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FISHERIES DIVISION

TECHNICAL REPORT

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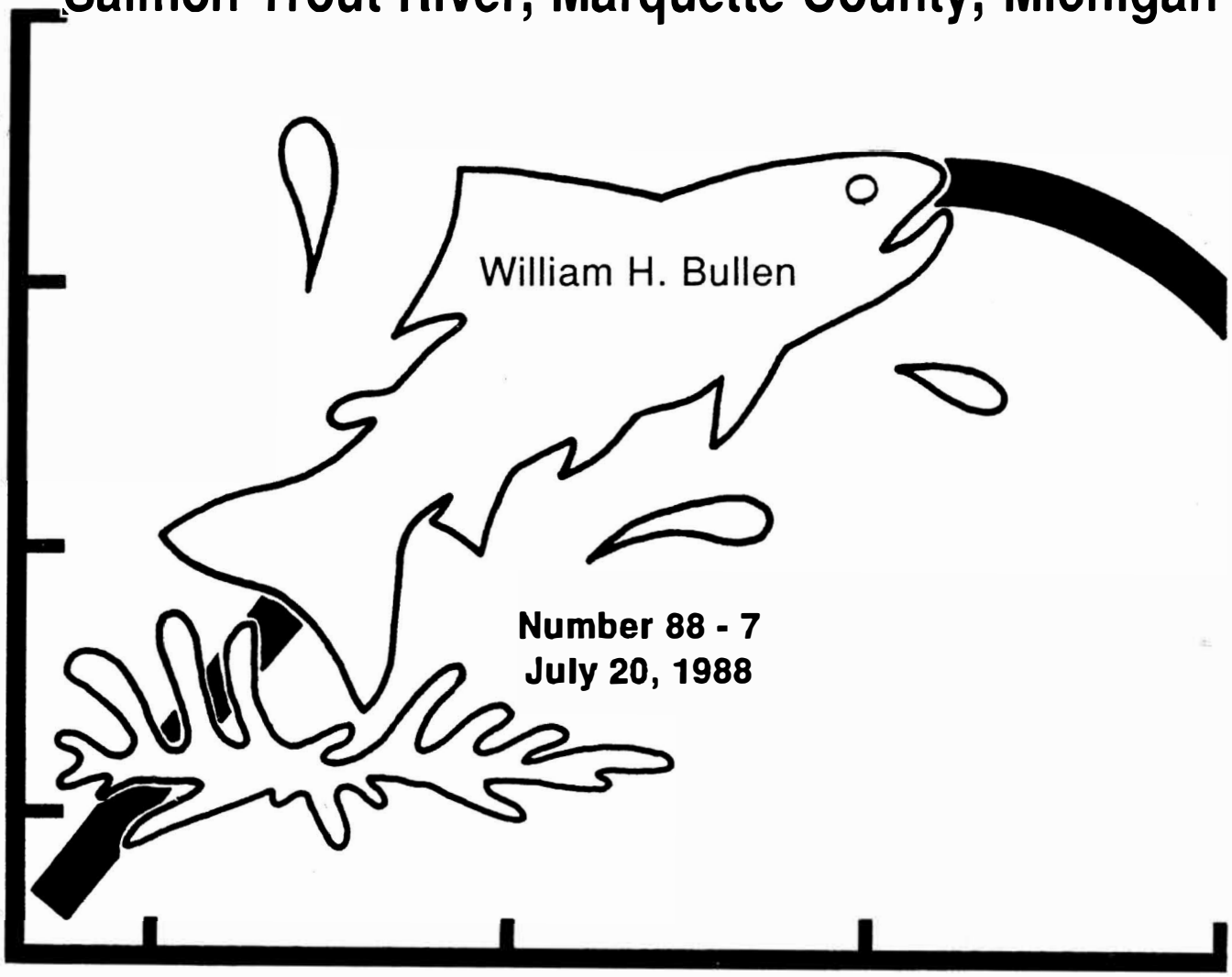

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MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION

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FISHERIES MANAGEMENT PLAN FOR THE SALMON TROUT RIVER, MARQUETTE COUNTY, MICHIGAN

William H. Bullen

INTRODUCTION

Historically, the Salmon Trout River has been best known for its coaster brook trout (*Salvelinus fontinalis*). However, in the past 20 years numbers of these large lake-run brook trout have declined. There is now considerable interest in developing a management plan to increase the abundance of these trophy fish.

