ARCTIC CHARR MANAGEMENT PLAN

DEPARTMENT OF INLAND FISHERIES AND WILDLIFE
DIVISION OF FISHERIES AND HATCHERIES

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ARCTIC CHARR LIFE HISTORY

Maine is the only state in the U.S. that still supports relic populations of Salvelinus alpinus oquassa, a distinct subspecies of arctic charr. The so-called Laurentian lineage of charr occurs only in southeast Quebec and New Brunswick, Canada and Maine. Charr populations in nearby Labrador and Newfoundland, Canada, are morphologically distinct from those in Maine and are not considered the same subspecies. Within Maine, recent genetic work has resolved some ongoing questions of differences among arctic charr populations. For example, the silver charr of Floods Pond (originally called Sunapee charr) were thought to be genetically different from other, so-called blueback charr populations. The genetic analysis, however, showed that all relict charr populations in Maine originated from a common ancestor. More importantly, the study concluded that Maine's populations are highly differentiated, each representing unique gene pools and worthy of individual protection.

Arctic charr populations in Maine are located in oligotrophic (deep, cold, well-oxygenated) lakes. Charr prefer water temperatures below 10°C and thus are usually captured near lake bottoms. However, they are not truly benthic (bottom dwellers) but can be found throughout the water column wherever water temperature is suitable. Arctic charr generally do not exist with large piscivores (fish-eating species such as lake trout) or other planktivores (plankton-eating species such as lake whitefish) probably due to hybridization with closely related species, predation, and competition. However, Arctic charr do commonly coexist with brook trout. Wherever the two species do occur together, they typically segregate by physical habitat. Brook trout utilize littoral areas (shallows) more extensively and remain near the thermocline (the zone of rapid temperature change from warm surface water to cold deep water), whereas arctic charr generally utilize the deeper areas of lakes.

Maine anglers are relatively unfamiliar with the physical attributes of arctic charr due to the difficulty of accessing charr waters and, also, the relative difficulty in angling charr at the few lakes that actually support sport fisheries. Arctic charr have elongate, slightly rounded bodies, a large mouth, a slightly to moderately forked caudal fin (tail fin), and small cycloid scales. Coloration is highly variable and ranges from white/silvery to bright orange with cream-colored spots during spawning (October-December in Maine). Some populations exhibit spawning coloration throughout the year, but non-breeding individuals are usually pale and non-descript. Both males and females may become brightly colored while spawning with yellow-to-orange ventral (lower) surfaces, green-to-bluish dorsal (upper) surfaces, white-to-yellow spots on their sides, and orange-paired fins with bright white leading edges. Juvenile charr have 10-15 irregularly spaced oval parr marks (vertical "stripes") on their sides.

Arctic charr are fall-spawners, similar to their close relatives, brook trout and lake trout. Few directed studies have been completed of the reproductive biology of arctic charr in Maine and therefore considerable gaps in knowledge still exist. Descriptions of spawning biology at Big Black Lake and Floods Pond indicate charr spawn over rocky, windswept shoals in shallow water (1.5-6 feet deep). No nest, or redd, is prepared. Eggs and sperm are broadcast over loose rock that generally ranges in size from 4 to 39 inches in diameter. Spawning occurs from late October into November as water temperatures fall below 50 degrees F (10 degrees C). Maturity occurs earlier in males than females, generally at age 2. All males are usually mature at age 4. Females usually mature one year later than males with most females maturing at age 4. Mature arctic charr in Maine are generally 6 to 9 inches in length with relatively few individuals larger than 9 inches. Notable exceptions are Pushineer Pond and Floods Pond where spawning charr are generally 8 to 16 inches.

Growth of arctic charr is relatively slow when compared to brook trout. A study of six blueback charr lakes in northern Maine indicated that at every age brook trout mean length exceeded the mean length of charr. However, in the same lakes charr lived up to three years longer (age 6 maximum) than brook trout (age 3 maximum). In 1997 twenty-two (22) blueback charr were aged during fall trap netting at Gardner and Deboullie Ponds. Age 2 charr averaged 6.5 inches in length; age 3 charr averaged 7.3 inches; and one age 4 charr was 8.0 inches. Most fish (77%) in this sample were sexually mature.

