 27.0 inches in total length generally weigh more than 4 pounds. Most of these larger fish are at least 10 year olds. Burbot as old as 16 years have been observed in Canada, though the maximum age for the species probably ranges between 10 and 15 years. The largest burbot on record for North America was taken in 1870 in Alaska and weighed 60 pounds. Great Slave Lake produced the largest burbot known in Canada. It was 38.3 inches long and weighed 18.5 pounds. In Europe the species has been reported to grow to a length of 46.0 inches and to a weight of 75 pounds.

Burbot over 20.0 inches long and 2 pounds in weight are commonly caught in Maine waters, and a few over 10 pounds are taken each year. Maine's largest angler-caught burbot on record weighed 18.5 pounds, caught in 1986 from Eagle Lake, Aroostook County.

It has been reported that burbot less than 400 mm (15.8 inches) fed on more invertebrates than fish. Obrey found that this was not the case for the burbot from Moosehead Lake during the winter. Burbot of all sizes fed on both fish and invertebrates. There was no relation between burbot size and the type of forage. Smelts occurred in 50% of the burbot stomachs (21% of the total volume of food) and crayfish occurred in 40% of the stomachs (27% of the total volume). The remaining stomach contents were comprised of unidentifiable fish remains, minnows,

insects, Mysis relicta (opossum shrimp), discarded bait and the remains of fish cleaned by other fishermen. Other fish species commonly observed in burbot stomachs include sculpins, sticklebacks, yellow perch and suckers. Crayfish are an important component of the burbot diet in early summer when burbot feed in relatively shallow water. The burbot must be considered an important competitor with coldwater sport fish species. It can also be a predator on newly stocked brook trout, lake trout and salmon.

Feeding occurs primarily at night, generally near the bottom. Based on studies of the seasonal variation in stomach contents, during the summer months, when burbot inhabit deeper waters, they do not appear to be active feeders. Activity increases with the advent of cooling surface water temperatures in the fall, and peaks in the late winter and early spring. There is evidence that burbot move into rivers to feed shortly after their spawning is completed.

BURBOT MANAGEMENT HISTORY

When caught by anglers, the burbot does not fight as well as the other more popular coldwater species; therefore, it is often not considered a sport fish. In part due to its appearance and its predatory habits, many anglers and even some management agencies, regard the burbot as a coarse fish and a nuisance in comparison to the other more important coldwater species, which share its habitat. In Maine the status of the burbot as a non-sport fish is quite evident. There are no length, weight or bag limits for the species. As limits on salmonids become more restrictive, interest in the burbot may increase. There is some evidence that the number of larger burbot (over 10 pounds) has declined on some waters where burbot have been a sought-after species (Moosehead Lake, Chamberlain Lake).

The flesh of the burbot is recognized as an excellent food. The firm white meat is very tasty and nutritious when baked, deep-fried or served as chowder. Skinning and filleting is the best method for preparing the burbot for the table.

Although Maine anglers occasionally take burbot during the open water season, they are readily caught during the winter ice fishing season. This coincides with the most active feeding period for the species. Live or dead bait fished on or near the bottom offers the best chance for catching burbot. Because of their nocturnal feeding habits, fishing at night will generally produce the best catches. Several Maine lakes provide locally popular night fisheries for burbot. During the day, burbot are also commonly caught incidentally to other coldwater sport fish, such as the lake trout and lake whitefish. In the past, anglers often discarded all but the largest burbot in favor of the sport species, which they sought. Recently however, more anglers have recognized the value of the burbot as a food fish, and all but the smallest ones are being kept.

There is no history of commercial fisheries for the burbot in Maine. Apparently in some areas they were used as an important source of food during the Depression. Burbot are taken in the commercial fisheries of the Great Lakes and in some of the Canadian lakes. It is quite likely that even there they are caught incidentally to the other, more important fish that are sough. They have a very low economic value relative to the other species, despite the excellent quality of the flesh as a food.

In general, the qualities of the burbot fishery and the opportunity to partake in that fishery have not changed greatly since 1980. The effort placed on direct management of the burbot is a reflection of the importance placed on the species by the general fishing public and not a failure on the Department's part to fully recognize the burbot's value. Statewide, only a minimum of effort by the Department of Inland Fisheries and Wildlife has been directed specifically toward addressing the problems outlined in the 1980 Burbot Management Plan and its subsequent updates. Fishery Management Regions E and G have collected winter creel survey information on burbot from waters where surveys were being conducted to gather fishery statistics on the other coldwater sport fishes. Using Department angler questionnaires, attempts have been made to estimate angler use and harvest of the burbot, day and night catches, winter and summer catches. Basic life history information, including age, growth, food habits and maturity, has been collected on a few waters but has remained concentrated on the burbot population at Moosehead Lake. As limits become increasingly more restrictive on the traditionally sought coldwater sport fish species, it is reasonable to expect a shift in fishing pressure, and thus management effort, toward burbot and other presently "unregulated" species.

BURBOT PAST MANAGEMENT GOALS

The Goals Stated in 1986 and in each subsequent update are to maintain present fishing opportunity and fishing quality. With each update, the inventory of lakes and acres of burbot habitat has changed. The changes reflect new surveys. No additional populations have been established through stocking. Changes in principal fishery ratings resulted from better understanding of individual fisheries rather than changes in management.

Objectives were defined in terms of Abundance, Harvest, and Fishing Quality. They established the status quo as minimum levels to be maintained through the planning period. To satisfy the Abundance objective, the Department was to study population dynamics to learn more about population levels needed to sustain fisheries. To that end, data from other States where burbot occur have been reviewed and added to the State's store of knowledge available to enhance our understanding of the species. Burbot size and catch data are constantly being recorded when burbot are taken as by-catch during work targeting lake trout or other species. The objective did not call for nor have there been any attempts made to manipulate burbot populations.