This report describes the Salmon Trout River, its past and present fish populations, the related sport fishery, and the coaster brook trout itself. Also discussed are reasons why the Salmon Trout has been, and can continue to be, an excellent coaster stream and factors which may have caused the long-term decline in brook trout abundance. Finally, several specific recommendations are listed for management of the coaster population in this river and nearby coastal waters of Lake Superior.

Because of the private ownership of most of this watershed, minimal physical and biological data have been collected by state biologists. Thus, some sections of this plan are brief and lacking in detail. Fortunately, the Huron Mountain Club has employed several consultant biologists during the past 50 years. Their recorded data form the basis of this plan. Other information on volume of flow, water temperatures, and angler catches have been collected by foresighted club members. Additional data on stream flows and water chemistries were obtained from the U. S. Department of the Interior, Fish and Wildlife Service, Marquette Biological Station (Sea Lamprey Control). Finally, a public meeting was held in Marquette to obtain the benefits of opinions and experiences of anglers who had fished for coasters for many years.

ENVIRONMENT

The Salmon Trout River, a tributary of Lake Superior, is located in northwestern Marquette County approximately 30 miles north and west of the City of Marquette, Michigan. Except for the uppermost reaches, the mainstream and most tributaries lie within the boundaries of the Huron Mountain Club, a privately owned and exclusive organization managed primarily to provide outdoor recreation for its members.

The Huron Mountain area consists of a series of high hills and granite outcroppings. Soils in the lower watershed are relatively thin but stable because of the forest cover. The upper watershed grades from flat to rolling terrain of predominantly sandy soils.

Most of the lands within the club boundaries and in the Salmon Trout watershed are heavily forested, many with virgin timber. Northern hardwoods, hemlock, and red and white pine are common in upland areas. Lowlands are covered with a wide variety of woody vegetation including white birch, white cedar, balsam fir, spruce, tamarack, and tag alder.

Extensive timber harvest has occurred, and is continuing, in the upper watershed outside of the club boundaries.

The stream begins about 10 miles south of Lake Superior in an area known as the Yellow Dog Plains. The two main branches (east and west) flow northerly for approximately 7 stream miles before joining and forming the mainstream. The upper portions of these branches flow first through relatively flat, then rolling terrain, until entering the Huron Mountain Club lands. Upon reaching Sections 15 and 16 of T51N, R28W, the branches and mainstream begin dropping rapidly, falling over 300 feet in the last 14 river miles. Most of this rapid decent (260 feet) occurs between the club boundary on the West Branch and the lower falls, a distance of approximately 7 river miles. There are several major falls and two dams within this stretch. The upper falls (T51N, R28W, Sec. 15) is on the West Branch about 0.5 mile above the junction with the East Branch. The middle falls (T51N, R28W, Sec. 14) is approximately 1 mile downstream from the junction of the two branches, and the lower falls (T51N, R28W, Sec. 13) is about 2 miles below the middle falls. Sheet Rock Falls is approximately 300 feet upstream from the lower falls. The upper dam (T51N, R28W, Sec. 15) is almost immediately below the junction of the west and east branches. The lower dam (T51N, R28W, Sec. 13) is approximately halfway between the middle and lower falls. A flat area between the middle and lower falls is known as The Meadows.

The lower falls is the first permanent barrier encountered by fish migrating upstream from Lake Superior. Under certain flow conditions brook trout and other salmonids have been observed ascending this falls. However, within approximately 300 feet the Sheet Rock Falls is encountered, which effectively blocks all further upstream fish movement.

Finally, the river flows a distance of almost 9 miles from the lower falls to Lake Superior. Most of the stretch is characterized by moderate velocities and increased meandering of the stream channel. The lowermost stretch (1.5 miles) flows slowly through tag alder marsh flats before entering Lake Superior.

Little information has been recorded about the east and west branches. These branches, and their many small feeder streams, originate at the base of a moraine which separates this drainage from the Yellow Dog system, located to the south and east. The base flows, even in midsummer, appear stable. The water is colorless and slightly alkaline. The pH of the main branches and selected feeder streams ranges between 7.4 and 7.8. Methyl-orange alkalinity of the West Branch on September 19, 1985, was 58 mg/L.

Clear and Snake creeks are clear spring feeders joining the Salmon Trout mainstream just above the lower dam. Both have stable flows and contribute significantly to the mainstream flow. No records of flow measurements exist.