Arctic charr of all ages are primarily planktivores based on the food habit studies conducted on Maine charr lakes. Juvenile charr are almost exclusively planktivores, whereas adult charr show a minor switch to feeding on fish. In addition to plankton, benthic organisms and aquatic insects comprise a significant portion of the diet.

ARCTIC CHARR MANAGEMENT HISTORY

Arctic charr in Maine are descendents of anadromous, or sea-run, arctic charr that populated coastal waters after several glaciation events during the Pleistocene era. Three genetic lineages of charr exist in North America. Through genetic studies, arctic charr in Maine have been classified as members of the Laurentian lineage that are also represented by populations in southeast Quebec and New Brunswick. This distinct lineage has been given subspecies status (Salvelinus alpinus oquassa). Maine is the last state in the U.S. to support natural populations of this subspecies.

Twelve lakes in Maine, in three major drainages, now harbor relic populations of arctic charr (Table 1). These populations are located near the headwaters of the St. John, the Union, and the Penobscot watersheds. Since the late 1960s charr from Floods Pond have been transferred to seven waters in an attempt to conserve the so-called silver charr by expanding its range. These efforts began in 1968 and involved culture of silver charr in State of Maine hatcheries. Two of these introductions were successful in establishing spawning populations. The status of a natural population at Foley Pond is yet to be determined.

The present, limited distribution of Arctic charr in Maine is likely a result of the species' narrow habitat requirements and intolerance of habitat changes, particularly the introductions of new species. Some populations in Vermont, New Hampshire, and Maine were extirpated during the 1900s as a result of human-induced changes to their environment. Over-fishing, habitat degradation, hybridization with other charr, and competition and predation by introduced fishes has been cited as reasons for the known extinctions. For instance, Maine lost populations of bluebacks in the Rangeley Lakes area when introductions of landlocked Atlantic salmon (Salmo salar) and rainbow smelt (Osmerus mordax) hastened the demise of the already exploited charr populations.

Maine anglers, in general, have little interest in Arctic charr due to the fish's lack of sporting qualities and their sparse distribution. Maine anglers prefer other larger, more sporting gamefish that are often more accessible. In Maine, arctic charr rarely exceed 16 inches in length, although extirpated populations in the Rangley Lakes reportedly had large individual fish. The largest silver charr recorded in Maine was 24 inches and 5 pounds in weight. The fish was observed at Floods Pond. Blueback charr are much smaller, usually less than 10 inches in length, although illegal introductions of forage fish, such as rainbow smelt, have resulted in some cases of increased growth rate. Overall, the small size of charr, the difficulty in catching fish in deep water on light tackle, and the remoteness of charr populations call contribute to the lack of interest in the species on the part of Maine anglers.

The most endearing angling quality of arctic charr in Maine is the opportunity to catch a sometimes highly colored, native, and very uncommon fish in remote environments. Nine of fourteen lakes where arctic charr occur support principal sport fisheries for the species. However, it is likely that some of these fisheries are incidental to fisheries for brook trout. The few anglers that seek arctic charr fish in remote environments. The possibility of catching one of Maine's most uncommon fish enhances this rare opportunity.

Sport fishery regulation of charr waters in Maine has been very conservative with the objectives of limiting harvest and preventing the introduction of new species. All charr waters are closed to winter (ice) angling, and one water has no open season for any species (Floods Pond, Hancock County) to protect a municipal water supply. Length and daily bag limits are conservative and since anglers release most of the legal-size fish caught, over-harvest is not presently a major concern. Most waters are managed with 8 or 10 inch minimum lengths with various 1-over limits; bag limits on all principal fisheries waters are 2 trout including brook trout. All waters are restricted to no-live-fish-as-bait or artificial-lures-only (ALO) to prevent the introduction of new fishes and minimize hooking mortality.

PAST MANAGEMENT GOALS

Management goals and objectives for landlocked Arctic charr in Maine as established in 1986 focused on preserving existing populations, expanding the range of the Floods Pond silver charr, and provide for minimal opportunity to meet demand for angling such an uncommon fish. Catch rate and fish size objectives have never been developed for arctic charr in Maine; instead management has focused on maximizing population size and sustainability. Past goals and objectives distinguished between the Floods Pond Sunapee charr, now termed silver charr, and the blueback charr. However, recent genetic work indicated that all 12 charr populations in Maine originated from the same lineage. Moreover, the same study confirmed that each population represents a unique gene pool where restricted gene flow and other evolutionary forces have acted to enhance the genetic divergence of these populations. These new insights on these rare fish warrant, more than ever, the importance of continued protection for each population.

