By Certified Mail

February 22, 2006

IN THE OFFICE OF ENDANGERED SPECIES

U.S. FISH AND WILDLIFE SERVICE

UNITED STATES DEPARTMENT OF THE INTERIOR

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Petition for a Rule to List the anadromous Coaster Brook Trout (*Salvelinus fontinalis)* under the Endangered Species Act, 16 U.S.C. Sec. 1531 *et seq*. (1973) as Amended and

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PETITIONERS

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PETITION FOR THE LISTING OF THE COASTER BROOK TROUT

AS AN ENDANGERED SPECIES

The Sierra Club Mackinac Chapter, the Huron Mountain Club, and Marvin J. Roberson, Jr. hereby petition to list as "endangered" the naturally spawning anadromous (lake-run) Coaster Brook Trout (*Salvelinus fontinalis*) throughout its known historic range in the conterminous United States, and to designate "critical habitat" under the Endangered Species Act, 16 U.S.C. section 1531-1543 (1982) (ESA). This petition is filed under 5 U.S.C. section 553 (e), 16 U.S.C. section 1533 (b)(3)(A) and 50 C.F.R. section 424.19 (1987) which give interested persons the right to petition for issuance of a rule. The United States Fish and Wildlife Service (FWS) has jurisdiction over this petition under 16 U.S.C. section 1533 (a) of the Endangered Species Act of 1973.

I. Endangered Species Act Implementing Regulations

Several sections of the regulations implementing the Endangered Species Act (50 C.F.R.) are applicable to this petition. Those concerning the listing of the Coaster Brook Trout as an endangered species are:

> 424.02(e) "Endangered species" means a species that is in danger of extinction throughout all or a significant portion of its range." (k) "species" includes any species or subspecies that interbreeds when mature."
>
> 424.11(c) "A species shall be listed . . . because of any one or a combination of the following factors:

1. The present or threatened destruction, modification, or curtailment of habitat or range;
2. Over utilization for commercial, recreational, scientific, or educational purposes;
3. Disease or predation;
4. The inadequacy of existing regulatory mechanisms; and
5. Other natural or manmade factors affecting its continued existence."

All five of the factors set out in section 424.11(c) are applicable to the Coaster Brook Trout.

Sections relevant to the designation of critical habitat are:

424.12(a)(2) "Critical habitat is not determined when one or both of the following situations exist: . . . (ii) The biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat."

424.12 (b) "In determining what areas are critical habitat, the Secretary shall consider those physical and biological features that are essential to the conservation of a given species and that may require special management considerations or protection. Such requirements include, but are not limited to the following: (1) Space for individual and population growth, and for normal behavior; (2) Food, water, air, light, minerals, or other nutritional or physiological requirements; (3) Cover or shelter; (4) Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally (5) Habitats that are protected from disturbances or are representative of the historic, geographical, and ecological distributions of a species."

424.14(d) "Petitions to designate critical habitat. . . . Upon receiving a petition to designate critical habitat . . . to provide for the conservation of a species, the Secretary shall promptly conduct a review in accordance with the Administrative Procedures Act (5 U.S.C. 553) and applicable Department regulations, and take appropriate action."

This petition documents the need for the designation of critical habitat to provide for the conservation of the Coaster Brook Trout.

Based on the documentation provided below, the provisions of 50 C.F.R. compel the expeditious listing of the Coaster Brook trout as "endangered" throughout its known historic range, and a review and appropriate action to designate "critical habitat" for the species.

II. Petitioners

The Sierra Club is an organization whose mission is to explore, enjoy and protect the wild places of the earth; to practice and promote the responsible use of the earth's ecosystems and resources; to educate and enlist humanity to protect and restore the quality of the natural and the human environment. The Sierra Club was created in 1892 and has over 500,000 members nationally and 18,000 members in Michigan.

The Huron Mountain Club is a Michigan Not-for-profit corporation founded in 1889 as a family retreat and wildlife preserve. The Preamble to the Huron Mountain Club's by laws provide:

By its Articles of Incorporation the Huron Mountain Club was created "for hunting and fishing, and for affording its members opportunities for healthy recreation." Sustained by the lasting ties of family, friendship and love of nature, the Club has for more than a century fulfilled those purposes well. Over the years, and as its old-growth forest has become more and more rare, the Club has also given its members a strong sense of the special value of the unspoiled forests and waters that our forebears so wisely preserved. By the terms of these Bylaws we in our turn commit to study and protect these forests and their wildlife for science and for the benefit and enjoyment of future generations.

The Huron Mountain Club owns the entire reach of the only river on the South Shore of Lake Superior used by breeding Coasters, the Salmon Trout River. As the owner of the land surrounding the Salmon Trout River, the Huron Mountain Club has been the primary conservator of this critical Coaster Brook Trout habitat for over a century. In recent decades, during which the Salmon Trout River Coaster population has been observed to decline, the Huron Mountain Club has taken several additional steps for the benefit of the Coaster, including funding and encouraging research on the species and habitat, with a long-term goal of enhancing the population by reducing competition with exotic salmonids, as well as urging the State of Michigan to close fishing on the Salmon Trout River during the season when Coasters are in the river.

Marvin Roberson is a permanent resident of the Upper Peninsula of Michigan, a lifelong conservationist, an avid trout fisherman, and visitor to the Salmon Trout River.

III. Present Legal Status of the Coaster Brook Trout

A. Classification Under the Endangered Species Act

Although the Coaster Brook Trout is not listed as “threatened” or “endangered” under the Endangered Species Act, the federal government has recognized for decades that the survival of the species in the wild is highly uncertain. The U.S. Fish and Wildlife Service has a team at the Ashland, WI office dedicated to the survival of the species, and the retired leader of this team has indicated that the species has been deserving of Endangered status for decades (Lee Newman, personal communication, 2003). The USFWS has a “Brook Trout Rehabilitation Plan for Lake

Superior documenting this status (Newman, Du Bois, Halpern, 2003). This plan recognizes resident, breeding populations in only a single river in the US outside of Isle Royale.

The State of Michigan has parallel programs and recognitions, also describing the Coaster Brook Trout as having been the dominant anadromous species in Lake Superior prior to the mid-nineteenth century, and also recognizing only the Salmon Trout as containing a resident, breeding population. In addition, the State of Michigan Department Of Natural Resources has sponsored a number of attempts to reintroduce Coasters to Lake Superior streams.

B. Relevant Laws and Conventions

There are several international and national conventions and laws that are important to the management of the Coaster Brook Trout. These include:

1. International

- Fishery Conservation and Management Act of 1976,

2. National

- Endangered Species Act,
- Fish and Wildlife Act of 1956,
- Anadromous Fish Conservation Act,
- Fish and Wildlife Coordination Act,
- Federal Power Act,
- Federal Water Pollution Control Act Amendments of 1972,
- National Environmental Policy Act of 1969,

C. Major Restoration Programs and Authorities

The U.S. Fish and Wildlife Service has identified the following governmental agencies as participating directly, under various interagency cooperative agreements, in the Lake Superior Coaster Brook Trout programs:

- Michigan Department of Natural Resources
- Minnesota Department of Natural Resources

- Wisconsin Department of Natural Resources
- Great Lakes Indian Fish and Wildlife Commission
- Keweenaw Bay Indian Community
- Bay Mills Indian Community
- Bad River Band of Lake Superior Chippewa
- Red Cliffs Band of Lake Superior Chippewa
- U.S. Fish and Wildlife Service
- U.S. Park Service

D. Major Programmatic Documents

Coaster Brook Trout restoration policies and activities are directed by a number of documents. These include:

- *A Brook Trout Rehabilitation plan for Lake Superior(USFWS)*
- *Ottawa National Forest Final Environmental Impact Statement*
- *Hiawatha National Forest Final Environmental Impact Statement*