The Harvest objective was to maintain harvest at approximately 0.10 pounds per acre (all burbot waters, incidental day and night catches combined). The only burbot harvest estimates that span the planning period are from Moosehead Lake. Few burbot are harvested in the open water season. Winter harvest is divided into incidental day catch and directed night catch. On Moosehead Lake, the night fishing pressure equals 11% of the day use average. The proportion of night burbot harvest to total winter burbot harvest averages 65% at Moosehead Lake. Winter harvest is directly influenced by the level of winter use. General use patterns observed at Moosehead Lake reflect changes observed statewide. Winter use peaked in the mid to late 1980s as did the burbot harvest. The harvest averaged 0.11 pounds per acre. Use decreased through the early to mid 1990s with harvest averaging 0.09 pounds per acre. From the mid 1990s to present, use has continued to decline and harvest decreased to 0.05 pounds per acre. The burbot fishery at Moosehead Lake may represent the upper limit of harvest rates and therefore may be an adequate measure of how closely Objectives are being met. The present harvest rates do not meet the Objective, but that reflects a decrease in use rather than a decrease in fish abundance or size.

The Fishing Quality objective was to maintain an average size of approximately 19 inches and 2 pounds on waters providing principal fisheries. Moosehead Lake is an example of one of the State's more heavily fished burbot populations. With no minimum size limit on burbot, it is not unusual to see many small fish in the angler catch, especially at night. Nighttime conditions can be quite uncomfortable causing anglers to remove and discard smaller burbot "on the ice" rather than carefully release them. The average size burbot in the harvest at Moosehead Lake is approximately 18 inches and approximately 29 ounces. On waters where the incidental day catch accounts for most of the harvest, the harvest typically reflects a smaller proportion of small individuals and the average size approaches or exceeds the Objective.

OPPORTUNITY

In this section and elsewhere in the plan, data are presented on the basis of the Department's Fisheries Management Regions, which are aggregations of townships (Figure 1).

Burbot populations are distributed in lakes and ponds throughout Maine (Figure 2). They commonly occur in the headwaters of the larger river systems, especially the Kennebec, Penobscot and St. John, and are conspicuously absent from the smaller coastal drainages. All are maintained through natural reproduction. There are no records of attempts to expand the range of the species by stocking; therefore, it is safe to assume that the populations, which have been found in surveyed waters, represent the natural distribution of the burbot in Maine.

Through 2001, burbot have been found in 158 lakes and ponds, with a combined area of 459,265 acres (Table 2). This represents less than 8% of the 2,076 lakes and ponds, which have been inventoried, but 48% of their total area. Maine's three northern Fishery Management Regions account for 75% of the total number and 78% of the total area of the State's burbot lakes.

Burbot are typically found in the larger lakes. One-half of the lakes with populations are over 1,000 acres in area. Although they also occur in a few small ponds (the smallest surveyed to date is 21 acres), waters less than 100 acres account for less than 9% of all those with burbot populations. Maine's largest lakes, Moosehead (74,890 acres), Sebago (28,771 acres), and Chesuncook (26,200 acres), all contain burbot. Together, they comprise 28% of the area of all Maine burbot lakes. Excluding these three lakes, the other 155 lakes average 2,125 acres.

Burbot are often found in association with other coldwater species, especially brook trout, lake trout and lake whitefish. Of all lakes with burbot, 104 (258,978 acres) are managed principally for coldwater species, 44 (189,619 acres) are managed for both coldwater and warmwater species, and 9 (10,591 acres) are managed for warm water species and 1 (77 acres) is managed for baitfish (Table 3).

Burbot are not among the principal species sought by anglers in many of the waters where they occur. By definition, the principal fisheries for burbot indicate only waters where angler use of the resource is considered significant. The magnitude of use probably reflects both the opportunity to fish during the winter, and to catch fish of a size which anglers consider worthy of preparing for the table. Although burbot are taken in the open water season, use directed toward burbot is concentrated in the winter. Of the 158 surveyed waters where burbot occur, 104 (66%) with a total area of 419,772 acres (91%) are open in the winter (Table 4). Night fishing is permitted on all of these waters. The magnitude of the night fishery for burbot may be greatly influenced by the availability of overnight lodging (private or commercial camps) or the proximity of the burbot lake to a human population center. Burbot less than 16 inches usually weigh less than a pound. In terms of the size of the fillets which they yield, the small fish are not as desirable as those over 16 inches long, and especially those over 20 inches which weigh more than 2 pounds.

Principal fisheries for burbot exist in 18% of all waters where they occur, and in 48% of the total acreage. The burbot is considered a principal fishery throughout the full range of lake sizes, in which it occurs, including Minnehonk Lake (Mount Vernon, Kennebec County) at 99 acres to Moosehead Lake at 74,890 acres. As expected from the distribution of the species, the three northern Fishery Management Regions account for the majority of both number and acreage of

principal burbot fisheries (Table 2). Maine's three largest lakes comprise 59% of the area of all lakes with principal fisheries. The 26 others average 3,493 acres in size. Most waters with principal fisheries for burbot are managed exclusively for coldwater species.

In addition to the principal fisheries, many of the other burbot lakes that are open to ice fishing support limited fisheries where the quality of the fishing (catch per angler and average fish size) may not be quite as good. As the amount and quality of creel survey data increases on some of the waters presently classified as principal fisheries for burbot, it is likely that we will find their burbot fisheries to be of lesser importance than originally thought. These will reflect an improvement in data and not necessarily a change in population status.

Burbot also inhabit many of Maine's larger rivers. They often occur in the tributaries to lakes where populations are found. However, there is no information on the distribution of the species in the State's 31,800 miles of stream habitat. Few streams offer significant fishing opportunities. Far more is known about the distribution and habitat of the burbot in Maine than about the abundance of the species. There have been no studies to determine its abundance in individual waters; therefore it is impossible to project burbot numbers on a statewide basis. The burbot has an excellent reproductive potential, a good growth rate, and it matures at a relatively early age. Where the burbot occurs it is quite probable that it can be as abundant, if not more so, than most of the coldwater sport fish whose habitat it shares.

Burbot lake habitat is not expected to change significantly. Existing land use laws should protect this habitat from degradation. Until more life history studies are undertaken to determine the effects of burbot upon the species with which it coexists, there should be no attempts made by the Department to increase its range beyond the waters where it is presently found.