Management goal (1985):

To maintain a minimum of self-sustaining populations sufficient to ensure the survival of the species, while affording a minimum amount of angling opportunity for those anglers seeking an unusual species of fish.

Management objective (1985):

Maintain the viability of the present ten-blueback trout populations and complete the life history of the species, preserve the Floods Pond Sunapee trout population and establish five additional self-sustaining Sunapee trout populations.

Attainment of goals and objectives:

None of the twelve relic Arctic charr populations have become extinct during the past 15 years. Status of several of the introduced populations from Floods Pond is in question. Some introductions are known failures; others resulted in some reproduction initially but may now be experiencing high mortality; and at least one was successful (Enchanted Pond). All of the waters have conservative fishery regulations in place to prevent introduction of new species and limit harvest.

All of the waters have good habitat protection in the form of state or private (e.g., The Nature Conservancy) ownership. Introduction of species through illegal means may be the most imminent threat. At least two illegal or accidental introductions of predator/competitor species have occurred since 1990.

OPPORTUNITY

Fourteen lakes in Maine comprising 9,382 surface acres support Arctic charr (Table 1). Twelve populations are endemic or relic, whereas two populations are the result of transfers of the silver charr from Floods Pond. Nine waters are considered principal fisheries (4,003 surface acres), where anglers actively seek charr with a reasonable expectation of catching one. Stocking is no longer being used, since range expansion of the species has concluded.

Statewide opportunity is low (Table 2). Eleven of our charr populations occur in the northern, interior region of Maine (Fishery Regions D, E, and G; Figures 1 and 2). Region C has two populations and Region F has one population (Table 2). Region C has the most total surface acres at 3,643 followed by Region E with 3,313 acres and Region G with 842 acres.

DEMAND

Angling use estimates have not been made on any charr waters. However, it is likely that angling use of Maine's Arctic charr resource is low compared to lakes with other cold-water sportfish. All charr waters are closed to ice fishing, and the remoteness of most waters during the open water season results in low use by anglers.

FISHING QUALITY

Available creel survey data for Maine charr waters indicate charr are caught at very low rates (Table 3). However, these data are limited in scope as only nine surveys were reported on six waters. Data obtained from voluntary records from fishing diaries resulted in an angler catch rate of 0.034-0.036 fish per hour (28.6 hours per legal fish).

Clerk survey records (collected through interviews by a biologist) for three waters in Region G in 1997 had charr catch rates that were barely detectable (Table 3). Anglers reported one charr kept at these three waters in 461 hours of fishing. In contrast, anglers reported catching three-hundred-sixty-two (362) legal brook. If charr were being misidentified as brook trout by anglers, then actual charr catch rates may have been higher than indicated.