- *Isle Royale National Forest General Management Plan Final Environmental Impact Statement*

- *Pictured Rocks National Lakeshore General Management Plan Final Environmental Impact Statement,*

- *Michigan Department of Natural Resources Coaster Brook Trout Restoration Plan,*

- *Bay Mills Indian Community Coaster Brook Trout Rehabilitation Grant Plan*

IV. Description of Species

General Description

Brook trout are widely distributed throughout northeastern North America in clean, well-oxygenated rivers, streams, and lakes having maximum water temperatures less than about 20^{o} C. They are relatively short-lived, at least in those populations that have been well studied, with few individuals surviving beyond 5 years of age (Naiman et al. 1987; Bullen 1988). The maximum size is about 5 kg, but average sizes are much smaller especially in heavily exploited parts of their range. Although most salmonids have populations that are to some extent anadromous, species differ greatly in their degree of anadromy, or the extent to which they exhibit anadromous traits (Rounsefell 1958). Strongly anadromous salmonids (obligatory anadromy) tend to have an extended period of residence in the sea, engage in oceanic migrations for great distances from their natal rivers, attain an advanced state of maturity at sea, invest sufficient energy in reproduction that they survive to spawn only once (semelparous), and have limited occurrences of freshwater forms.

By contrast, less strongly anadromous salmonids (optional anadromy) are characterized by a tendency to have short periods of residence in the sea, remain in coastal or estuarine areas often close to natal streams, mature in freshwater, survive to spawn more than once (iteroparous), and have frequent occurrences of freshwater forms. Among salmonine genera, *Oncorhynchus* exhibits anadromous traits most strongly, *Salmo* is intermediate, and *Salvelinus* is least strongly anadromous. Throughout their range, brook trout typically exhibit either exclusive freshwater stream residence or only weakly anadromous traits. Brook trout are, however, known to undergo migrations from coastal habitats into tributary rivers and streams for reproduction, feeding or refuge (Northcoate 1997) and the Coaster Brook Trout appears to be an exceptional instance of this, having evolved a life history that involves spending most of its adult life in Lake Superior, returning to natal streams primarily to spawn.

Coaster brook trout were greatly reduced or eliminated from most areas of Lake Superior before scientific data about their populations could be collected. Although some reduced or remnant populations still exist in the Nipigon River system and other north shore areas of the lake, in the vicinity of Isle Royale, and perhaps in other isolated locations, these populations may either not be representative of most of the historic Lake Superior stocks or may be so reduced as to no longer exhibit traits typical of healthy populations. Additionally, the healthier populations appear to persist in remote and inaccessible areas and are therefore difficult to study. To understand the life history of the Lake Superior coaster, we must therefore collect and summarize as much information as possible from extant but reduced populations while also reconstructing their probable population characteristics from themes common to anadromous brook trout throughout their range.

Reproduction

Brook trout spawn in late summer or autumn in freshwater streams. They mature over a wide range of ages and sizes with a greater proportion of males than females maturing at small sizes; size is a more important determinant of maturation than either age or growth rate (Naiman et al. 1987). Anadromous populations mature at a later age than nonanadromous populations, often not reaching maturity until their third summer (White 194; Dutil and Power 1980; Castonguary et al. 1982). Maturation of the gonads, which is dictated by photoperiod, occurs throughout the summer months. Timing of final maturation varies regionally with some populations spawning as late as December. Anadromous brook trout generally exhibit final gonad development upon their return to natal streams (Power 1980).

Anadromous brook trout are flexible in choosing spawning sites with lower river and river mouth areas (White 1940; Vladykov 1942; Slade 1994) and near shore lacustrine and estuarine settings (Scott and Crossman 1973; Weed 1934) often being used where suitable conditions exist. Specific conditions required for redd locations include loose, silt-free gravel or coarse sand over strong groundwater seepage. Thermal stability seems to be a key factor in the use of spring seeps as redd sites. Water temperatures falling from the 40's to the 30's (degrees Fahrenheit) typically trigger spawning activity. Anadromous brook trout usually spawn each year once maturity is reached (Naiman et al. 1987).

Fecundity of anadromous brook trout is size-dependent and varies only slightly among stocks. However, fecundity of anadromous stocks is greater than that of nonanadromous stocks to an extent beyond that predicted from simple increases in body size (Naiman et al. 1987). Egg counts ranged from 444 to 1,857 per female for Ungava stocks (Power 1966); the Koksoak River, Quebec, stock seemed to increase fecundity with increasing fish size more rapidly than other stocks (Naiman et al. 1987). For the anadromous population in Riviere a la Truite, Quebec, egg numbers ranged from 138 to 2,305 per female (Montgomery et al. 1990). Female, Lake Nipigon strain brook trout broodstock at the Dorion, Ontario hatchery produce about 1,500 eggs per kg. of bodyweight.

Hatching is temperature and oxygen dependent. Time required for hatching ranges from 100 days at 5 C to about 50 days at 10 C (Scott and Crossman 1973). The upper lethal temperature limit for egg survival is 11.7 C (Scott and Crossman 1973). Upon hatching, alevins remain in the redd until the yolk sac is nearly fully absorbed. Emergence from the redds usually occurs in March, but may be earlier or later depending on latitude. Despite extensive observations, Naiman et al. (1987) were not able to detect any significant differences in choice of spawning sites, reproductive behavior, fertility, early ontogeny, or early life history between anadromous and nonanadromous stocks.

Feeding

Brook trout are carnivorous, opportunistic feeders on a wide variety of organisms depending on their size and the availability of prey. Feeding behaviors of anadromous brook trout vary greatly from young to mature fish and riverine to sea or lacustrine environments. In rivers, the newly emerged young feed on Copepoda and Cladocera and soon add Diptera (mainly chironomids and simuliids), terrestrial insects, and the larvae of Trichoptera, Ephemeroptera, and

Plecoptera to the diet during their first summer of life (White 1940; Bridges 1958; Miller 1974; Williams 1981). As they grow, aquatic insect larvae and terrestrial insects continue to form the dominant foods, but small fish become increasingly important in the diet as the growing brook trout reach 8 to 12 inches in length (Bridges 1958; Verreault and Courtois 1989; Montgomery et al. 1990). Annelids, crustaceans and mollusks are also occasionally eaten (Brasch et al. 1982; Verreault and Courtois 1989). Larger fish will occasionally take larger prey such as frogs and mice (Scott and Crossman 1973). Food choices in freshwater lakes are similar to those in rivers, with chironomids, gastropods, amphipods, coleopterans, cladocerans, ephemeropterans, trichopterans, and fish forming the major components of the diet (Power 1966). Brook trout are voracious feeders, leading Scott and Crossman (1973) to comment that the list of organisms eaten is astonishing and suggestive that they will eat anything their mouths can accommodate.

The only existing data on Coaster Brook trout diet in Lake Superior was gathered by Conner et al between 1981 and 1987 (Connor, et al 1993), Miller (1968, MI DNR, unpublished data) examined the stomachs of a small sample of hatchery brook trout that had been planted in Keweenaw Bay, Michigan. He found that isopods, amphipods, gastropods, a variety of aquatic insects (mostly Diptera), and fish (primarily sticklebacks, (*Gasterosteidae)*and sculpins (*Cottus*)) were the dominant food items. Coaster brook trout in Lake Superior likely fed opportunistically on whatever small fish species and arthropods that are available in near shore areas.

Significant qualitative and quantitative changes in the forage base of near shore waters have occurred since the late 1800's (MacCallum and Selgeby 1987; Hansen 1994) when coasters were last abundant in Lake Superior. There is also now a much more diverse predator complex exerting pressure on available forage. However, these predators appear to be less strongly tied to near shore areas than are coasters, which may minimize the severity of direct competition for food in the lake.