In the summer, nearly all of the burbot acreage throughout the State is accessible by vehicle, with boat landings historically present on waters that account for over 90% of the acreage. Public rights-of-way are not present on all waters, especially in the north, but public access to waters without rights-of-way is not seriously restricted. Fees are charged to the public for access to waters that lay within the North Maine Woods multiple ownership area, principally in Regions E, F, and G. Fees are associated with general land and road use, and are not charged specifically for the right to fish.

In the winter, when most of the demand occurs, opportunities for use of burbot waters are also quite good. Waters that cannot be reached by plowed road can easily be reached by snowmobile. No land or road use fees are charged in the winter. Of all burbot lakes, 66%, comprising 91% of their combined area, are open to ice fishing. In southern Regions, where there is less use opportunity due to the limited number of burbot lakes and acreage available, all waters are open to ice fishing. In the northern Regions, more burbot lakes are closed to ice fishing, but these involve only 11% of the total area of the burbot lakes in the three Regions. Waters closed to ice fishing in the north are generally the smaller lakes and ponds. Their closure is most often due to the presence of other cold water species, especially brook trout, and not to protect the burbot. Only one principal fishery water is closed to ice fishing. Of all principal fishery burbot waters, 97% are open to ice fishing comprising 99% of the principal fishery acres.

Previous Species Plans have defined opportunity in terms of number and acres of burbot habitat by Region and described either a positive or negative relationship based on the estimated human population of each Region. The angler population is extremely mobile and most burbot fishing occurs in conjunction with other major coldwater species. Therefore the earlier comparisons did little more than point out the obvious. Where the majority of the human

population occurs (the southern Regions) there are fewer burbot waters and less acreage available to fish burbot. In the northern Regions, there are fewer people, more burbot waters, and considerably more acres available to fish for burbot. Regional estimates of use suggest that anglers who live in southern Regions spent a significant portion of their fishing effort in the northern Regions. It can be assumed that the willingness to travel reflects a desire to fish for more popular cold-water species such as lake trout, brook trout, salmon or lake whitefish. Although the more significant burbot fisheries are referred to as principal fisheries, it must be remembered that they usually occur in association with other cold water fisheries and, in terms of angler preference, are secondary to other species with which they occur.

Without information on the abundance of burbot in Maine, no estimate can be made of the supply available for harvest. Without estimates of burbot-specific effort, there can be no real measure of demand by Region. Based on the size at which burbot mature, and the minimum size which many anglers find desirable, the number of fish over 16 inches should be considered as the available supply. Based on measured samples from the Moosehead Lake burbot fishery (day and night fisheries), about 60% of all burbot caught are 16 inches or longer (Table 6).

Under present levels of management, the effect of existing angler use on population abundance and its influence on fishing quality, statewide, is unknown. However, there is evidence to suggest a decrease in the number of larger (over 10 pounds), individuals in waters fisheries for burbot have been popular for several years.

DEMAND

As expressed by angler preference, the burbot is not highly regarded by Maine anglers. Responses to the Department's 1982-83 questionnaires indicate that winter anglers rate the burbot behind all other coldwater species except the lake whitefish, and behind all warmwater species except the yellow perch and sunfish. Open water anglers rated the burbot behind all species except yellow perch, eel, sunfish, black crappie and chub (fallfish) in 1983. On the basis of anglers reporting, "targeting" a species, burbot were ranked 14 of the 16 species listed in the 1999 Open Water Survey. Furthermore, only 7% of the anglers responding to the 1999 Open Water Survey rated the opportunity to catch this species as important or very important to them on an inland fishing trip, placing burbot last in a list of 16 other species rated. Little information is available on angler-day use and harvest of burbot during the open water season. Estimates of the open water catch and harvest of burbot derived from the Maine Open Water Fishing Survey, Summer, 1999 are felt to be unreliably high because of the small sample of anglers on which the estimates are based. Clerk summer surveys on waters where burbot are present consistently show little or no harvest; consequently, out assessment of demand is based on the winter fishery only (Table 5).

Winter use falls into two categories. Burbot are caught during the day incidentally to other species sought by anglers. Little of the daytime ice fishing on waters with burbot populations is directed exclusively at the species. Nevertheless, because daytime use is so much higher than night use, significant numbers of burbot of all sizes are caught during the day. The "incidental" day catch must be considered very important.

Moosehead Lake is the only water in the State with long-term estimates of use and harvest that include burbot in the aggregate of species studied. This assessment relies heavily on the results of work done on Moosehead Lake to describe the winter burbot fishery in Maine. If and when similar data are available on other Maine waters those statistics will be useful in redefining the burbot on terms that are more statewide in nature.

Early surveys on Moosehead Lake (1977-1984) showed that only 5% of the burbot caught (day and night) were released. During the period 1985 to 1989, the release rate increased to 10%. Creel surveys from 1990 to 1994 showed a further increase in the release rate to 25%. The most recent survey data from 1995 to 2000 reveal a release rate (day and night) of about 35%. This mirrors a more conservative trend observed in nearly all of the State's fisheries.

Ice fishing for burbot is best at night, as they are more active at night and most actively feeding during the winter. Traditionally, the real demand for burbot is expressed in the night fisheries, which occur on several lakes throughout the State. Some night fisheries are quite popular, especially among local residents and "sports" on overnight trips at private and commercial camps. The magnitude of night use must be influenced by the availability of overnight lodging. On Moosehead Lake, the night fishery averages 11% (angler nights) of the estimate for the day fishery (angler days) for all species. Due to the high number of commercial sporting camps and private camps on Moosehead Lake, the proportion of night use to day use may be higher than that proportion calculated statewide, if those figures were available. Moosehead Lake surveys (Table 6) indicate that night catch rates average 1.60 burbot per angler and day catch rates average 0.08 burbot per angler. These statistics need to be collected from a representative cross-section of burbot waters throughout the State in order to adequately depict the entire fishery in terms of use and harvest.