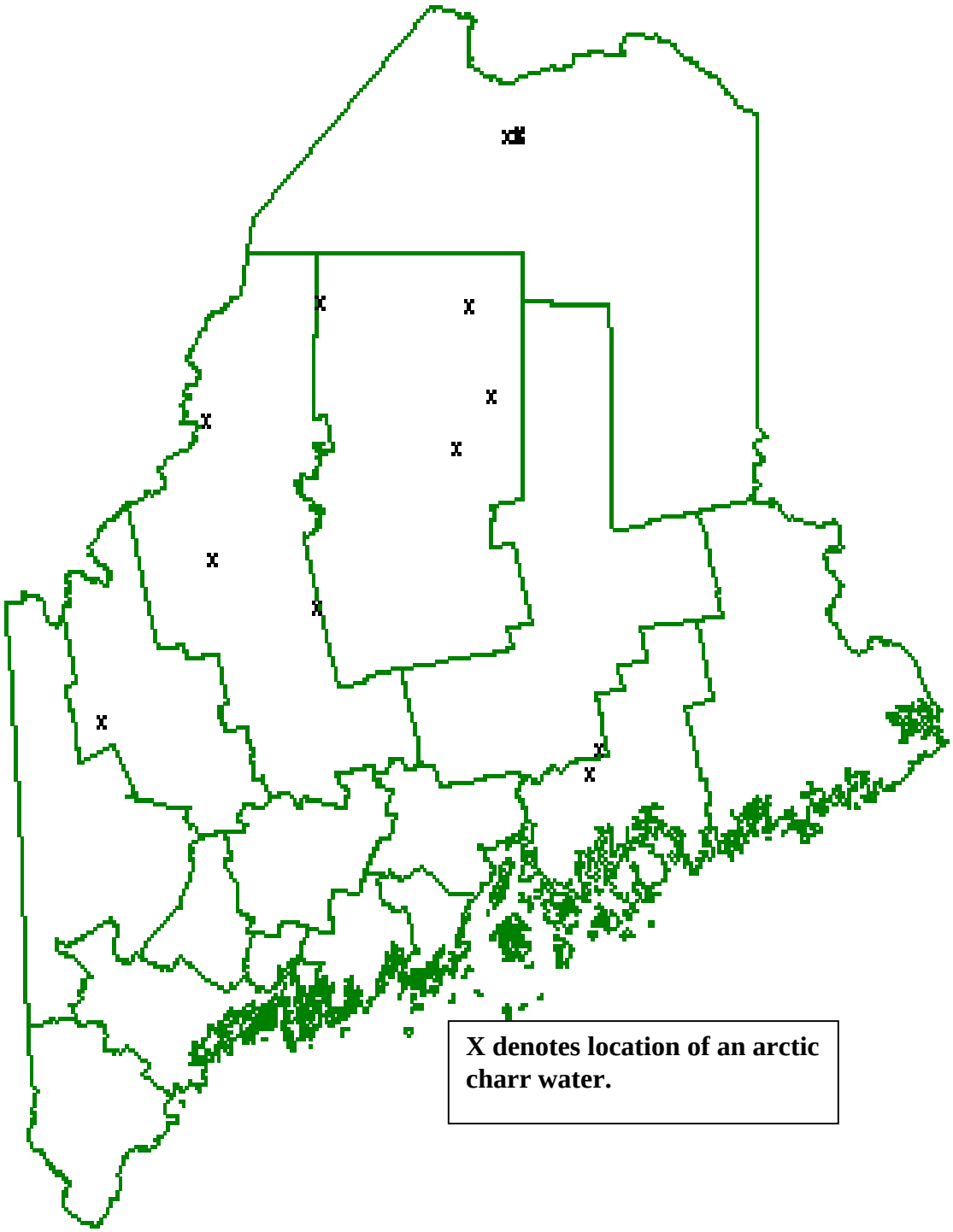

FIGURE 1. THE DISTRIBUTION OF ARCTIC CHARR IN MAINE YEAR 2000 UPDATE

Table 1. Occurrence of Arctic Charr in Maine

COUNTY	LAKE	TOWN	ACRES	ABUNDANCE
Aroostook	Black L	T15R9 WELS	147	High
	Deboullie L	T15R9 WELS	262	Moderate
	Gardner L	T15R9 WELS	288	Moderate
	Pushineer P	T15R9 WELS	55	low
Franklin	Long P [1]	Township E	254	High
Hancock	Floods P	Otis	654	High
	Green L	Dedham	2,989	Low
Piscataquis	Rainbow L	Rainbow Twp	1,664	Moderate
	Reed P (Big)	T8R10	90	Moderate
	Wadleigh P	T8R15	157	High
	Wassataquoik L	T4R10	178	High
Somerset	Bald Mountain P	T2R3	1,152	High
	Enchanted P [1]	Upper Enchanted TWP	330	v. low
	Penobscot L	Dole Brook TWP	1,162	High
TOTAL			**9,382**	

[1] Population introduced from Floods Pond, Otis

Table 2. Occurrence and Principal Sport Fisheries of Arctic Charr in Maine by Administrative Region

REGION	TOTAL OCCURRENCE		PRINCIPAL FISHERIES	
	NUMBER OF LAKES	ACRES OF LAKES	NUMBER OF LAKES	ACRES OF LAKES
C	2	3,643	0	0
D	2	1,406	0	0
E	4	3,313	3	2,983
F	1	178	1	178
G	5	842	5	842
STATE	**14**	**9,382**	**9**	**4,003**

Table 3. Available Catch and Harvest Data (Per Hour) for Arctic Charr at Maine Lakes by Administrative Region. Data are Separated by Voluntary and Clerk Methods of Collection. Values are Weighted Means of Means Obtained From Regional Creel Surveys. N is Number of Surveys and SE is Standard Error of the Weighted Means.