Movements

The movement pattern characteristic of anadromous salmonines includes hatching and rearing of young in natal streams, migration from these streams as smolts at ages that vary among species down to a large lake or the sea (functionally equivalent habitats), movements during the growth phase in the sea that are usually unknown or poorly described for most species, and return to the natal streams for spawning by mature adults. There is virtually nothing known about the movements of anadromous brook trout in Lake Superior beyond the assumption that they generally fit into the above model. For sea-run populations that have been studied, downstream migration was characterized by the sudden movement, usually during spring, of primarily 2 to 4-year-old. These fish then maintained a coastal sea residence for just 1-5 months before returning to the natal stream (White 1940; Wilder 1952; Dutil and Power 1980; Castonguay et al. 1982; Montgomery et al. 1990). A variety of environmental cues for movement have been suggested including temperature, spring flooding, lunar cycles, tides and migrations by other species (Naiman et al 1987; Montgomery et al. 1983), but rises in river discharge appear to trigger most movements (White 1940; Montgomery et al. 1990). Anadromous populations of brook trout often live sympatrically with resident forms (Randall et al. 1987). It is not clear how and to what extent these life history differences between forms are influenced by genetics, the environment, and chance.

Sea-run brook trout usually made relatively short upriver migrations during late summer or autumn. Maximum distances traveled to spawning areas were between 30 and 50 km in the Moisie and St. Jean Rivers (MacGregor 1973; Castonguay et al. 1982).

Movements within the ocean were quite limited for sea-run stocks; fish either remained in estuaries or in near shore areas within 10 miles of their natal rivers (White 1942; Smith and Saunders 1958; Dutil and Power 1980; Naiman et al. 1987). Straying to non-natal streams for short periods occurred (White 1942; Castonguay et al. 1982), but extensive straying was unusual (Gibson and Whoriskey 1980; Whoriskey et al. 1981; Naiman et al. 1987).

Age and Growth

Personnel of the Michigan Department of Natural Resources (MIDNR) and U.S. Fish and Wildlife Service (Ashland, Wisconsin, Fishery Resources Office) have determined growth rates for coaster brook trout at Isle Royale by scale age and back calculation of length-at-age. Mean lengths at each annulus were 112-113 mm at age I, 213-215 mm at age II, and 336-366 mm at age III. Growth rates appear to vary widely depending on the portion of life spent in the lake versus the stream.

Coaster brook trout of the Nipigon River, Ontario, have an unusually long life span. Spawners of ages III to V are common, and occasional trophy-size individuals may attain ages of VIII years. Nipigon River coasters reach sexual maturity at age III, when first-time spawning males average 401 mm and females average 457 mm (R. Swainson, OMNR, Nipigon, pers. commun.). Most of the spawning adults range from 1 to 2 kg, with an average of about 1.5 kg. The largest individuals may reach a weight of 4 kg.

In contrast to this age and maturation pattern in coasters, Becker (1983) describes inland populations: "*In Wisconsin, brook trout mature early in life. At Lawrence Creek, 5% of the males are mature at the end of the first summer of life; the smallest mature fish are about 89 mm (3.5in) long. Most females (about 80%) mature as yearlings, at minimum lengths of about 127 mm (5in).*"

Size Structure

Historical evidence suggests that coasters along the south shore of Lake Superior were smaller than those along the north shore of the lake. According to Shiras (1935), "the largest speckled trout taken on the south shore of Lake Superior prior to 1890 weighed 5.25 pounds; a much larger number varied from four to five pounds; and the minimum weight was about a pound." He went on to say that the immature trout do not enter the lake from the breeding streams (i.e. smolted) until they weigh about a pound. Shiras (1935) added that since 1900 speckled trout have been taken on the south shore that weighed more than 6.5 pounds. He attributed this increased weight to the decreased number of trout in relation to the food supply. Lanman (1847) described the weight of Lake Superior coasters as "varying from 10 to 40 ounces", but later mentions catching "boat-loads" of them at certain times that "averaged from three to four pounds in weight". Roosevelt (1865) stated that Lake Superior coasters averaged more than two pounds, but added significantly that those on the southern shore averaged a pound while those along the northern (Canadian) shore averaged fully two pounds in weight. Additionally, several articles from the *Bayfield County Press* from 1877 to 1880 indicate a size structure near Bayfield, Wisconsin, that ranged from one half pound to four pounds ten ounces and probably averaged well under 2 pounds. Any size differences that may have occurred between north shore and south shore areas of the lake could have been due to unique growth characteristics of genetically separate strains, to size selective commercial netting along the south shore, or to greater angling pressure along the more accessible south shore that led to a reduced size structure.

Shiras' (1935) statement that smolts weighed about a pound is at odds with all other available information on anadromous brook trout smolts. Smolts from populations that have been well studied out-migrated at an average size less than 8 inches in total length (less than one half pound), which is more typical of other anadromous salmonids (Wilder 1952; Dutil and Power 1980; Castonguay et al. 1982; Montgomery et al. 1990).

The ongoing study of Salmon Trout Coasters has observed the following total numbers of "large" (300 mm. or more, total length) upstream migrants

Total Number of Large Upstream Brook Trout Migrants Observed, Salmon Trout River, 2000-2004	
	≥ 300 mm TL
2000	**161**
2001	**93**
2002	**65**
2003	**18**
2004	**118**

These figures understate the total spawning population, because in each year the traps used to capture migrating fish were inoperable, due to various factors, for at least part of the spawning season. This is particularly true of the 2003 count, because the traps were dismantled for a substantial portion of that year's spawning season. The size of the fish observed in 2004 is based on visual estimates. The data do indicate, however, that the annual spawning population is likely less than 200 individuals, which contrasts dramatically with early 20th century accounts of small fishing parties catching 100 fish in only a day or two.

Community Ecology

There is some direct evidence to indicate that Lake Superior coasters can coexist with exotic salmonines. In the Nipigon River, Ontario, coasters spawn successfully near coho salmon (*Oncorhynchus kisutch*), chinook salmon (*O. tshawytscha*), pink salmon (*O. gorbuscha*), rainbow trout, and brown trout, as well as adjacent to their native congener the lake trout (R. Swainson, OMNR, Nipigon, pers. commun.). Smaller streams in Ontario such as the Cypress, Gravel, and Little Gravel Rivers also have a suite of naturalized salmonines coexisting with coasters. Additionally, an unpublished set of stream salmonine population data of two-decades duration from Wisconsin tributaries to Lake Superior suggests that the recent (1970's) establishment of coho salmon in those streams has not measurably affected existing stream-resident brook trout populations (B. Swanson, WI DNR, Bayfield, pers. commun.).

However, some data pertaining to stream-resident brook trout exist that suggest that negative effects on coaster brook trout from competition with exotic salmonines are possible, at least during the riverine stage of their life history. Rose (1986) documented a growth reduction of sub-yearling brook trout in a Lake Superior tributary following emergence of rainbow trout in June. He suggested that such growth reductions could result from interspecific competition for food and space and that they may represent a mechanism by which brook trout could be excluded by rainbow trout from some areas. An historical anecdote by Shiras (1935) suggested that the introduction of rainbow trout may influence the survivorship of native brook trout in Lake Superior. This was the first recorded indication of interspecific competition involving coaster brook trout in Lake Superior.

Juvenile coho salmon may be the most serious competitive threat to brook trout in Lake Superior tributaries because of similar habitat preferences of the two species and the earlier emergence (2 - 3 weeks) and larger size at emergence of coho salmon (Fausch and White 1986). Moreover, in a laboratory study, Fausch and White (1986) found that coho salmon dominated brook trout of equal size and remarked that coho salmon should have an advantage over brook trout in Great Lakes tributaries when resources become limiting. Stauffer (1977) also reported data suggesting that when age 0 coho were abundant in three Lake Superior tributaries, numbers of brook trout were lower.