The burbot has not received high management priority. Consequently information on use, catch and harvest is available from only a few burbot waters where creel surveys have been aimed at other species. Unfortunately, information on the burbot is not being recorded on all waters where it is considered a principal fishery even though those waters are presently being surveyed for catch statistics on the more popular coldwater species. More information is available on day use and incidental day catch than on night use and catch. Harvest estimates based on this information are speculative at best.

Nearly all data concerning the incidental day catch of burbot have been collected in Regions E and G. Catch rates vary greatly among waters. They are higher on waters with principal fisheries for lake trout and lake whitefish where most fishing is done near the bottom. Burbot catch rates tend to be lower on waters with principal fisheries for salmon, where most fishing is near the surface.

Much more information from individual burbot waters around the State will be required to generate useful estimates of use and harvest for this species.

Where night fisheries for burbot are known to exist, fishing can be extremely productive. As in any fishery the catch varies, but on some nights individual catches of 20 or more burbot have been recorded. Most anglers spend only a few hours fishing in the early evening, others fish all night. Survey data for night anglers on Moosehead Lake is presented in Table 6. From 1990-2000 the catch averaged 1.60 burbot per angler-night. When compared with the daytime incidental catch, the night catch per angler and the catch per angler-hour (0.34 burbot/hour) are considerably higher. Day and night harvest estimates for Moosehead Lake for the 1990-2000 ice fishing seasons are presented in Table 6. It is clear that where local fisheries occur, the night harvest will easily equal or exceed the incidental day harvest, even with far less fishing pressure at night.

No information is available on the supply of and demand for the burbot in Maine rivers and streams. Most are closed to ice fishing. With no estimate of the present supply of burbot, it is not possible to project the supply of the species into the future.

The 1980 Burbot Management Plan predicted that the increase in winter use on burbot waters would likely exceed 13% by 1985. Based on use estimates from 1981 to 1985, the use on burbot waters increased by 35%. This increase was considerably higher than anticipated based on license sales trends. From 1985 to present, use decreased by 17%. Fishing for burbot seems to be secondary to fishing for the more popular coldwater species. Use and harvest of burbot may be greatly influenced by the availability and quality of the other fisheries with which it is associated, especially the lake trout fisheries in the northern part of the State. The burbot is sought for its table quality rather than its “sporting” quality. As the value of the burbot as a food becomes more widely recognized, utilization of the species may increase. However, it appears that the past performance of the burbot fishery is not an indicator of how anglers will avail themselves of the opportunity to fish for burbot in the future. In general, the public has expressed few concerns over the quality of burbot fishing and demonstrated little interest in introducing burbot to new waters. If expanded distribution of the burbot is ever considered, extreme care must be exercised in the selection of waters due to potential competition with and predation on coldwater game species. Use opportunity will be limited only by the distribution of burbot lakes and is not likely to change unless the general law ice-fishing season is changed or more waters are opened. Without a change in management policies, fishing regulations will remain very liberal.

FISHING QUALITY

The Fishing Quality Objective Stated in the initial and all subsequent updates of the Burbot Management Plan has been to maintain the average size of harvested fish at about 19 inches and 2 pounds. With only a few surveys to draw upon, it is impossible to say if the Objective has been met statewide.

Several years of clerk surveys at Moosehead Lake provide a picture of a relatively heavily fished burbot population. The statistics representing that fishery are shown on Tables 1 & 6. The average size of day-caught burbot tends to be larger than night-caught burbot, but the difference is only about an inch. Both samples have been combined to produce an average size burbot in the harvest of about 18 inches and 29 ounces. There is no minimum size limit on burbot in Maine. The result of no size limit can be seen in the distribution of sizes of fish kept on Table 6. Nearly 40% of the burbot harvested at Moosehead Lake are smaller than the length considered to be desirable (16 inches). If the Moosehead Lake harvest had been taken under a 16-inch minimum length limit, the average size would have been 19.4 inches. If taken under an 18-inch minimum length limit, the average size would have been 21.0 inches. This suggests that where use is high and night fishing comprises a major component of the harvest, it may be necessary to impose a minimum length limit to achieve the Stated Objective.

A small sample of day-caught burbot from a few northern waters with light exploitation indicates the average size of harvested fish ranges from 19 to 20 inches. Every winter burbot over 10 pounds are reported throughout their entire range, but especially in the northern Regions. There is no evidence that either significant gains or losses have occurred in burbot fishing quality since the initial Burbot Management Plan was written. There is no evidence to suggest that the current liberal management (no size or bag limits) has caused a reduction in abundance at the historically observed levels of use. There have been no complaints by the public about size or catch rates and no demands to restrict the current levels of use and harvest. It can be assumed that the fishing quality for burbot meets or exceeds the fishing public’s expectations.

TABLE 1. PROFILE OF BURBOT FISHERY MOOSEHEAD LAKE DAY AND NIGHT SAMPLES COMBINED

LENGTH FREQUENCY			AGE-LENGTH-WEIGHT		
INCHES	SAMPLES		AGE	LENGTH (INCHES)	WEIGHT (OUNCES)
7	1		1		
8	1		2	9.60	3.3
9	7		3	11.99	7.0
10	10		4	13.67	9.8
11	44		5	14.40	11.2
12	80		6	16.48	19.7
13	109		7	18.09	24.0
14	169		8	18.65	25.3
15	169		9	22.31	50.1
16	180 1lb 39% <1lb		10		
17	154		11	21.97	37.4
18	136		12		
19	90		13	27.48	110.0
20	97 2lb 38% 1-2lb				
21	62				
22	49				
23	36 3lb 23%>2lb				
24	27				
25	23 4lb 5%>4lb				
26	13				
27	10				
28	5				
29	4				
30	9				
31	1				
32	4				
33	4				
34	3				
ALL	1,497				