Only four tributaries enter the mainstream below the lower falls. Their characteristics are noticeably different from those found in upstream waters. Spring Creek, a small, short

seepage tributary is almost dry in summer months. A flow volume of 0.5 cfs was recorded on May 17, 1983. This water is more alkaline than that in other tributaries (pH 7.7–8.1, total alkalinity 85–92 mg/L). Murphy Creek enters the mainstream from the east about 1 mile above County Road 550. It too becomes dry in summer and flows only after snowmelt or rainfall. Recorded pH and alkalinity values have a range of 6.8–7.2 and 12–92 mg/L, respectively. Measured flows in Conway Creek have varied from 3.0 to 5.5 cfs in May and June but decline later in the summer. This water is stained and slightly acid (pH 6.2–6.5, alkalinity 16–25 mg/L). Sullivan Creek is very similar to Conway Creek with low summer flows, a stained color, and slightly acid water. None of these lower river tributaries provide significant spawning habitat or other productive environments for anadromous fish.

Water temperatures in the Salmon Trout mainstream seldom rise above 70 °F at County Road 550 Bridge. In fact, during most years when temperatures were consistently recorded (1971–1975) the water rarely exceeded 65 °F. Daily temperature fluctuations vary seasonally and usually are within 3–7 °F but range with occasional differences up to 10 °F. Although not recorded, winter temperatures are undoubtedly warmer than in most other area streams due to the same considerable groundwater seepage in the upper watershed that keeps the water cool in summer months. These temperatures make the river system well suited for brook trout production. The surrounding mature forest, relatively undisturbed watershed, and extensive headwater spring seepage are significant factors in maintaining this vital stability not often found in Lake Superior tributaries.

Water chemistry of the mainstream is reflective of its tributaries. It is a slightly alkaline stream with May-September (1959–1985) pH values ranging from 7.5 to 7.8 at County Road 550. Total alkalinity readings were between 44 and 70 mg/L. Measurements taken at the lower dam on the same days were within these same ranges. Similar values (pH 7.0–8.2 and total alkalinities 28–77 mg/L) were recorded in 1938–1939 (Smith 1942).

The steep terrain and relatively thin soil layer covering the extensive rock substrate in the lower portion of the watershed cause rapid runoff from rainfall and snowmelt. In addition to the high mainstream flows experienced each spring, severe floods have been common even in midsummer months as the result of heavy rains. Summer floods occurred at least in 1937, 1938, 1939, 1949, 1959, 1969, and 1974. These floods caused a rise in water level of 7 to 10 feet at County Road 550 Bridge. Records kept during 1973–1975 for the same location indicate spring runoff flows typically peak over short periods of time (5–10 days) at heights of 4–5 feet above normal. Excluding these seasonal extremes and the major summer floods, the mainstream flow remains relatively stable. Short-term rises in the stream level of 1 foot or more are not uncommon following rainfall but rarely is the flow less than 35 cfs with a water depth of 1.3 feet at County Road 550 Bridge. Flow measurements taken on the same days upstream at the lower dam were similar, indicating minimal input from lower tributaries and

groundwater seepage in this stretch. These physical differences in the upper and lower portions of the river (divided approximately at the lower dam) are significant to the production of brook trout.

Streambed soils vary considerably through the length of the stream. The headwaters flow mostly over sand and small gravel until the area of steeper gradient is reached. Exposed bedrock and rock rubble then become common until the Meadows is reached where sand and silt prevail. Below the lower dam ledge, rock, rock rubble, and sand are prevalent. Between the lower falls and County Road 550, sand bed load exists downstream to the vicinity of Sullivan Creek. The remaining streambed is firm sand covered with silt. Sand and small gravel predominate in the feeder creeks.

Instream cover also varies considerably by area. Small pools, rock ledges, and overhanging streambank vegetation are fairly common in the reaches above the lower dam. Below the lower falls, large pools on the many river bends provide fish cover. Log jams exist in some pools but instream log cover between pools is rare. Below County Road 550, sand has filled many pools and cover is limited to undercut banks, stream-side vegetation, and occasional logs. The lower 2 miles of stream provide deeper, slower water, and larger pools.

FISH POPULATION

Smith (1942) identified 31 species of fish in the Salmon Trout River. Brook trout and rainbow trout (*Salmo gairdneri*), northern pike (*Esox lucius*), and burbot (*Lota lota*) were the only predatory species listed. Pike and burbot were found only in the deeper waters of the lower river below the Harrison Pool, located approximately 3 miles upstream from the mouth. All species maintained their abundance through natural reproduction although some brook trout were planted annually to improve midsummer angling success.