Cunjak and Green (1983) found that brook trout were displaced from preferred habitats when sympatric with rainbow trout in two Newfoundland streams. Additionally, encroachment by rainbow trout is thought to have contributed to reduced distributions of native brook trout since 1900 in streams in the southern Appalachian Mountains, but other factors were clearly involved as well (Moore et al. 1983; Larson and Moore 1985; Bivens et al. 1985).

Brown trout encroachment has also been associated with population reductions of brook trout. Waters (1983) reported an 88% reduction from 1965 to 1980 in the spring standing stock of brook trout in a Minnesota stream in which a burgeoning brown trout population had become established, but again, other habitat-related factors were involved. In the Ausable River, Michigan, brook trout (> 15 cm) were displaced from preferred habitats that were scarce when sympatric with brown trout (Fausch and White 1981). However, brook trout dominated brown trout of equal size in the laboratory (Fausch and White 1986).

Clearly, evidence from studies involving stream-resident brook trout leads to the conclusion that the potential for competitive interactions between coasters and several naturalized salmonid species warrants some concern. However, the reduction of coasters was well underway decades before competition with exotic salmonids might have come into play during the period from 1890 to 1930. It therefore appears doubtful that competition played a large role in reducing coaster brook trout and there is no direct evidence to suggest that this has happened along large areas of the Lake Superior shoreline.

An additional consideration is that well-documented reductions of brook trout have usually occurred in concert with habitat destruction, in marginal habitats, or near the periphery of their range, which according to Flebbe (1994) is an often overlooked kind of marginal habitat.

Populations located within the heart of the species range where habitat conditions are generally not marginal, as is the case in general with Lake Superior tributaries, may be better able to coexist successfully with exotic salmonines. While it is certainly possible that a number of factors, including competition, combined to reduce coasters, we suggest that the role competition played was modest.

V. Population and Distribution of the Coaster Brook Trout in the United States

A. Historic

Until the mid 1800s, Coaster Brook Trout were found in at least 105 streams in the Lake Superior basin. Coasters served as a major food source for indigenous peoples. European colonists heavily utilized the species for food and for sport fishing.. They typically caught the fish by weir, net, spear, and hook.

Beginning in the early 1800s, Coaster habitat throughout New England was radically altered by dam building, unregulated logging, log drives, and industrial and municipal pollution. A combination of these factors is believed to be the major cause of the disastrous decline in Coaster populations over the next century (Netboy, 1968).

In the mid 1900s and beyond, Lake Superior streams from which Coasters had been largely extirpated were restocked with Salmon, Brown Trout, and Rainbow Trout, all species which were not endemic to the Lake Superior basin. In addition, hatchery raised Brook Trout which were not adamandrous were introduced. The combination of habitat alteration, over fishing, and competition from non-native species resulted in the virtual extirpation of Coaster Brook Trout from the U.S.

B. Present situation

For most of the 20th century, Coasters have been documented in the U.S. in only two locations. A number of streams on Isle Royale National Park and Wilderness Area supported Coaster populations, reportedly in part due to the fact that factors contributing to mainland decline (logging, pollution, sedimentation from roads, exotic species introduction and competition) are largely or wholly absent. In the late 20th century a decline in these populations has been documented, although the reasons for this decline are not readily understood.

On the mainland, only one of the originally documented 30 or more streams retained breeding populations of Coaster Brook Trout. This was the Salmon Trout River in Marquette

County, Michigan. The entire reach of this river used by the Coaster Brook Trout has been owned continuously by a single owner, the Huron Mountain Club (HMC). Due to this single ownership over the long term, as well as the landowner management objectives, many of the factors thought to contribute to the decline of Coasters was able to be avoided or mitigated.

HMC allows very limited logging on their lands, thus avoiding sedimentation of spawning beds which is apparently a factor in the Coaster's lake-wide decline. In addition, the HMC has always strictly limited fishing methods that its members may use on the Salmon Trout River, and in recent decades the members have mostly practiced catch-and-release. Beginning in 1995, HMC prohibited its members from killing Coasters. Starting in 2000, the Huron Mountain Wildlife Foundation, an independent charitable organization dedicated to scientific research, has sponsored a long-term study of the population, ecology, and genetics of the Salmon Trout Coaster. The results of that study have confirmed an observed decline in the Salmon Trout population, versus earlier decades. As a result, HMC has supported closure of the river to fishing by the Michigan DNR during seasons when Coasters are present, as well as the adoption of stricter take limits in Lake Superior. HMC has sponsored and encouraged academic research into the Coaster population dynamics and health in the Salmon Trout, with over a dozen academic articles, as well as in-stream video monitoring of each returning Coaster during spawning season. The ongoing Salmon Trout River study, sponsored by the Huron Mountain Wildlife Foundation, indicates that the total spawning population in each of the years 2000-2004 was under 200 individuals.

VI. Factors Contributing to Population Decline

The Endangered Species Act states that "a species shall be listed . . . because of any one or a combination of" factors. Several of these factors are relevant to the Coaster:

- "The present or threatened destruction, modification, or curtailment of its habitat or range;"
- "Overutilization for commercial, recreational, scientific, or educational purposes"
- "The inadequacy of existing regulatory mechanisms;" and
- "Other natural or manmade factors affecting its continued existence."

A. The present or threatened destruction, modification, or curtailment of habitat or range

Beginning in the mid 1800s, many human-caused factors began altering river habitat and breeding areas necessary for the Coaster Brook Trout. Extensive logging resulted in dams being constructed for log drives down the rivers. These log drives scoured river bottoms, changed stream channels, and increased sedimentation on gravel beds, which was exacerbated by streamside logging. Dams were constructed for power operations. Paper and tanning plants were constructed at the mouths of many rivers, which resulted in toxins, temperature changes, and pH changes in the rivers used by the Coasters to spawn and rear.

The forces that have caused such severe damage to the Lake Superior tributaries continue to affect the entire historic range of the Coaster Brook Trout. The following discussion focuses on the most significant of these: (1) dams and river diversions; (2) toxic pollution; (3) acid level changes; (4) river siltation; and (5) changes in water temperature and flow.

1. Dams and river diversions

The potential size and distribution of Coaster Brook Trout populations in Upper Great Lakes rivers are determined largely by the quality and accessibility of the spawning and nursery habitats. Newman (2003) states that "A major cause of decline was the construction of dams that blocked the access of migrating fish to upstream spawning areas." Dams divert, disrupt, and interfere with the natural characteristics of a free-flowing stream. The impacts of dams on fish populations include the elimination of upstream passage, flooding of habitat, delay or other constraints on upstream migration in the powerhouse forebay, increased predation of migrating fish in the headpond, increased water temperatures, and changes in natural water currents. Such disruptions may confuse, delay, discourage, or eliminate both upstream and downstream migration.

By the 1940s, dams and other river obstructions had rendered over 90 percent of original anadromous fish habitat in Upper Great Lakes streams inaccessible. Over the last several decades some dams have been modified with fishways and other mitigation measures. Some dams have been removed or altered, although there still exist situations such as that of the Ontonagon river, where one branch has been entirely diverted to another, in order to operate power plants.

While there have been no studies to date of Coaster mortality due to hydropower dams, due to the lack of Coasters to study, we include studies of fish mortality in New England as an example.

Juvenile salmonids, especially smolts, may be delayed during downstream passage in dam reservoirs if they are unable to find the fishways, are diverted into the power station tunnel, or encounter a dam with no spillover (Mills, 1991 at 191). Dams can also reduce or eliminate spawning and nursery areas by inundating them under reservoirs. In addition, dam operation often causes rapid fluctuation in water level below power stations, which can expose redds and rearing habitat (Mills, 1989).

While some dams have screens (or weirs) to prevent fish from passing into the turbines and being killed or injured, these are not always effective. For example, downstream bypass weirs were installed at the West Enfield Dam on the Penobscot River. Despite these weirs, 85 percent of the fish went through the turbines (ASAC, 1992).

