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RAINBOW TROUT MANAGEMENT PLAN FOR THE MINNESOTA WATERS OF LAKE SUPERIOR

Prepared by

Minnesota Department of Natural Resources,
Division of Fisheries, in cooperation with the
Rainbow Trout Advisory Group

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PREFACE

Management of rainbow trout in the Minnesota waters of Lake Superior continues to evolve. This plan entitled a *Rainbow Trout Management Plan for the Minnesota Waters of Lake Superior* (RTMP) replaces a version developed 10 years ago called the *1992 North Shore Steelhead Plan* (NSSP) (Schreiner 1992). The change in the title from "steelhead" to "rainbow trout" reflects the inclusion of the Kamloops strain of rainbow trout in management of the rainbow trout resource. The title change in no way reflects a reduced effort by the Minnesota Department of Natural Resources (MNDNR) to manage steelhead. It does recognize the reality that Kamloops are currently part of the rainbow trout management program in Minnesota, and cannot be segregated from steelhead management.

The format of the RTMP is different than the earlier NSSP and has been modified to fit the chapter format used in the *Fisheries Management Plan for the Minnesota Waters of Lake Superior* (LSMP) (Schreiner 1995). This format enables direct insertion into the LSMP as a chapter when the LSMP is revised in 2005. Thereafter, the RTMP will become a chapter in the LSMP and will be updated when the LSMP is revised.

Many individuals and organizations interested in rainbow trout management in Lake Superior have come together to develop and support the RTMP. A planning group was formed as a sub-group of this larger group and will be referred to as the Rainbow Trout Advisory Group (Appendix 1). This group donated much time and energy to developing the RTMP and their efforts are greatly appreciated. A large number of personnel from the MNDNR Division of Fisheries were also involved in the planning effort (Appendix 2). It is our hope that we will be as successful in accomplishing the goals of the RTMP as we were in accomplishing the goals of the NSSP.

I. History

Anadromous rainbow trout (steelhead) from the west coast of North America were first introduced into the Minnesota waters of Lake Superior in 1895 (Hassinger et. al. 1974). The species has become naturalized and supports an important recreational fishery. Minnesota has approximately 180 miles of tributary streams accessible to steelhead, of which a more limited portion is suitable for spawning. For the most part, these areas supported a good fishery for naturalized steelhead from the 1940s through the 1960s. During the 1970s and 1980s, fishing pressure increased and anglers perceived that the number of steelhead were declining. In response, the MNDNR initiated a number of programs to enhance steelhead during this period. In several streams, upstream barriers to migration were altered to permit fish passage, and in-stream structures were designed to increase the amount and quality of habitat available to juvenile steelhead. From 1981-1992, natural reproduction of steelhead was supplemented by stocking large numbers of steelhead fry, usually in tributaries above the first barrier. A portion of the stocked fry came from eggs that were collected from adult steelhead returning to the French River trap. However, the majority of eggs used for fry production came from fish captured in the Little Manistee River trap in Michigan. Stream surveys indicated that fry stocking had increased the number of age 0+ steelhead in the streams, but that survival of fry to age 1+ was variable and largely dependent on environmental conditions.

Starting in the 1970s, experimental stocking of rainbow trout yearlings began in Minnesota as an attempt to augment the wild steelhead stocks. A large number of rainbow trout strains, both natural and domestic, were available. In 1972 and 1973, three domestic strains of rainbow trout, Donaldson, Madison, and Kamloops, were stocked and their performances in Lake Superior were evaluated (Close and Hassinger 1981). Results indicated that the Kamloops strain was the best suited for a put-grow-and-take fishery that would augment the growing harvest from the naturalized steelhead fishery. In 1976,

Minnesota began a Kamloops program with the goal of establishing a put-grow-and-take migratory rainbow trout fishery. Yearling Kamloops are reared in the hatchery, and have been stocked annually since the program began. Kamloops returning to the French River trap are used as the egg source for the hatchery-reared fish. Kamloops are stocked as yearlings, live in the lake, and first return to spawn in streams at ages 3-5. The Kamloops program has increased fishing opportunity and provided for an expanded harvest of rainbow trout. Since 1997, when catch and release regulations were implemented for wild steelhead, the Kamloops program has provided the only significant harvestable rainbow trout fishery in Minnesota's portion of Lake Superior. Kamloops have a tendency to stage off river mouths in fall, winter and early spring, entering the streams before steelhead. This provides shore-fishing opportunities that would not normally be available. This accessibility and the opportunity for harvest have made the Kamloops program very popular with a large number of anglers.