A significant coaster migration occurred in late summer in the 1930's but was reported by Smith (1942) as "greatly diminished, apparently in response to the thinning of the population in Lake Superior".

More recent fish surveys in 1966, 1973, and 1983 found brown trout (*Salmo trutta*) and coho salmon (*Oncorhynchus kisutch*) also present downstream from the lower falls. The coho salmon were successfully reproducing in 1975, but no young brown trout were captured.

In 1983, juvenile steelhead (*Salmo gairdneri*) were apparently the most abundant salmonid in the lower river (Diana 1983). In October, Diana collected approximately 550 steelhead (4–5 inches) while capturing only 41 brook trout of all sizes. His sampling occurred at several locations above and below County Road 550. A survey by the Michigan Department of Natural Resources (MDNR) on October 13, 1966, 1.5 miles above County Road 550

captured a more even distribution of 34 brook trout (3–7 inches) and 33 steelhead in the same size range.

The salmonid population in the lower Salmon Trout River has changed significantly in the past 45 years. Brook trout and rainbow trout dominated prior to 1960 with little, if any, competition from other species. Both of these fish are anadromous, living most of their life in Lake Superior and returning to the river only to spawn. In the 1980's coaster brook trout numbers have declined significantly while rainbow trout (steelhead) have at least maintained and perhaps increased their abundance. In some years young rainbow trout may outnumber brook trout by at least 10 to 1. Fall spawning species (brook and brown trout and coho salmon and chinook salmon (*Oncorhynchus tshawytscha*) have increased considerably in the lower river. Young coho salmon also numerically exceed brook trout in some years although reproduction of this species seems highly variable. No records exist to indicate whether total fingerling production has changed since 1940.

Brook trout typically spawn in small tributary streams in areas of significant groundwater upwellings. Egg incubation, hatching, and fry survival are all enhanced by the warmer groundwater during the winter months. Additionally, these smaller spawning streams provide excellent rearing habitat for young trout. The lower Salmon Trout mainstream contains few groundwater seepage areas and very little small fish habitat. The periodic floods also produce a hostile environment for young trout, particularly early spring-hatched brook trout. As a result, it is not likely the lower river ever produced large numbers of brook trout fingerlings even prior to the increased competition and habitat degradation.

No fish population surveys have been completed on the east and west branches above the club boundaries. Anglers report, however, that brook trout are abundant but small (catch size range 4–9 inches) in the many headwater creeks. Clear and Snake creeks are also reported to be excellent producers of small brook trout.

Between 1910 and 1983 the planting of brook trout represented a major investment by the Huron Mountain Club. Fry and fingerling trout (0.5–4.0 inches) were planted prior to 1921 but most subsequent plants have been yearlings (5–7 inches) or adults (8–9 inches). The number of fish planted annually by the club varied considerably but has ranged from 750 to 1,000 adult trout in recent years. The State of Michigan planted brook trout in the headwater areas above the club boundary from 1935 to 1948. Again, sizes and numbers varied from 50 adults in 1948 to 2,000 fall fingerlings in several years. While it is possible some of these planted fish eventually moved down to Lake Superior, their low numbers make it doubtful they made any significant contribution to the overall spawning run of coasters.

Although no recent surveys have been completed, it is believed that brook trout are the only game fish species found above the lower falls. Angler interviews and personal

observations above the club boundary support this belief. The headwater streams provide good habitat for brook trout.

THE COASTER FISHERY

Opinions on just when coaster fishing was considered "good" vary considerably with the age and fishing experience of the angler. Smith (1942) reported runs were declining in the 1930's. More recent comments, however, indicate success was best in the early to mid-1950's. Many correlate a decline in the mid-1960's with the introduction of salmon to Lake Superior, yet the 1969 run was described as "one of the finest seasons recorded." Others say the real decline occurred in the early 1970's. Regardless of exactly when fishing was good, anglers agree fishing success in the 1980's is considerably poorer than at any time in their memories.

The major problem in determining the extent of the decline is the lack of consistent catch or survey records. Fortunately, the Huron Mountain Club maintained member catch records during certain years and they provide some insight to variations in coaster abundance. Smith (1942) also provides data for the years 1938–1940 on the total brook trout catch. Since the catch was separated by week, the number of brook trout most likely to have been coasters can be estimated. Smith (1942) states, "With the advance of the season, the peak of fishing intensity on the river shifted from the lower dam pond to the sector below Murphy's. This change is due in part to the desire of the fishermen to try for the lake-run brook trout which start up the river during the first week of August." If one estimates that 50% (an arbitrary number) of all brook trout caught between August 14 and Labor Day of each year by club members were coasters, then some indication of relative abundance can be gained. The above method results in an estimate that 270, 384, and 147 coasters were caught annually by club members in the years 1938–1940. The 3-year average of 267 may be high or low depending on the accuracy of the 50% coaster assumption. Additional coasters were also taken by non-club anglers fishing the lowermost river area and the near-shore waters of Lake Superior.