Ineffective screening leads to fish loss as the salmon are damaged or destroyed in the generator turbines. Increases in water speed, turbulence, and pressure, as well as cavitation and collision with machinery are contributing factors to the loss of salmon, particularly smolts. Fish mortality from passage through turbines varies, depending on size of the fish, type of runner, blade diameter, runner efficiency and speed, clearance between wicket gates, clearance between runner blades, tailwater elevation, and the degree of cavitation (Baum, 1983).

In a study of the mortality of juvenile clupeids (American shad, blueback herring, and alewives) during passage through a turbine, Stokesbury and Dadswell (1991) found that "although there were two fishways adjacent to both sides of the turbine intake, 98 percent of the clupeids passed through the tidal-power turbine. Total mortality of clupeids from turbine passage was estimated to be 46.3 percent for both years combined." Cramer and Oligher (1964) found that mechanical damage to the fish, direct contact between the fish and a solid object such as wicket gates, the sides of the draft tube, or the turbine blade, caused 74.4 and 76.6 percent, respectively, of the total damage observed among salmon passing through Francis and Kaplan turbines. At the Northfield Mountain Pumped Storage Project on the Connecticut River, another study found that over 28 percent of smolts are being "churned to death by turbines" (*The Boston Globe*, May 4, 1993).

Biologists have found that stream flow and the intensity of smolt migrations are linked. There are reports that in many locations fish move downstream in greater numbers when stream flows increase (Allen, 1944; Evropeitseva, 1957; Mills, 1964; Youngson and Webb 1992). The maintenance of large reservoirs for hydro-electric production adjusts stream flow to the needs of the operators of the dam, which can have negative impacts on aquatic ecosystems.

In addition, the remains of many dams exist in Upper Great Lakes rivers. Whether constructed for log drives, tannin, power, or other industrial facilities which are now closed, or mill ponds, disruptions to flow regimes, with all the effects noted above, continue in these areas.

2. Toxic pollution

Coaster Brook Trout populations could be significantly threatened by a number of forms of toxic pollution.

Organo-mercury compounds, which are generally used as fungicides and in wood pulp treatment, are highly toxic to fish and humans. Several fisheries have had to close down because mercury levels in the fish were too high (0.5 pm) for human consumption. All inland lakes in Michigan and most streams carry fish consumption advisory warnings, and pregnant women in Michigan are advised not to consume any fish caught in Michigan whatsoever.

Organo-phosphorus compounds are also toxic to fish (although less so than chlorinated hydrocarbons). Mills (1991) states that "Fenitrothion [a chemical that replaced DDT after it was banned] is designed to kill arthropods, therefore lowers stream densities of aquatic insects after spraying, thus reducing the food supply of young fish with a consequent reduction in growth and in numbers." (Ibid. at 227-228).

Deoxygenation can also jeopardize trout survival. This phenomenon is mainly the result of the bacterial breakdown of organic material such as effluents from dairies, silage, manure heaps, cattle yards, slaughter houses, sugar beet factories, textile manufacture, canning plants, laundries, breweries, tanneries, fish-meal factories, paper mills, and domestic sewage. The oxidation of sewage can decrease the amount of dissolved oxygen, often to a level below the required minimum for the survival of fish. This is especially true in the summer, when higher water temperatures decrease the amount of dissolved oxygen while the amount required by the trout increases. If large quantities of dissolved oxygen are lost from the water as a result of decomposition, conditions tend to become anaerobic. This is accompanied by a foul smell and the death of most plant and animal life (Ibid. at 231).

Existing research is inadequate to assess the full impacts of these potentially threatening factors on the Coaster Brook Trout in the United States. Without more study, the magnitude of the threat will remain unknown, although since most of these threats are located near the mouths of streams, due to the locations of paper mills, etc., the effects are likely to be more severe on Coasters than on stream-resident brook trout.

3. Acid Level Changes

Acidic water has been shown to have detrimental effects on all brook trout, and are particularly toxic to post-emergent fry and pre-smolts. (Watt, 1987; Mills, 1989; Lansky, 1992). Eggs and alevins are highly sensitive to acidification and are likely to be killed at levels below 4.5 pH. Low pH interferes with reproductive functions of the brook trout, including delayed or inhibited hatching of eggs. Respiration, gill performance, and regulation of body salts are also harmed by low pH levels. Short-term pH depressions from spring snowmelt have caused overwintering of adult brook trout, resulting in increased mortalities (Mills, 1989). When the pH drops below 5.0, aluminum—a component of soils which is very toxic to fish—becomes more soluble and leaches into water (Shearer, 1992).

Tributary streams in the Upper Great Lakes typically lack adequate buffering or acid neutralizing capacity, and therefore are sensitive to acid rain (FWS, 1989 at 10). The major sources of acid rain are emissions of the gaseous oxides of nitrogen and sulfur from the burning of hydrocarbons (Mills, 1989).

A study on Atlantic salmon in first- and second-order streams in New England from 1980 to 1982 revealed that pH values declined to as low as 4.7 during spring runoff and snowmelt in Maine (Haines, 1987). Throughout the rest of the year pH levels in tested third-order Atlantic salmon streams did not drop below 5.0 (Ibid.). A survey on severely acidified rivers in Nova Scotia revealed that the rivers were all in areas of shallow soils and poor drainage, underlain by granite and metamorphic rocks lacking in basic minerals that would buffer acidic deposition

(Watt, 1986). Similar soil and bedrock types are found in the Upper Great Lakes, suggesting similar effects.

The acidification of streams and rivers may seriously hinder the restoration of the Coaster Brook Trout. The Michigan DNR has on file over 100 acid generating spills from pulp and paper mills into stream mouth areas from 2000-2006. A large number of potential Coaster streams have, or are close to, acid generating pulp and paper mills.

In addition, there is a new acid generating activity proposed for areas which could be Coaster restoration streams, sulfide mining. Sulfide mining extracts minerals from sulfide ore deposits, which generate sulfuric acid when exposed to air or water. In fact, there is a proposal to operate a sulfide mine directly the headwaters of the Salmon Trout river in Marquette County Michigan, noted above as the last remaining naturally regenerating population of Coasters on the south shore of Lake Superior.

4. River Siltation

Silt and sediment in rivers can threaten Coaster reproductive success. These substances can fill holding areas, rendering them unsuitable for adult migrating Coasters. In addition, silt and sediment can fill hollows, decreasing the amount of available protection for juvenile Coasters .

Suspended and settling solids smother algal growth and kill rooted plants and moss. This changes substrate structure, which greatly decreases the biomass of benthic invertebrates on which the young Coasters feed.

Coaster eggs may be killed due to lack of oxygenated water if silt is deposited in the interstices of the gravel substrate of the redd and diminishes the flow of water. Heavy concentrations of silt may cause problems with the respiration of fish, and fine silt has been known to cause alevin deaths by collecting on the gill membranes (Mills, 1989; Shearer 1992).

Siltation can also affect water clarity and flow. Suspended solids reduce the amount of light penetration in the water column, which can affect the feeding and migration patterns of anadromous salmonids. Changes in flow patterns within the rivers due to bank erosion can effect the timing of migrations (Shearer, 1992).

The issue of siltation and possible impacts on U.S. Coaster Brook Trout is not widely understood and requires further study.

5. Changes in water temperature and flow

All Brook Trout are very sensitive to changes in water temperature. If the temperature is too high, dissolved oxygen is reduced, causing stress to the trout. If the temperature is too low, migratory behavior may be disrupted.

The forest along rivers and streams shades the water, streambed, and bank from the sun, which keeps the water temperature cool. Deforestation in river corridors allows more sunlight to penetrate, and increases the temperature of the water column. It also reduces the amount of shaded ground, allowing the soil to be heated and resulting in warmer surface water and groundwater flowing into rivers and their tributaries.