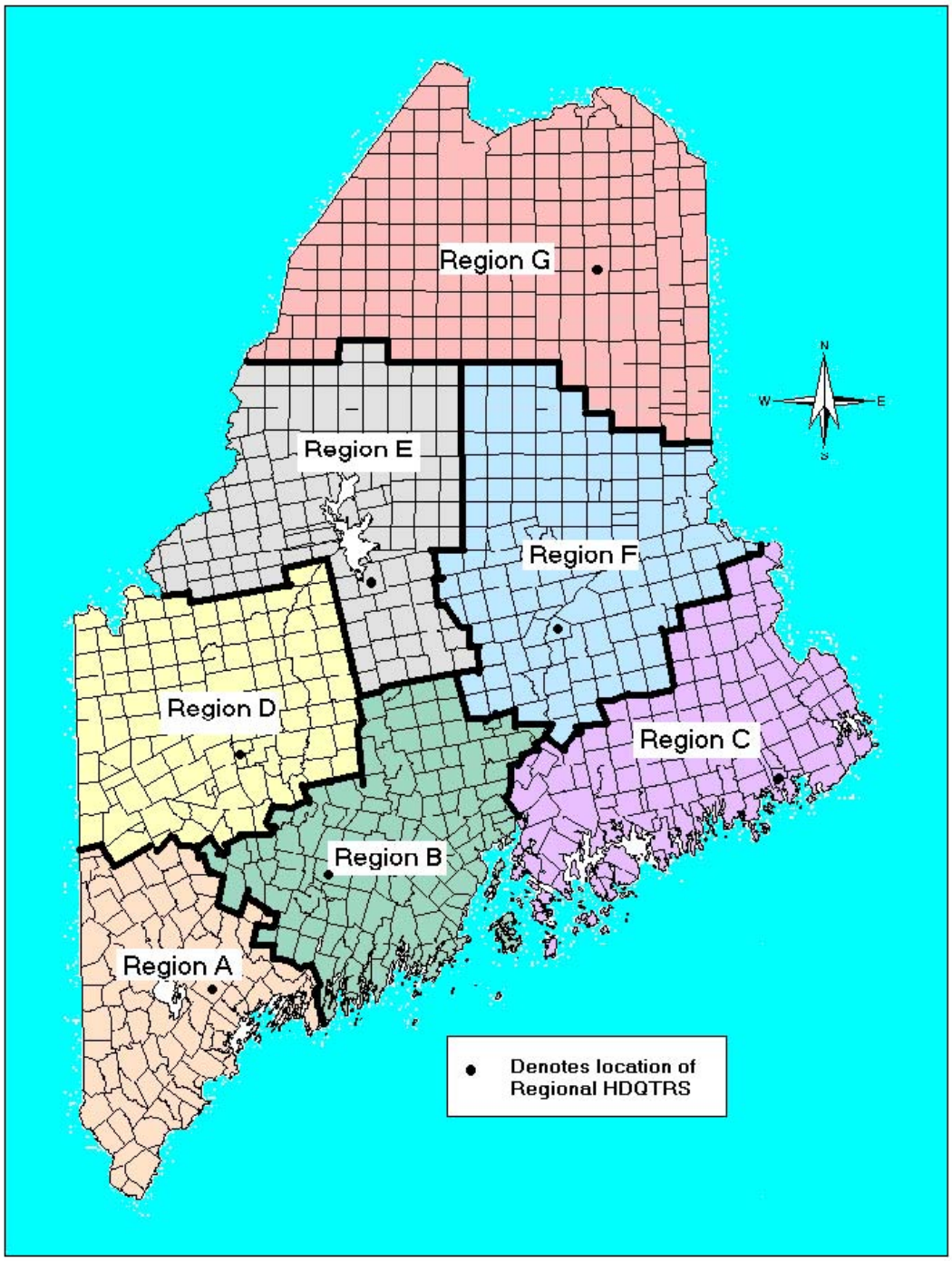

FIGURE 1. MAINE DEPARTMENT OF INLAND FISHERIES AND WILDLIFE FISHERIES MANAGEMENT REGIONS

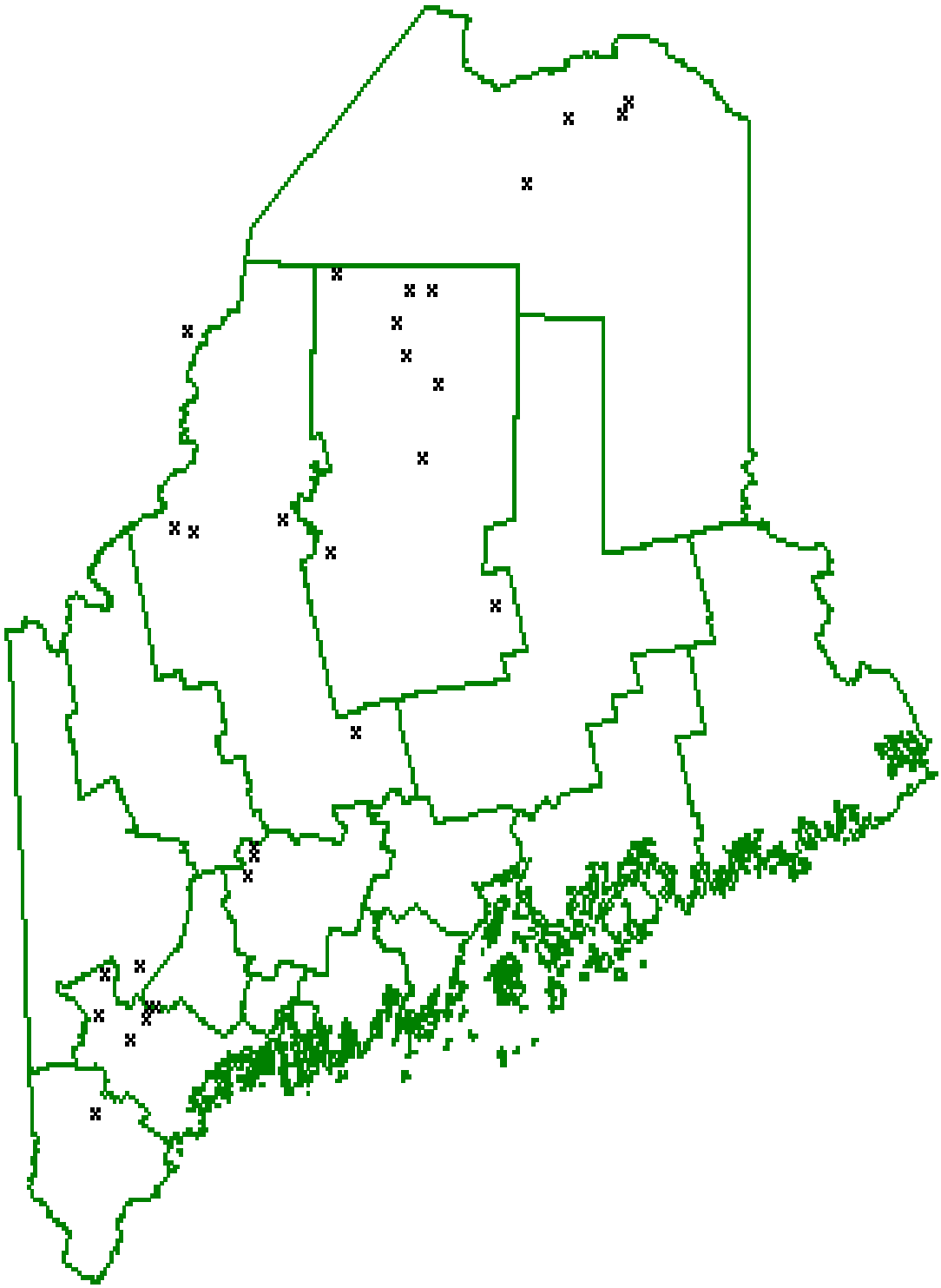

FIGURE 2. 1980 SPECIES DISTRIBUTION IN LAKES BURBOT (CUSK) LOTA LOTA PRINCIPAL FISHERY

TABLE 2. NUMBER AND ACRES OF MAINE BURBOT LAKES, BY FISHERY MANAGEMENT REGION LAKES WITH BURBOT

MGT REGION	ALL LAKES		LAKES WITH PRINCIPAL FISHERIES		OTHER BURBOT LAKES		ALL INVENTORIED LAKES	
	NUMBER	ACRES	NUMBER	ACRES	NUMBER	ACRES	NUMBER	ACRES
A	12	45,101	8	41,864	4	3,237	297	91,047
B	15	17,130	4	5,198	11	11,932	273	100,338
C	5	28,517	0	0	5	28,517	274	138,017
D	7	8,406	0	0	7	8,406	261	107,536
E	50	184,918	8	130,552	42	54,366	420	224,326
F	28	102,988	1	7,168	27	95,820	272	189,486
G	41	72,205	8	35,890	33	36,315	279	94,597
STATE	**158**	**459,265**	**29**	**220,672**	**129**	**238,593**	**2,076**	**945,347**

TABLE 3. NUMBER AND ACRES OF MAINE BURBOT LAKES, BY LAKE MANAGEMENT TYPE, AND BY FISHERY MANAGEMENT REGION

MGT REGION	COLDWATER		WARMWATER-BAIT		COMBINATION		ALL BURBOT LAKES	
	NUMBER	ACRES	NUMBER	ACRES	NUMBER	ACRES	NUMBER	ACRES
A	0	0	2	1,108	10	43,993	12	45,101
B	1	99	4	3,710	10	13,321	15	17,130
C	1	1,613	0	0	4	26,904	5	28,517
D	5	7,553	0	0	2	853	7	8,406
E	43	141,499	0	0	7	43,419	50	184,918
F	14	36,086	3	5,773	11	61,129	28	102,988
G	40	72,128	1	77	0	0	41	72,205
STATE	**104**	**258,978**	**10**	**10,668**	**31**	**189,619**	**158**	**459,265**

TABLE 4. NUMBERS AND ACRES OF MAINE BURBOT LAKES OPEN TO ICE FISHING BY FISHERIES MANAGEMENT REGION

MANAGEMENT REGION	ALL BURBOT LAKES		BURBOT LAKES OPEN TO ICE FISHING[1]	
	NUMBER	ACRES	NUMBER (%)	ACRES (%)
A	12	45,101	12 (100)	45,101 (100)
B	15	17,130	15 (100)	17,130 (100)