Prior to 1969, the trout fishing season on Michigan streams closed on Labor Day. Since then trout fishing has been permitted through September 30 on all streams and longer on selected coastal streams. Because the greatest concentration of spawning coasters in the Salmon Trout occurs in September, many anglers believe the harvest allowed by the later closure is responsible for the decline seen in the club members' catch since 1973.

Club members' catch records identified the actual coaster catch in 1969. They noted, "one of the finest seasons recorded." It also was the first year of the extended statewide trout season. As of September 7, 1969, the recorded coaster catch was 84, and the total catch through September 30 was 125.

Club records for the years 1970–1983 depict an abrupt decline in catch from 81 coasters in 1970 to 5 in 1974 but a mild recovery to 24 in 1975. Subsequent records show a relatively stable annual catch of 14–30 fish.

Although the above numbers reflect the catch by members of the Huron Mountain Club, which could vary for several reasons, they are the best data available. They also coincide with angler observations of coaster declines in the Salmon Trout River since at least 1938. If used as future goals, they should be remembered as only partial catches. Non-club anglers also fished portions of this stream and their catch is totally unknown, although by some estimates, it was as high as four times the club members' catch.

Many anglers relate coaster fishing with streams, however, conversations with longtime coaster fishermen indicate some of the best success was experienced in late spring among the large rocks or boulders scattered along the Lake Superior shoreline. Coasters apparently prefer this type of cover in shoal waters which is common near the mouth of the Salmon Trout River.

Fishing success reportedly declined in the shoal habitat in late June and July but improved again in August as the coasters congregated closer to the river mouth prior to spawning. These large brook trout were considered easy to catch both in the near-shore areas and in the river. The main factors limiting the spring and summer fishery were the unpredictable Lake Superior weather and the unprotected boating distance from Big Bay.

Since all adjacent uplands to the lower Salmon Trout River are owned by the Huron Mountain Club, public access to the stream fishery is very limited. Legal access to the lowermost portion is available via the river mouth by boat from Lake Superior. This area is most attractive to anglers in August when coasters first enter the stream and hold in the slower, deeper water. This boat fishery is restricted to approximately 1 mile of stream just above the mouth. Fishing success in past years has been reported as "good" with most anglers catching one or more coasters per trip.

Much of the remaining lower Salmon Trout River is not legally accessible to the public. County Road 550 Bridge is used as a legal public access point but only by wading anglers remaining in the stream. A legal opinion on the status of this road crossing as access should be obtained. Violations of the trespass law are enforced by police officers employed by the Huron Mountain Club. Angler trespass across club lands continues but has reportedly declined in recent years.

The traditional coaster fishery moved upstream into the shallow, gravel spawning areas above County Road 550 as the fall season progressed. Fly fishing for these large brook trout was common and most fish caught by club members were released.

Coasters as large as 5–6 pounds have been reported but most fish are in the 1.5–3.0 pound range (15–20 inches). The largest brook trout caught in recent fall surveys was 20.0 inches long.

COASTER BROOK TROUT LIFE HISTORY

Little has been written about coaster brook trout in Michigan. The following summarizes what is generally known or believed about coasters. This information was obtained from discussions with longtime coaster fishermen, and management biologists, and from MDNR district files, research reports, and personal observations.

Coaster brook trout spawn in the stream. Juveniles rear for sometime in the stream before migrating downstream to the lake. Manion (1977) recorded a significant downstream movement of brook trout in the Big Garlic River, Marquette, County, Michigan. A sea lamprey (*Petromyzon marinus*) trap operated over a 12-year period captured 2,896 brook trout that were moving downstream. Fifty-seven percent were caught during September through November and 25% during May and June. Once in the lake, coasters seem to remain in the vicinity of the parent stream. They apparently retain some homing instinct as do most salmonids and only have to travel short distances when returning to spawn. Fish surveys of near-shore Great Lakes waters usually produce the highest catch regardless of season.