The practice of releasing water from the bottom of dams can also affect water temperature. By drawing water from the lower, colder level of the reservoir, this reduces the temperature of the downstream section of river. As a result, migratory behavior in anadromous salmonids can be affected.

Despite the possible threats these factors may pose, little research has been done on their possible impacts on Coasters in the Upper Great Lakes. This lack of adequate information is a serious concern.

B. Overutilization for commercial, sporting, scientific, or educational purposes

1. Commercial fishing

A commercial fishery, using weir techniques, existed on many rivers used by Coasters in the 19th century. However, by the 1940s, Coaster populations were reduced to present locations. While the extremely low numbers of Coasters extant means that almost none will be caught by commercial vessels, this also means that any which are will disproportionally impact recovery efforts. Isle Royale allows no keeps of Coaster by commercial fishers.

2. Sport fishing

Sport fishing has been a continuing source of pressure on Coasters populations since the 1800s. It was reported that by 1850, all streams within 30 miles of Marquette Michigan had been "fished out" (Roosevelt, 1865)

Both the Huron Mountain Club and Isle Royale National Park have restrictions on keeping these fish (and in the case of HMC, even fishing for other species during the time of year when spawning Coasters may be in the stream).

C. Inadequacy of existing regulatory mechanisms and programs

Petitioners support existing programs seeking to restore viable populations of Coaster Brook Trout to multiple aquatic ecosystems in the United States. However, these programs are inadequate to provide for the long-term viability of *Salvelinus fontinalis* in the United States and the restoration and protection of its habitat. Moreover, the limited resources available are often not used to maximum effect.

Among the serious shortcomings of the present program are: (1) lack of a single government entity with overall program authority; (2) inadequate authority to prevent conflicting government policies and programs, land-use practices, and toxic pollution; (3) over-reliance on hatchery production and stocking; (4) inadequate program funding; (5) and a lack of public education and involvement in Coaster Brook Trout restoration.

1. Lack of a single government entity with overall program authority

At present, Coaster Brook Trout programs are administered and implemented by a wide variety of federal, state, private, and international institutions. No single agency has ultimate policy-making or enforcement authority over the Coaster program as an integrated whole.

The result has been duplicated effort, inadequate communication, and sometimes contradictory policies and practices. This has undermined the effectiveness of Coaster restoration programs, as seen in the lack of a significant population increase. In addition, monitoring of the impact of various dams, development projects, and habitat-altering activities on aquatic life in Upper Great Lakes rivers has not been adequate in the past, in large part due to a lack of coherent oversight for the various programs.

The closest approximation to a coherent program for Coaster populations in the United States is that described in the *A Brook Trout Rehabilitation plan For Lake Superior* (FWS, 2003). The goal stated in the Rehabilitation document is as follows: “The rehabilitation goal for brook trout in Lake Superior is to maintain widely distributed, self-sustaining populations in as many of the original, native habitats as practical". (at 6). Yet the role of the FWS described in the document is one of "involvement," not leadership.

This program of assistance and support for other state and federal programs is necessary and appropriate, as far as it goes. However, it clearly does not provide the strong mandate for policy-making, long-term monitoring, implementation, enforcement, or funding that the ESA provides in a recovery program.

2. Inadequate authority to enforce program compliance

The absence of a single focus of authority for Coaster Brook Trout restoration programs is not merely a bureaucratic inconvenience. The result has been inadequate communication and coordination, overlapping or inconsistent policies, conflicts between the various federal, state, and private programs, and the inability to control harmful activities by public and private entities. Areas of particular concern are:

a. Conflicting governmental policies and programs

A serious shortcoming of current programs is the lack of authority on the part of a lead agency to require that the policies of all government agencies are consistent with Coaster restoration. Present Coaster restoration programs rely primarily on voluntary agreements with no binding obligations. They are generally not enforceable legal contracts.

There are numerous examples of the problems this situation has created:

(1) Fish passage at existing dams

The U.S. Fish and Wildlife Service cannot guarantee that all threats to imperiled Coaster populations in the United States can be removed without restoring unobstructed and unpolluted aquatic ecosystems. However, the agency lacks the legal authority to ensure that new projects are consistent with Coaster restoration programs. It is also unable to ensure that existing facilities and activities that conflict with these programs are brought into compliance.

The relicensing of existing dams by the Federal Energy Regulatory Commission is a major opportunity to compel dam owners to provide adequate fish passage, water quality and flow, and other environmental safeguards. Federal law requires that fish passage facilities be provided at dams licensed for the production of hydroelectric energy under the *Federal Power Act* following the prescription of such passage facilities by the departments of Interior or Commerce. Yet the Department of Interior has been unwilling or unable to prescribe adequate passage facilities, and FERC has not responded with strict enforcement of the Act.

b. Land-use practices

Ecologically disruptive land use practices in watersheds can have major impacts on the Coasters. Of special concern are siltation caused by agriculture, silviculture, and road development; alteration in water temperatures and flow volume regimes due to the clearing of lands adjacent to tributaries and rivers; and infusion of runoff with pesticides and other chemicals used in intensive agriculture and silviculture.

Forest practices include clear cutting along stream banks, increasing sedimentation which affects water clarity and covers spawning beds. Increases in road building in Coaster habitat has led to increased road crossings of important streams, which also increases sedimentation. In 2005, a road crossing over the Salmon Trout River washed out, dumping over 80 tons of sediment into the river.

VII. Similarity of Appearance – Coasters as a Distinct Population Segment

Under Subpart E, section 17.50, the Director may determine that a species is listed with the notation "S/A" (similarity of appearance) based upon

1) The degree of difficulty enforcement personnel would have in distinguishing the species, at the point in question, from an Endangered or Threatened species.

If a species may be listed based upon enforcement personnel's inability to distinguish it from a listed species, the converse must also be true. If qualified personnel can distinguish a Distinct Population Segment from a non-listed species based on appearance, then this species must be treated as a separate species. Since the USFWS itself recognizes the difference between Coaster and stream-resident brook trout, the Coasters must be treated a as distinct species (Newman and DuBois, 1996).

In addition, new research has demonstrated that the Salmon Trout Coaster population is reproductively isolated from the in-stream resident brook trout population

Consequently, it cannot be argued that the Salmon Trout River population of Coaster Brook Trout is not a Distinct Population Segment, nor that it is simply identical to stream-resident brook trout.

VIII. Critical Habitat Designation Requested

Petitioners recommend the designation of "critical habitat" for *Salvelinus fontinalis* under the Endangered Species Act. This should occur within a reasonable time period after the listing of the species as "endangered." This is necessary because aquatic habitat upon which this rare trout depends continues to be degraded and destroyed.

The designation of critical habitat should include at the least the Salmon Trout River watershed, the last watershed inhabited by Coaster Brook Trout. It should also encompass aquatic areas in need of restoration to stimulate successful spawning and rearing of Coasters. Petitioners believe that "critical habitat" designation for *Salvelinus fontinalis* appears to be determinable and prudent.

IX. Benefits of Listing the Coaster Brook Trout as "Endangered"

The listing of the Coaster Brook Trout as "endangered" under the Endangered Species Act would greatly strengthen federal and state restoration programs. Among other benefits, it would:

- mandate and encourage the preparation and implementation of a comprehensive restoration plan for the Coaster Brook Trout throughout its historic range;

- result in increased funding—through federal, state, and regional cooperative agreements and additional federal funding sources—for research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation;

- give agency officials an added mandate and legal authority to implement fish passage at dams and other barriers in the waterways, to ensure that construction of new dams and other stream alterations do not reduce the viability of the species; to minimize incompatible new land use adjacent to rivers, and to regulate fishing to prevent overexploitation of the species;

- stimulate a more effective public information and education program on behalf of the Coaster Brook Trout, thereby reducing human-caused mortality and building public support for increased funding of critical programs.