REGION	N	CATCH RATE		HARVEST RATE	
		MEAN	SE	MEAN	SE
VOLUNTARY SURVEYS					
E	5	0.036	0.011	0.013	0.0073
G	1	0.034		0.0034	
CLERK SURVEYS					
G	3	0.00088	0.0000023	0.00088	0.0000023

ARCTIC CHARR GOALS AND OBJECTIVES
2001-2016

STATEWIDE GOAL

Maintain all existing populations of Arctic charr to ensure survival of the species in Maine while providing for a minimum amount of angling opportunity for anglers seeking a rare fish species.

STATEWIDE OBJECTIVES

1) Maintain self-sustaining charr populations in the current 14 lakes.
2) Maintain the genetic integrity of Arctic charr in Maine.

Capability: Arctic charr habitat in Maine can sustain the current level of abundance throughout the 2001-2016 planning period. The statewide goal should be achieved unless a significant habitat perturbation occurs that would alter water quality, the physical habitat upon which a charr life stage depends, or the species assemblage. Subtle habitat changes (positive or negative) might also influence the long-term viability of populations. Land-use patterns within the watershed, including forest management and shoreline development, might alter the water quality of charr habitat. Present arctic charr habitat is confined to headwater lakes of major watersheds, and thus may be less prone to cumulative impacts of habitat degradation.

Feasibility: Maintaining populations of Arctic charr in Maine is feasible with proper enforcement of environmental regulations and adherence to existing fishery regulations. Conserving many aspects of Arctic charr habitat, including water quality, physical habitat, and species presence, will be crucial in ensuring viable populations during the next planning period. Where possible sensitive land areas within Arctic charr watersheds should be protected through purchase or easement to maintain habitat. Priority status should be given those waters known to harbor relic populations of charr (12).

Regulation of Arctic charr waters have been relatively conservative with the past goals of maintaining the endemic charr populations and establishing additional populations with the Floods Pond genotype. Fishery regulations on all Arctic charr waters are intended to limit harvest, to minimize hooking mortality, and to prevent accidental or unauthorized introductions of new fish species. However, establishment of new species that are potential competitors or predators with Arctic charr remains a serious threat to charr populations. Fishery regulations, including the regulation of access, may need to be modified further to achieve the stated goal through the next planning period.

Desirability: Achieving the stated goal and objectives through the next planning period is desirable because Arctic charr represent a unique genetic and recreational resource in Maine and throughout the fish's overall distribution. Recent genetic work indicates that each population is different, representing unique gene pools that are worthy of individual protection. Compromising a single population would be equivalent to an irretrievable loss of genetic material. Although relatively few Maine anglers utilize the resource, angling for Arctic charr is an extremely unique opportunity that substantially contributes to the angling diversity available in Maine.

POSSIBLE CONSEQUENCES

Achieving the goal and objectives for the planning period 2001-2016 will require strict adherence to laws, rules, regulations, and policies designed to protect aquatic habitat, which includes the introduction of new species of fish. Disallowing introductions of new species eliminates the potential for providing new, and possibly better, sport fisheries for other fishes at Arctic charr waters. In the event that new information on the life history and habitat requirements of a population become available or significant threats to a population become identified that might endanger the existence of a population, the laws, rules, regulations, or policies may need to be modified to achieve the stated goal and objectives. These changes might impact access to Arctic charr fisheries or traditional regulation of sport fisheries for sympatric species of salmonid or nonsalmonid fishes.

ARCTIC CHARR
MANAGEMENT PROBLEMS AND STRATEGIES

FINANCIAL ISSUES:

PROBLEM 1. Existing staff and financial resources are inadequate to fully accomplish the goal and objectives of the charr management plan.

Strategy a. Seek financial and personnel assistance from non-governmental organizations, private individuals, and educational institutions to support the study of Arctic charr in Maine.