Two major hypotheses exist as to the mechanisms which cause juvenile trout to migrate to the lake. Many anglers and some biologists believe the coaster brook trout is a distinct strain or stock. The difference between coasters and stream brook trout is perceived to be similar to the difference between Great Lakes steelhead and rainbow trout. One strain of each species migrates to the Great Lakes and returns only to spawn while the other remains non-migratory. The observation that some Great Lakes tributaries receive much larger runs of coasters than other nearby streams is viewed as circumstantial evidence that some streams contain genetically distinct coasters while others hold non-migratory brook trout. A migratory strain in the Salmon Trout River would necessarily spawn downstream of the lower falls.

Alternatively, coaster brook trout may be the result of natural reproduction or the stocking of young trout producing an instream population which exceeds the carrying capacity of the stream. Low, midsummer flows limit the amount of habitat by decreasing the stream depth and pool area. Young brook trout are forced downstream to find larger habitat (growing room) and end up in one of the Great Lakes. Seasonal floods may also force young trout into downstream areas because of insufficient local cover which would provide adequate shelter during high flows. If these conditions occur annually, consistent coaster runs would result. Thus, the best coaster streams would be those which have the best conditions for natural reproduction, a limited amount of cover to hold older (larger) trout, and highly fluctuating flows. Fall rains would reestablish suitable flows and permit the larger and older brook trout to enter the stream for spawning. This scenario is feasible for the historically good Upper Peninsula coaster streams, as these share the following characteristics:

(1) Extensive natural reproduction of brook trout. Included is the necessity of clean gravel of suitable size for spawning, considerable groundwater seepage, and minimal competition from other salmonids. Small, stable feeder streams offering preferred spawning habitat are often present.
(2) Limited amounts of habitat for larger trout.
(3) Floods and widely fluctuating flows are common.
(4) Access to the Great Lakes, where offshore waters provide preferred habitat.

At this time, sufficient information does not exist to distinguish between the above hypotheses for Great Lakes coasters. Wilder (1952) studied migratory (sea trout) and non-migratory brook trout in the Moser River System in Nova Scotia to determine if differences in coloration, relative size of body parts, meristic counts, weight-length relationships, age and growth, or resistance to seawater could be used to distinguish one group of fish from the other. He concluded that no evidence was obtained that indicated sea trout and freshwater trout from the Moser River System differed hereditarily. Smith (1958) recorded movement of tagged brook trout in Ellerslie Brook, Prince Edward Island, during the years 1946–1952. A 4-year average of only 16.6% of 3,580 stream-tagged brook trout actually moved downstream into saltwater. As one conclusion Smith states, "Data obtained at Ellerslie Brook, as well as those reported by other investigators, notably Wilder (1952), argue in support of a contention that movements of brook trout from fresh to salt water are basically no more than meeting the requirements of trout, with growth, for larger and more suitable living quarters...there appears no need to postulate races of brook trout with heritable differences to explain their seaward movements and occurrences in salt water."

Age-growth studies on coasters caught in 1982 in Lake Superior found age-1 fish averaging 4.0 inches in total length. Age-2, 7.3 inches; age-3, 11.5 inches; age-4, 14.4 inches; and age-5, 18.3 inches. Few coasters live past age 5 which is also typical of rainbow and brown trout found in Great Lakes waters. Most mature coasters found in a fall spawning run are ages 4 and 5.

DISCUSSION

Coaster brook trout have not been studied extensively anywhere in Michigan. The following discussion is based on the observations of biologists, fishermen, and members of the Huron Mountain Club.

Future progress in understanding the biology of coasters hinges on answering the critical question of whether juvenile coasters migrate lakeward due to genetic programming or to limits in available stream habitat. Answering this would indicate whether coasters were produced in

the river above or below the barrier falls, what were the most probable causes of their decline, and what would be the most productive restoration strategies to employ.

The stocking of relatively large numbers of young brook trout into tributary streams with highly fluctuating flows and minimal holding or protective habitat has sometimes been coincident with subsequent increases in coaster populations. As mentioned earlier the Salmon Trout coaster run in 1969 was reportedly much larger than had been seen since the mid-1950's. Later runs again became smaller. This temporary change in a long-term trend was believed to be the result of the Department of Natural Resources planting 25,000 yearling brook trout in 1967 and another 10,000 in 1968 in nearby Marquette Bay. Following the limited-habitat hypothesis, stream conditions may have forced the young hatchery trout downstream to the lake. If conditions for natural reproduction were poor, the newly established run of coasters soon disappeared unless annual plants continued. This same phenomenon has been observed in Lake Michigan tributaries with brown trout. They disappear shortly after being planted in certain streams but reappear, when mature, as large, lake-run fish in the fall. This evidence supports the above hypothesis, but is far from conclusive, as: (1) a relationship between stocking and coaster abundance has not been clearly documented and (2) if it were, the fact that stocked fish move into Lake Superior and survive does not permit the conclusion that the same phenomenon occurs in wild populations.