Efforts to augment the steelhead fishery were only partially successful, and despite the enhancement programs initiated, anglers and biologists remained concerned because the number of wild steelhead continued to decline through the 1980s. These trends were documented through returns to the French River trap and low numbers of steelhead sampled during creel surveys.

To address the decline of wild steelhead in the Minnesota waters of Lake Superior, the MNDNR, Division of Fisheries developed the North Shore Steelhead Plan (NSSP) (Schreiner 1992). Public input on the NSSP was received at a series of public meetings held in the winter of 1991-1992. Many changes were made to the plan based on this public comment. However, as expected, there was not unanimous support for all the proposed strategies.

The NSSP was implemented in 1992, modified during the development of the Lake Superior Management Plan (LSMP), and was scheduled for revision after 10 years, in 2002. Management strategies for rainbow trout detailed in the NSSP and the LSMP included: restrictive angling regulations; revised stocking strategies; beaver dam removal and increased beaver trapping; the construction of migratory fish traps and monitoring stations; a shore-wide genetics study; an economics study; and a variety of other projects. The NSSP was written to be flexible, and a number of modifications were made when it was incorporated into the LSMP. All objectives and many of the strategies outlined in the original plan have been addressed (Appendix 3). A steelhead plan progress report has been published annually over the last 10 years, and a biennial newsletter is published to continually update anglers and other interested citizens on the progress of the Lake Superior management program. A wide variety of reports and publications are available that describe the results of studies and assessments proposed in the NSSP.

The goal of the NSSP "to stop the decline of adult steelhead and gather the necessary information to rehabilitate wild steelhead stocks" has largely been accomplished. The decline in adult steelhead numbers has been reversed and although there are still information needs relevant to wild steelhead, the knowledge base on steelhead in Minnesota has grown significantly over the last 10 years. The purpose of the Rainbow Trout Management Plan (RTMP) is to utilize the information gained and work closely with interested citizens to continue restoration of wild steelhead stocks. Citizen participation included extensive dialog with the Rainbow Trout Advisory Group, solicitation of comments from the general public, and discussions with interested anglers about the rainbow trout fishery. As always, there were differences among user groups on how best to proceed, and the Rainbow Trout Advisory Group discussed those differences at length. Although no single group or individual is supportive of every strategy put forth in the plan, most have accepted the long-term goal and are interested in seeing restoration of wild steelhead continue. The information that follows is an attempt to build on the successes of the past plan and move forward with restoration efforts.

II. Goals and Objectives

Goal: The long-term goal of the RTMP is to *rehabilitate steelhead stocks using Minnesota strain fish to achieve a level that will allow limited angler harvest, largely supported by naturally reproducing populations.*

Objectives:

1. Protect or improve steelhead habitat in North Shore watersheds by maintaining suitable stream flows, water temperatures, water quality, and access to spawning and nursery areas.

2. Continue to investigate the factors limiting sustained production of naturalized steelhead in the Minnesota waters of Lake Superior by monitoring the fishery and conducting research.

3. Implement management strategies to rehabilitate naturalized steelhead populations with initial emphasis on the Knife River system.

4. While the rehabilitation plan is in progress, continue to provide a rainbow trout fishery that utilizes Kamloops, while attempting to minimize their genetic impacts on naturalized steelhead populations.

III. Present Management

A. Regulations – These regulations apply to the Minnesota waters of Lake Superior and its tributaries below the posted boundaries. The rainbow trout season is continuous. The possession limit is three rainbow trout, all of which must have a clipped adipose fin. All rainbow trout with an adipose fin must be released. The minimum size is 16 inches for rainbow trout with clipped adipose fins. In tributaries to Lake Superior above the posted boundary, no harvest of any rainbow trout is allowed. There are a number of fishing sanctuaries that have been established to protect spawning steelhead and their redds. Fishing for all species, in most of these areas, is closed from September 1 to May 31. A few areas are closed permanently to angling. See current fishing regulations for details.