C	5	28,517	5 (100)	28,517 (100)
D	7	8,406	6 (86)	8,086 (96)
E	50	184,918	20 (40)	160,190 (87)
F	28	102,988	26 (93)	101,874 (99)
G	41	72,205	20 (49)	58,874 (82)
STATE	**158**	**459,265**	**104 (66)**	**419,772 (91)**

[1] Includes all waters in each Region with principal fisheries for burbot except for one water in Region G (Fish River Lake 2,642 acres)

TABLE 5. ESTIMATED TOTAL ANGLER-DAY USE AND HARVEST OF BURBOT ON MAINE WATERS OPEN TO ICE FISHING BY FISHERY MANAGEMENT REGION

REGION	FISHERY TYPE	BURBOT WATERS		TOTAL ANGLER-DAYS	TOTAL FISH HARVESTED	TOTAL POUNDS HARVESTED	POUNDS PER ACRE
		NUMBER	ACRES				
A	Principal	8	41,846				
	Other	4	3,237				
	Total	12	45,101	20,931	4,252		
B	Principal	4	5,198				
		11	11,932				
		15	17,130				
C	Principal	0	0				
	Other	5	28,517				
	Total	5	28,517	2,265	314		
D	Principal	0	0				
	Other	7	8,406				
	Total	7	8,406	1,115	314		
E	Principal	8	130,552				
	Other	12	29,638				
	Total	20	160,190	59,564	12,825		
F	Principal	1	7,168				
	Other	25	94,706				
	Total	26	101,874	15,474	4,600		
G	Principal	7	33,248				
	Other	13	25,626				
	Total	20	58,874	24,094	7,005		
STATE	Principal	28	218,030	62,575	14,730 d+9,386 n=24, 116 PF	48,232 PF	0.22
	Other	77	202,062	74,997	9,725 d=non PF	9,725 non PF	0.05
	Total	105	420,092	137,572	33,841	57,957	0.14

Calculation of angler days for PF waters: 218,030 PF acres X 0.287 (mean angler days/acre Regs E & G surveys)= 62,575 angler days on PF waters. Use on non PF waters is Total use minus PF day estimate or 137,572-62,575=74,997 angler days on non PF waters. Angler nights on PF waters is angler day estimate times 11% (11% is the average ratio of night use to day use per Moosehead Lake surveys) or 62,575X.11=6,883 angler nights.