Almost every angler has a strong personal opinion as to the cause of the decline in the coaster run in the Salmon Trout River. Commercial fishing, lamprey predation, poaching, extended trout season, salmon, steelhead, beavers, poor reproduction, sand, no planting, and acid rain are among the reasons voiced. In all likelihood, none is solely responsible yet few are totally blameless. The coaster decline is probably the result of several factors impacting over a period of many years, not one or two catastrophic events.

Because of its life history, a coaster brook trout population could decline as a result of problems in either the stream environment or the Great Lakes environment or both. Each should be examined separately.

The environment of the Salmon Trout River system has been responsible for making it what many consider the best coaster stream in Michigan. It has been a very productive brook trout system with stable flows, excellent spring-fed tributaries, and almost ideal water temperatures. Natural reproduction has been consistently good. The lower portion of this watershed has remained relatively unchanged by man's influence due to its preservation by the Huron Mountain Club. In that respect it is unique among Michigan's trout streams. The sport fishery on the river has been controlled. Steelhead and salmon are denied access to most of the stream. But the Salmon Trout River has changed over the years. In several river areas a duned, sand bed load indicates excessive and detrimental downstream movement of sand. This sand movement appears to have increased significantly in recent years as evidenced by the

obvious front edge of the dune seen below County Road 550 in the lower river. Some of this sand apparently comes from eroding stream banks above County Road 550, but much sand is also evident in the upper reaches of the east and west branches and their tributaries. The most obvious sources in this area are the many logging roads and trails which erode severely with each snowmelt and rainfall. Washed-out culverts, fords, and flow diversions across roads by beaver dams are allowing tons of sand to enter these once productive headwater feeder creeks. Only recently have detailed studies by Michigan research biologists proven and quantified the highly damaging effects of such sand movement.

Recently beaver populations have increased dramatically in stream systems throughout the Upper Peninsula. The Salmon Trout has been similarly impacted. A new beaver dam now extends across the mainstream above Murphy Creek. Other dams block upstream migration into Spring Creek, Clear Creek, and Snake Creek. Many dams in upper river areas and tributaries outside the club boundaries interfere with fish movement, spawning, and stream productivity.

Competition from young coho and possibly chinook and pink salmon has existed at least during some years since 1966. Young steelhead continue to be very numerous in the lower river. This situation is not unique to the Salmon Trout River nor are the probable results. Based on observed changes in brook trout populations in other Lake Superior tributaries, it is very likely that mainstream production of young brook trout is significantly less now than it was before 1970.

Periodic chemical treatments in the lower river for sea lamprey larvae may have stressed the resident fish population to some degree. The first chemical treatment to kill lamprey larvae was completed in September 1959. Subsequent treatments downstream from the lower dam occurred in 1963, 1971, 1975, 1978, 1983, and 1985. The Salmon Trout River is considered a moderate to heavy producer of sea lampreys and must be routinely treated to minimize the number of these parasites leaving the stream. Treatments have been completed in May, June, or July since 1971 to avoid possible harm to the adult coasters entering the stream in August and September.

The extended fall fishing season (September), and thus a proportionally higher harvest of coasters in the lower river prior to and during spawning, also could have reduced egg deposition and young fish production in recent years. Historical trends in the river harvest by non- Huron Mountain Club members are unknown, however, an increase in this could conceivably have significantly reduced population numbers.

It is possibie that changes in Lake Superior had as great an impact on Salmon Trout coasters as those noted in the river. The effect of the sea lamprey in the 1950's and early 1960's was devastating on lake trout (*Salvelinus namaycush*). It also severely affected other trout, including coasters. The use of gill nets also killed coasters in Lake Superior, but poachers using

illegal, near-shore sets probably were more damaging than the licensed commercial fishery which operated in deeper, offshore waters. Large-mesh gill nets are no longer permitted except for certain research fisheries. Poaching continues but not to the same degree as in past years. As for the river fishery, data on the lake sport harvest are not available, however, an increased lake harvest over time could have contributed to reduced population numbers.