HABITAT PROTECTION AND ENHANCEMENT:

PROBLEM 1. Cumulative impacts of watershed uses including silviculture, road building, shoreline development, and other sources of non-point source pollution could impact the physical and chemical quality of charr habitat and therefore reduce the productivity of a population.

Strategy a. Encourage and facilitate the enforcement of environmental laws where violations are observed.

Strategy b. Support the modification of environmental laws that would enhance the protection of a population at risk due to environmental degradation.

POPULATION AND MANAGEMENT INFORMATION:

PROBLEM 1. Current knowledge of the life history and life cycle requirements of Arctic charr in Maine is insufficient to provide maximum protection for this species

Strategy a. Continue to collect information on Arctic charr populations to improve our understanding of charr life history and to provide pertinent information for management and protection.

FISHERY RESOURCE PROTECTION AND ENHANCEMENT:

PROBLEM 1. The establishment of exotic fish species increases the likelihood of eliminating a charr population through competition, predation, or other biological interactions.

Strategy a. Continue regular evaluation of the status of charr populations and monitoring of the fish assemblages in charr waters for the occurrence of new fish species.

Strategy b. Utilize the rule-making procedure to enact fishery regulations to extirpate or minimize the impact of new species whose presence threatens the existence of any charr population.

Strategy c. Utilize the Department's public information resources to educate the public on the potential loss of native fish and fisheries that may result with the unauthorized introduction of new fish species.

APPENDIX A

COLDWATER WORKING GROUP INPUT

CHARR MEETING SUMMARY

13December2001

Jeff's Catering, Brewer

Issues:

- ✓ Introduction of illegal species.
- ✓ Preservation of genetic stocks.

Goals:

I. Maintain existing populations of this species in Maine.

Objectives:

A. Maintain self-sustaining charr populations in 14 lakes.

B. Maintain the genetic integrity of Maine's charr populations.

SUMMARY

CW-Working Group Meeting
12March2002

General

1. Presentation of Burbot Goals and Objectives and DIFW "review". No substantive comments.
2. Presentation of Arctic charr Goals and Objectives and DIFW "review". No substantive comments.
3. Presentation of Whitefish Goals and Objectives and DIFW "review". Although the basic premise of the whitefish goals and objectives were acceptable to the group, two significant suggestions for substantive changes were made:
   - **a.** Provisions should be made to allow for expansion of the range of lake whitefish into new waters, where fisheries heretofore did not occur. This goal should be secondary to the primary goals of maintaining principal fisheries in areas where they now occur and restoring/ rehabilitating populations that formerly supported principal fisheries for lake whitefish.
   - **b.** It has been suggested that since this species is in decline, consequently achieving the **PRIMARY** goals of the whitefish plan should be a high priority in the Department's strategic management plan for fisheries.

PRIORITIZED ARCTIC CHARR MANAGEMENT OBJECTIVES

DESCRIPTION OF STATEWIDE OBJECTIVES	COLDWATER GROUP RANKINGS
Maintain self-sustaining populations in 14 lakes.	2
Maintain the genetic integrity of Arctic charr in Maine.	1

PRIORITIZED ARCTIC CHARR MANAGEMENT PROBLEMS

DESCRIPTION OF MANAGEMENT PROBLEMS	FISHERIES	COLDWATER GROUP	FINAL RANKING
The establishment of exotic fish species increases the likelihood of eliminating a charr population through competition, predation, or other biological interactions.	1	1	1
Cumulative impacts of watershed uses including silviculture, road building, shoreline development, and other sources of non-point source pollution could impact the physical and chemical quality of charr habitat and therefore reduce the productivity of a population.	3	2	2
Current knowledge of the life history and life cycle requirements of Arctic charr in Maine is insufficient to provide maximum protection for this species	4	3	3
The DIFW lacks sufficient fisheries staff and financial resources to fully accomplish the goals of the charr management plan.	2	4	4

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

PRIORITIZED ARCTIC CHARR 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**
Maintain the genetic integrity of Arctic charr in Maine.	**1**	0	0	0	0	0	0	2	2	0	2	2	0	4	4	0	1	1	0	5	5	0	14	14	0
Maintain self-sustaining populations in 14 lakes.	**2**	0	0	0	0	0	0	2	2	0	2	2	0	4	4	0	1	1	0	5	5	0	14	14	0

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