X. Summary

Wilcove, et al. (1993) contend that

> Early intervention is critical to the success of endangered species recovery efforts. Yet our analysis indicates that most species, subspecies, and populations protected under the ESA are not receiving that protection until their total population size and number of populations are critically low. (At 92)

If vanishing plants and animals are listed as threatened or endangered before the situation reaches a crisis stage, government agencies have many more options for protecting them. Moreover, the social and economic costs are likely to be lower (Ibid.).

The most up-to-date scientific data available indicate that anadromous *Salvelinus fontinalis* is, at the very least, biologically threatened in its native habitat in the conterminous United States. The species has apparently been sliding towards extirpation from since the early Michigan logging boom and over-exploitation of the 1800s.Today, it is one of the rarest unprotected native fish species in this country—rarer than many species of fish already designated as threatened or endangered under the Endangered Species Act. Indeed, one fisheries biologist characterizes the existing Coaster Brook Trout population as little more than a "zoo population" since true restoration efforts have yet to begin (Interview with Newman).

In conclusion, the undisputable facts require that the Coaster Brook Trout *Salvelinus fontinalis* be listed as "endangered" under the Endangered Species Act. A Memorandum of Understanding (MOU), Habitat Conservation Plan (HCP), or Conservation Agreement (CA) cannot be used as a compromise that either forecloses or delays the possibility of listing *Salvelinus fontinalis* under the ESA. Substituting a MOU or CA for listing would be inadequate and inappropriate for reasons discussed in detail throughout this petition.

As one of the rarest, unprotected native fish species in the conterminous United States, petitioners urge the Service to expedite the listing and protection of the Coaster Brook Trout as "threatened" or "endangered" under the Endangered Species Act, and to designate "critical habitat," including the Salmon Trout River watershed, and all watersheds historically inhabited by Coaster Brook Trout that can be deemed critical to the restoration of wild Coaster populations to safe levels, and aquatic areas in need of restoration to provide for successful spawning and rearing of Coaster Brook trout..

Dated this 22d Day of February 2006

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REFERENCES

Becker, G.C. 1983. Fishes of Wisconsin. University of Wisconsin Press. 1052 pp.__Behnke, R. 1994. Coaster brook trout and evolutionary "significance" (About Trout). Trout (Autumn 1994). Pp. 59-60.

Bivens, R. D., R. J. Strange, and D. C. Peterson. 1985. Current distribution of the native brook trout in the Appalachian region of Tennessee. J. Tenn. Acad. Sci. 60:101-105.

Brasch, J., J. McFadden, and S. Kmiotek. 1982. Brook trout - Life History, Ecology, and Management. Wis. Dep. Nat. Resour., Pub. 26-3600(82), Madison.

Bridges, C. H. 1958. A compendium of the life history and ecology of the eastern brook trout (*Salvelinus fontinalis*) (Mitchill). Mass. Div. Fish. Game. Fish. Bull. No. 23.

Bullen, W. H. 1988. Fisheries management plan for the Salmon Trout River, Marquette County, Michigan. Mich. Dep. Nat. Resour. Fish. Div. Tech. Rep. No. 88-7.

Busiahn, T. R. (Ed) 1990. Fish community objectives for Lake Superior. Great Lakes Fishery Commission Special Publication 90-1. 23 pages.

Castonguay, M., G. J. Fitzgerald, and Y. Cote. 1982. Life history and movements of anadromous brook charr, *(Salvelinus fontinalis*), in the St. Jean River, Gaspe, Quebec. Can. J. Zool. 60:3084-3091.

Caswell, H., R. J. Naiman, and R. Morin. 1984. Evaluating the consequences of reproduction in complex salmonid life-cycles. Aquaculture 43:123-134.

Cunjak, R. A. and J. M. Green. 1983. Habitat utilization by brook char (*Salvelinus fontinalis*) and rainbow trout (*Salmo gairdneri*) in Newfoundland streams. Can. J. Zool. 61:1214-1219.

Curtis, G. L. 1990. Recovery of an offshore lake trout (*Salvelinus namaycush*) population in Eastern Lake Superior. J. Great Lakes Res. 16(2):279-287 Internat. Assoc. Great Lakes Res.

DuBois, R. B. and D. M. Pratt. 1994. History of the fishes of the Bois Brule River system, Wisconsin, with emphasis on the salmonids and their management. Trans. Wis. Acad. Sci., Arts and Lett. 82:33-71.

Danzman, R.G.; P.E. Ihssen and P.D.N. Hebert Genetic Discrimination of Wild and Hatchery Reared Brook Char, *Salvelinus fontinalis* (Mitchell) in Ontario Using Mitochondrial DNA Analysis. J. Fish. Biol.; 39(suppl. A):69-77. 1991. FR 37(4)

Dutil, J. D. and G. Power. 1980. Coastal populations of brook trout, (*Salvelinus fontinalis)*, in Lac Guillaume-Delisle (Richmond Gulf) Quebec. Can. J. Zool. 58:1828-1835.

Fausch, K. D. and R. J. White. 1981. Competition between brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) for positions in a Michigan stream. Can. J. Fish. Aquat. Sci. 38:1220-1227.

Fausch, K. D. and R. J. White. 1986. Competition among juveniles of coho salmon, brook trout, and brown trout in a laboratory stream, and implications for Great Lakes tributaries. Trans. Am. Fish. Soc. 15:363-381.

Flebbe, P. A. 1994. A regional view of the margin: Salmonid abundance and distribution in the southern Appalachian Mountains of North Carolina and Virginia. Trans. Am. Fish. Soc. 123:657-667.

Gibson, R. J. and F. G. Whoriskey. 1980. An experiment to induce anadromy in wild brook trout in a Quebec river on the north shore of the Gulf of St. Lawrence. Naturaliste Can. 107:101-110.

Goodier, J.L. 1981. Native lake trout stocks in the Canadian waters of Lake Superior prior to 1955. Masters Thesis, Dept. Of Zoology and Inst. For Env. Studies, University of Toronto.

Goodier, J. L. 1982. The Fish and Fishes of Canadian Lake Superior. Institute for Environmental Studies, University of Toronto and Ontario Ministry of Natural Resources.

Goodyear, C.D., T.A.Edsall, Ormsby Dempsey, G.D. Moss and P.E.Polanski. 1982. Atlas of spawning and nursery areas of Great Lakes Fishes. Vol.II, Lake Superior. U.S. Fish. Wild. Serv., FWS/OBS-82/52: 122 pp.

Halpern, T. And D. Schreiner. 1992. Lake Superior anadromous brook trout plan: recommendations for plan development. Minn. Dept. Nat. Res. 15 pp.

Hansen, M. J., editor. 1994. The state of Lake Superior in 1992. Great Lakes Fishery Commission, Special Publication 94-1, Ann Arbor, Michigan.

Harmon, M. E. and 12 others. 1986. Ecology of coarse woody debris in temperate ecosystems. Adv. Ecol. Res. 15:133-302.

Heding, R. And V. Hacker. 1960. A trout's thermostat; springs. Wis. Cons. Bull. 25(5):19-22

Havey, K. A. and D. O. Locke. 1980. Rapid exploitation of hatchery-reared brook trout by ice fishermen in a Maine lake. Trans. Am. Fish. Soc. 109:282-286.

Johnson, L. 1980. The Arctic charr, (*Salvelinus alpinus*). Pages 15-98 *in* E. K. Balon, ed. Charrs: salmonid fishes of the genus *(Salvelinus)*. Dr. W. Junk, The Hague, The Netherlands.

Lanman, C. 1847. A summer in the wilderness; embracing a canoe voyage up the Mississippi and around Lake Superior. D. Appleton & Co., New York. 208 p.