Game fish populations in Lake Superior have been restored since the mid-1960's by massive plantings of lake trout, steelhead, brown trout, coho and chinook salmon, and splake (*Salvelinus namaycush* x *Salvelinus fontinalis*). Except in a few instances, brook trout have not been routinely planted in large numbers in Lake Superior or its tributaries.

RECOMMENDATIONS

As mentioned before it has been difficult to establish a benchmark of former coaster abundance. Yet such a number is highly desirable when attempting to develop management objectives. It appears that spawning migrations in the 1930's could have included as many as 500–750 adult coasters, perhaps more. The total return in 1969 may have been as high as 300–500. Recent years have produced only 15–25% of that abundance.

Based on available information, a reasonable 10-year objective would be to increase the instream, spawning coaster abundance to approximately 300 adults. A longer term objective would be to increase that number to 750. These numbers include all fish entering the stream to spawn, not just those escaping angler harvest. Spawning populations of these magnitudes would significantly improve sportfishing success in both near-shore waters of Lake Superior and lower Salmon Trout River.

Several programs should be encouraged on the Salmon Trout River both to add to our knowledge of coaster brook trout and to improve the population in the river. Fact-finding projects that do not influence the fish population could be conducted simultaneously. However, management techniques designed to improve the population should be conducted in order of priority and evaluated for a reasonable length of time before proceeding to the next technique.

The following should be considered as ongoing fact-finding projects:

(1) Detailed records of club members' fishing effort and catch should be maintained, preferably throughout the open season but most importantly for the period August 1–31. Records should indicate measured length of all brook trout caught in the lower river.

(2) The Huron Mountain Club should consider purchasing and using equipment to monitor water chemistry throughout the year. The question of possible increased acidity during snowmelt runoff can be best answered by long-term monitoring.

(3) The number and type of spawning beds in the lower river should be counted annually following completion of most spawning activity.

(4) Periodic electrofishing surveys should be conducted in selected mainstream and tributary areas to document population changes. Population estimates should be made for all salmonids.

(5) Law enforcement officers employed by the Huron Mountain Club should be empowered to enforce State of Michigan conservation laws and rules.

(6) No fish species other than brook trout should be planted above the lower dam. Previous plants of rainbow trout have not resulted in natural reproduction but other species may reproduce creating undesirable competition.

(7) Lamprey treatments should continue to be made prior to August when adult coasters enter the stream.

There are several management procedures that conceivably can improve the coaster brook trout population in both the river and in the nearby coastal waters of Lake Superior. They should be put into practice in the following order of priority with each procedure being evaluated individually:

(1) The precise identity of coaster brook trout should be determined before any attempt to change either the abundance or the genetic makeup of the population. The specific question to be answered is whether coasters result from spawning by a migratory strain downstream of the first falls or simply the return of individuals that have drifted downstream from headwater areas as a result of crowding, floods, lack of cover, etc. This question could be partly answered by electrofishing throughout the length of the river system and using identifying fin clips in different locations. Trapping downstream migrants at the mouth of the river could then determine origin of individuals leaving the river. This work should be supplemented with electrophoresis to determine origin of returning adults and whether distinct populations exist above and below the lower falls.

(2) After the coaster brook trout has been defined, attempts to increase the population can be made. First in priority should be improvement of stream habitat by maintaining permanent sediment traps and removing beaver dams throughout the stream system. Sediment traps should be constructed in the following tributaries, with exact locations yet to be determined:

a) Clear Creek: Section 24
b) Snake Creek: Section 23
c) East Branch: Section 5 or 34
d) West Branch: Section 29

Long-term beaver control should include timber management to minimize aspen regeneration within 300 feet of tributary streams.

(3) Yearling (6+ inches) brook trout should be planted in early spring in the mainstream between the lower falls and County Road 550. A minimum plant of 5,000–10,000 yearlings should be planted. All planted fish should be marked with fin clips. Effectiveness of plants should be evaluated by noting the abundance of marked fish in subsequent years' catches. In years when lamprey treatments are scheduled by the U. S. Fish and Wildlife Service, trout plants should be made after the treatments.

(4) The Salmon Trout River should be closed to all fishing after September 1 for a period of 5 years. At the end of the fifth year, an evaluation of the overall effectiveness of this plan should be made. If coaster runs have improved significantly, consideration should be given to modifying this closure and permitting harvest of larger brook trout.

(5) The magnitude of the harvest of coasters in Lake Superior and in areas of the Salmon Trout River which are accessible to the public should be determined. This harvest could be a factor limiting abundance in the stream, especially if harvest is high, relative to the population size.

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Approved by W. C. Latta

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