Calculation of burbot harvest by management type:

PF day use 62,575 angler days X 0.15 (ave day harvest Regs E & G)=9,386 burbot

PF night use 6,883 angler nights X 2.14 (ave night harvest Reg E)=14,730 burbot

Non PF Total harvest 33,841 burbot minus total PF burbot 24,116=9,725 burbot

Mean weight PF burbot=2 pounds; non PF burbot=1 pound

TABLE 6. COMPARISON OF NIGHT BURBOT FISHING CATCH WITH DAY INCIDENT/CATCH AT MOOSEHEAD LAKE 1990 TO 2000

YEAR	NIGHT FISHING					DAY FISHING				
	FISH PER ANGLER	FISH PER HOUR	TOTAL ANGLERS	NUMBER S HARVESTED	POUNDS HARVESTED	FISH PER ANGLER	FISH PER HOUR	TOTAL ANGLERS	NUMBERS HARVESTED	POUNDS HARVESTED
1990	1.80	0.35	1,941	3,485	5,798	0.08	0.01	25,210	1,983	3,299
1991	1.69	0.30	2,932	4,941	5,772	0.08	0.01	22,932	1,903	2,777
1992	1.99	0.44	1,632	3,248	4,409	0.07	0.01	20,404	1,499	1,492
1993	1.93	0.33	1,986	3,838	3,672	0.04	0.01	16,550	706	689
1994	1.42	0.24	1,666	2,367	2,258	0.07	0.01	15,503	1,094	2,572
1995	1.16	0.24	1,617	1,879	2,756	0.04	0.01	11,486	416	705
1996	1.05	0.22	1,448	1,525	1,153	0.08	0.01	11,141	938	986
1997	1.55	0.36	1,212	1,879	2,645	0.10	0.01	9,619	967	1,229
1998	2.35	0.70	919	2,158	3,897	0.16	0.02	11,052	1,806	3,261
1999	1.57	0.38	915	1,439	2,248	0.11	0.02	11,182	1,265	1,976
2000	1.13	0.22	1,229	1,390	2,748	0.06	0.01	11,820	768	1,518
MEAN	**1.60**	**0.34**	**1,591**	**2,559**	**3,396**	**0.08**	**0.01**	**15,173**	**1,213**	**1,864**

BURBOT
GOALS AND OBJECTIVES

(Until more is known about the existing fisheries, goals will be defined for waters providing principal fisheries only.)

GOALS: Maintain present fishing opportunities and fishing quality in the 29 waters providing principal fisheries.

> **Abundance Objective:** Continue to study the population dynamics of the burbot to establish relative population levels needed to sustain fisheries, especially on principal fishery waters.
> **Harvest Objective:** Maintain a harvest rate of approximately 1.5 burbot per angler (night fishery) and 0.10 burbot per angler (day fishery) for principal fishery waters.
> **Fishing Quality Objective:** Maintain the present average size of burbot in the angler creel at about 19 inches and 2 pounds on waters providing principal fisheries.
> **Habitat Quality Objective:** Maintain the present amount of suitable habitat (a well oxygenated hypolimnion) for burbot, especially in the principal fishery waters.

Capability of Habitat: The habitat presently supports self-sustaining populations of burbot. At present, there is no evidence to indicate any habitat loss. There is a potential to increase the distribution of the species throughout most Regions in the State but there has been no demand expressed to do so.

Feasibility: These objectives represent the present conditions and quality of the burbot population and fishery. As populations are self-sustaining, there is no additional demand on the State's hatchery system. Regional Fishery Biologists will be expected to record data on burbot on any waters where fishery surveys are presently being conducted and burbot are either present or considered a principal fishery.

Desirability: Although the burbot is not traditionally considered a sought after species, use on burbot waters and harvest of burbot increased significantly between 1980 and 1990, then decreased through 2000. The changes in burbot use reflect general trends in winter use measured statewide. Some evidence exists that fishing quality for the burbot has declined slightly where fishing pressure has been relatively high (fewer large fish). Since the burbot provides an alternative to other more restricted coldwater sport fisheries, the popularity of the species and its exploitation may increase.

Possible Consequences: Meeting these objectives will continue the status quo with regard to burbot abundance, distribution, harvest and average size. The continued study of the burbot will increase our knowledge of the species. There should be no adverse effects to other coldwater species currently coexisting with the burbot. There should be no additional need for Department manpower or hatchery space to meet these objectives. More effort will be required to assess the status of burbot fisheries by including this species in population and creel surveys now being conducted for other species.

BURBOT
MANAGEMENT PROBLEMS AND STRATEGIES

PROBLEM 1. Information on angler use and harvest of Maine's burbot resources is very limited.

Strategy 1. Request that all Regions report burbot catch statistics on all waters currently being surveyed for data on other coldwater species.

Strategy 2. Refine the list of waters where the burbot is classified as a principal fishery.

Strategy 3. Include as a portion of the State's, or each Region's, plan to determine total angler use for at least one water per Region for which the burbot is considered a principal fishery.

Strategy 4. Revise and/or refine the Department's Angler Questionnaire in order that use and harvest results will more closely reflect actual conditions.

PROBLEM 2. The effects of present fishing pressure, with the existing liberal fishing regulations, on burbot populations are unknown.

Strategy 5. Increase the number of waters on which burbot catch data is being reported by specifically requesting burbot fishing information on waters where surveys are presently being conducted in order to monitor changes in success, catch per unit of effort, and average burbot sizes.

Strategy 6. Conduct creel surveys designed to provide data on incidental daytime as well as night burbot fisheries.

PROBLEM 3. Knowledge of the life history and ecology of the burbot in Maine waters is incomplete.