Larson, G. L. and S. E. Moore. 1985. Encroachment of exotic rainbow trout into stream populations of native brook trout in the southern Appalachian Mountains. Trans. Am. Fish. Soc. 114:195-203.

MacCallum, W. R. and J. H. Selgeby. 1987. Lake Superior revisited 1984. Can. J. Fish. Aquat. Sci. 44 (Supplement 2):23-36.

MacGregor, R. B. 1973. Age, growth, and fecundity relationships of anadromous brook trout, *(Salvelinus fontinalis)* (Mitchill), in the Moisie River, Quebec. Undergrad. Hon. Thesis, Univ. Waterloo, Ontario.

MacPhee, C. 1966. Influence of differential angling mortality and stream gradient on fish abundance in a trout-sculpin biotope. Trans. Am. Fish. Soc. 95:381-387.

Miller, B. R. 1968. Stomach analysis of brook trout released in Keweenaw Bay, Baraga County, Michigan. Unpublished Report filed at Mich. Dept. Conserv., Fish Div., Baraga.

Miller, J.M. 1974. The food of brook trout (*Salvelinus fontinalis)* (Mitchill) fry from different subsections of Lawrence Creek, Wisconsin. Trans. Am. Fish. Soc. 103:130-34.

Montgomery, W. L., S. D. McCormick, R. J. Naiman, F. G. Whoriskey, and G. A. Black. 1983. Spring migratory synchrony of salmonid, catostomid and cyprinid fishes in Riviere a la Truite, Quebec. Can. J. Zool. 61:2495-2502.

Montgomery, W. L., S. D. McCormick, R. J. Naiman, F. G. Whoriskey, and G. A. Black. 1990. Anadromous behaviour of brook charr (*Salvelinus fontinalis*) in the Moisie River, Quebec. Pol. Arch. Hydrobiol. 37:43-61.

Moore, S. E., B. Ridley, and G. L. Larson. 1983. Standing crops of brook trout concurrent with removal of rainbow trout from selected streams in Great Smoky Mountain National Park. N. Am. J. Fish. Manage. 3:72-80.

Naiman, R. J., S. D. McCormick, W. L. Montgomery, and R. Morin. 1987. Anadromous brook charr, *(Salvelinus fontinalis)*: opportunities and constraints for population enhancement. Marine Fisheries Review 49:1-13.

Newman, L. and DuBois, R. 1996. Status of Brook Trout in Lake Superior. US Fish & Wildlife Service, Ashland, WI.

O'Donnell, D. J. 1944. A history of fishing in the Brule River. Trans. Wis. Acad. Sci., Arts and Lett. 36:19-31.

Opel, F. 1986. Fishing in North America 1876-1910. Castle, a Division of Book Sales Inc., Seaucus, N.J.

Power, G. 1966. Observations on the speckled trout in Ungava. Naturaliste Can. 93:187-198.

Power, G. 1980. The brook charr, Salvelinus fontinalis. Pages 141-203 *in* E. K. Balon, ed. Charrs: salmonid fishes of the genus (*Salvelinus)*. Dr. W. Junk, The Hague, The Netherlands.

Randall, R. G., M. C. Healey, and J. B. Dempson. 1987. Variability in length of freshwater residence of salmon, trout, and char. Am. Fish. Soc. Symp. 1:27-41.

Roosevelt, R. B. 1865. Superior fishing - The striped bass, trout, and black bass of the northern states. Originally published by G.W. Carleton. Minnesota Historical Society Press. St. Paul. 1985. 310 pp.

Rose. G.A. 1986. Growth decline in subyearling brook trout (*Salvelinus fontinalis*) after emergence of rainbow trout (*Salmo gairdneri*). Can. J. Fish. Aquat. Sci. 43:187-93.

Rounsefell, G. A. 1958. Anadromy in North American salmonidae. U. S. Fish and Wildl. Serv., Fishery Bull. 58(131):171-185.

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Fish. Res. Bd. Can. Bull. 184. Ottawa.

Shiras, G. 1935. Hunting wild life with camera and flashlight; a record of sixty-five years' visits to the woods and waters of North America. Chap. 20, The Huron Mountain District; Fishes of Lake Superior. National Geographic Society. Vol. 1, Lake Superior Region. Washington, D. C.

Slade, J.W. 1994. A pilot study on the status of coaster brook trout in the waters of Isle Royale National Park, Lake Superior. Unpublished report, U.S. Fish and Wildlife Service. Ashland, WI.

Smith, L. L. and J. B. Moyle. 1944. A biological survey and fishery management plan for the streams of the Lake Superior north shore watershed. Min. Dep. Cons. Tech. Bull. No.1.

Smith, M. W. and J. W. Saunders. 1958. Movements of brook trout, (*Salvelinus fontinalis)*(Mitchill), between and within fresh and salt water. J. Fish. Res. Bd. Can. 15:1403-1449.

Staufer, Thomas M. 1977. Numbers of juvenile salmonids produced in five Lake Superior Tributaries and the effect of juvenile coho salmon on their numbers and growth, 1967-1974. MI DNR Fisheries Research Report No. 1846

Thorpe, J. E. 1987. Smolting versus residency: developmental conflict in salmonids. Am. Fish. Soc. Symp. 1:244-252.

Thorpe, J. E., R. I. G. Morgan, C. Talbot, and M. S. Miles. 1983. Inheritance of developmental rates in Atlantic salmon. Aquaculture 33:123-132.

Verreault, G. and R. Courtois. 1989. Changements saisonniers de l'alimentation de l'omble de fontaine anadrome (*Salvelinus fontinalis*) dans les rivieres Matapedia et Ristigouche (Quebec). Naturaliste Can. (Rev. Ecol. Syst.) 116:251-260.

Vladykov, V. D. 1942. Precision with which speckled trout (*Salvelinus fontinalis*) return to the same spawning grounds. Can. Field-Naturalist 56:134-136.

Waters, T. F. 1983. Replacement of brook trout by brown trout over 15 years in a Minnesota stream: production and abundance. Trans. Am. Fish. Soc. 112:137-147.

Waters, T. F. 1987. The Superior north shore. Univ. Of Minn. Press. Minneapolis. viv + 361 pp.

Weed, A. C. 1934. Notes on the sea trouts of Labrador. Copeia 3:127-133.

White, H. C. 1940. Life history of sea-running brook trout (*Salvelinus fontinalis*) of Moser River, N. S. J. Fish. Res. Bd. Can. 5:176-186.

White, H. C. 1942. Sea life of the brook trout (*Salvelinus fontinalis*). J. Fish. Res. Bd. Can. 5:471-473.

Whoriskey, F. G., R. J. Naiman, and W. L. Montgomery. 1981. Experimental sea ranching of brook trout, (*Salvelinus fontinalis*) Mitchill. J. Fish. Biol. 19:637-651.

Wilson, L. 1990. Historical literature review of the Nipigon area with emphasis on fisheries from 1654 to 1990. Ont. Min. Nat. Res. 178 pp.

Wilder, D. G. 1952. A comparative study of anadromous and freshwater populations of brook trout (*Salvelinus fontinalis)* (Mitchill). J. Fish. Res. Bd. Can. 9:169-203.

Williams, D.D. 1981. The first diets of post-emergent brook trout (*Salvelinus fontinalis*) and Atlantic salmon (*Salmo salar*) alevins in a Quebec river. Can J. Fish. Aquat. Sci. 38:765-71.

Winchell, N.A. 1880. The geological and natural history survey of Minnesota. 8th Annual Report for the year 1879. St. Peter, 183 plus iv pp.

Zalewski, M., P. Frankiewicz, and B. Brewinska. 1985. The factors limiting growth and survival of brown trout, (*Salmo trutta* m. *fario*) L., introduced to different types of streams. J. Fish. Biol. 27 (supplement A):59-73.