Strategy 7. Seek assistance from the Cooperative Fishery Unit and other non-Department sources to identify individuals who might wish to conduct life history studies on the burbot.

Strategy 8. Determine the effects, if any, to spawning of winter draw downs in the various controlled lakes where burbot occurs.

PROBLEM 4. It is not fully understood how the burbot fits into allowable harvest projections as estimated by the morpheodaphic index (MEI).

Strategy 9. Keep abreast of all newly published material pertaining to harvest estimates and MEI projections, especially waters involving multiple species including the burbot.

PROBLEM 5. The needs for fishing regulations to manage the use and harvest of the burbot have not been identified.

Strategy 10. Develop regulation options to address various fishery problems that may arise.

Strategy 11. Implement a public information program to promote burbot regulations should the need develop.

PROBLEM 6. Quantitative data on population abundance of the burbot in Maine lakes are lacking.

Strategy 12. Search literature to determine if population studies completed in other areas within the range of the burbot might apply to Maine waters.

Strategy 13. Select representative waters in the various Regions upon which population studies might be conducted as time and manpower permit.

PROBLEM 7. Habitat will be degraded or destroyed if land and water uses are not managed effectively.

Strategy 14. Continue to support strict adherence to LURC, DEP and all other agencies' laws designed to protect the environment.

PROBLEM 8. Angler preferences and attitudes regarding the burbot as a sportfish are insufficiently known.

Strategy 15. Revise and/or refine the Department's Angler Questionnaire to reconcile the obvious disparity between the present low reported preference and the relatively high harvest rates for burbot.

Strategy 16. Determine angler attitudes through personal interviews during on-going creel surveys on waters where the burbot occurs.

PROBLEM 9. There is a lack of Department and public recognition of the burbot as an important fishery.

Strategy 17. Increase the creel survey of the burbot by encouraging all Fishery Management Regions to request and report burbot fishing data on all waters currently being surveyed where burbot are present and now being ignored.

Strategy 18. Inform the fishing public as to the relative importance of the current burbot fishery and its potential in the future as limits on other coldwater species become more restrictive.

PROBLEM 10. Information on the distribution and abundance of the burbot on Maine rivers is lacking.

Strategy 19. Continue to survey Maine's riverine habitat.

PROBLEM 11. This update of the Burbot Management Plan relies almost exclusively on use, harvest and life history information generated in the northern two Fishery Management Regions and may not adequately represent statewide burbot populations and/or fisheries.

Strategy 20. Revise the next Plan to reflect any advance in the knowledge of the life history of the burbot, any increases in information with respect to population dynamics of the burbot and any broadening of use and harvest data to represent the various Regions throughout the State.

PROBLEM 12. The Fisheries Division lacks sufficient staff and financial resources to fully implement the objectives of the management plan.

Strategy 21. Pursue sufficient funding and staff to address the plan's objectives in a timely manner.

APPENDIX A

COLDWATER WORKING GROUP INPUT

BURBOT (CUSK) MEETING SUMMARY

April 28, 2001

Issues:

Has there been a decline in the largest fish in the fishery?
Are burbot significant competitors/predators with/on other gamefish?
Are other salmonids caught by anglers who are night-fishing for burbot?

Goals:

I. Maintain existing amount and quality of habitat in waters having principal fisheries for burbot.
II. Maintain existing levels of harvest.
III. Maintain existing fishing quality.

Objectives:

A. Maintain principal fisheries for burbot in 29 lakes having a total surface area of 220,672 acres.
B. Maintain fishing quality at:
1. 1.5 burbot harvested per angler-night.
2. 0.1 burbot harvested per angler-day.
3. Average size of fish harvested at 19.0 inches/ 2.0 pounds.

PRIORITIZED BURBOT MANAGEMENT OBJECTIVES

DESCRIPTION OF STATEWIDE OBJECTIVES	COLDWATER GROUP RANKING
Establish relative population levels needed to sustain burbot fisheries, especially on principal fishery waters	1
Maintain the present amount of suitable habitat for burbot, especially in the principal fishery waters.	2
Maintain current harvest rates for burbot principal fishery waters.	3
Maintain the present average size of creeled burbot on waters providing principal fisheries for the species.	4

PRIORITIZED BURBOT MANAGEMENT PROBLEMS

DESCRIPTION OF MANAGEMENT PROBLEMS	FISHERIES	CW GROUP	FINAL RANK
Quantitative data on the population dynamics of the burbot in Maine lakes are not adequate to permit the most complete and efficient implementation of the species' management plan.	2	3	3
Information on angler use and harvest of Maine's burbot resources is very limited.	1	7	8
Habitat degradation through human cultural activities could lead to the loss of burbot fisheries	9	4	5
Appropriate fishing regulations to manage the use and harvest of the burbot have not been identified.	5	6	7
Information on the distribution and abundance of the burbot on Maine rivers is lacking.	8	5	6
The Fisheries Division lacks sufficient staff and financial resources to fully implement the objectives of the burbot management plan.	3	1	1
There is a lack of Department and public recognition of the burbot as an important fishery	6	8	9
Angler preferences and attitudes regarding the burbot as a sportfish are insufficiently known.	7	8	2
Knowledge of the life history and ecology of the burbot in Maine waters is incomplete.	3	2	3

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

PRIORITIZED BURBOT MANAGEMENT OBJECTIVES, (COLDWATER WORK GROUP)		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**
Establish relative population levels needed to sustain burbot fisheries, especially on principal fishery waters	**1**																								
Maintain the present amount of suitable habitat for burbot, especially in the principal fishery waters. **NOTE: The numbers displayed here include principal fishery waters, only.**	**2**	8	8	0	4	4	0	0	0	0	0	0	0	8	8	0	1		0	8	8	0	29	29	0
Maintain current harvest rates for burbot principal fishery waters.	**3**	8	8	0	4	4	0	0	0	0	0	0	0	8	8	0	1		0	8	8	0	29	29	0
Maintain the present average size of creeled burbot on waters providing principal fisheries for the species.	**4**	8	8	0	4	4	0	0	0	0	0	0	0	8	8	0	1		0	8	8	0	29	29	0

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