B. Stocking - Only the gametes from steelhead and Kamloops strain rainbow trout taken from the Minnesota waters of Lake Superior are used for stocking programs. Streams are not stocked if they have very limited fishing access, or if they have good potential for natural reproduction by wild steelhead. Streams managed for Kamloops are given a lower priority for steelhead fry stocking. An annual quota of approximately 500,000 steelhead fry and 92,500 Kamloops yearlings has been established. When available, steelhead fry are stocked above the first barrier in selected tributaries, and Kamloops yearlings are stocked in the French River, Lester River and Chester Creek (Schreiner 1995).

Stocking hatchery-reared steelhead yearlings derived from Knife River gametes has been an ongoing program since 1989. The first phase of the Knife River steelhead yearling-stocking program began in 1989 and ended in 1993. The objective was to examine the feasibility and cost of rearing steelhead to yearling size in the French River Hatchery (Tureson 1994). The second phase of the program evaluated the return rate for the four year-classes of hatchery-reared Knife River yearlings to the French, Little Knife, and Knife river traps. Results were compiled in 2000 and information on return rates of stocked yearlings was presented at the Steelhead Conference held in September 2001, and discussed in detail with the Rainbow Trout Advisory Group while revising the RTMP.

In the spring of 1996, the MNDNR in cooperation with the Steelhead Focus Group (a precursor to the Rainbow Trout Advisory Group), agreed to reinstate the yearling steelhead stocking program at the level of 40,000 fish annually. This program was conducted under a memorandum of understanding between the MNDNR and the various organizations that comprised the Steelhead Focus Group. Each year 40,000 yearlings were reared with the financial assistance of the Lake Superior Steelhead

Association. Approximately 20,000 yearlings were stocked each year, alternating between the French and Knife rivers. Stocking yearlings in either the French or Knife rivers facilitated program evaluation and gamete collection for fry stocking in short run streams. The remaining 20,000 yearlings were stocked into streams determined by the Steelhead Focus Group and the MNDNR. Streams chosen by the Steelhead Focus Group since 1996 include Split Rock River, Gooseberry River, and Silver Creek.

C. Assessment - Stream surveys and population assessments are conducted on Lake Superior tributaries to determine the abundance and survival of juvenile rainbow trout, along with physical and chemical characteristics of each stream. Index stations have been established as described in *North Shore Index Station Assessment 1992-1999* (Morse 2000), and are assessed annually to determine the abundance of juvenile rainbow trout produced through natural reproduction.

Angling pressure, catch, and catch rate of rainbow trout are determined from creel surveys conducted in the spring, summer, and intermittently in the fall and winter on the Minnesota waters of Lake Superior. The spring creel survey targets rainbow trout, and has been conducted almost every year since 1970. The summer creel survey targets the lake fishery, but includes rainbow trout caught during this period. The fall creel survey targets the chinook salmon run, but also includes rainbow trout that are caught during this season. The winter survey normally targets the Kamloops and coho fishery that routinely develops along the Minnesota shoreline from Duluth to Two Harbors.

The French, Knife and Little Knife river traps are used to assess returns of adult rainbow trout. The French River adult trap has been in place since the mid-1970s, and is also used to collect feral brood stock for gamete production. In the spring of 1994, a smolt trap was constructed as part of the existing dam on the French River, to determine the number of juvenile steelhead migrating downstream that originated from fry stocking. The smolt trap has greatly increased the amount of information collected on steelhead in a medium-sized North Shore stream, and has helped document the effectiveness of fry stocking. The Little Knife River trap has been in operation since 1988, and data are being collected to determine trap efficiency, the smolt-adult relationship, smolt survival and other information that can be related to steelhead populations in a small stream. The Knife River adult trap was constructed in 1995 (Fish Pro 1993) and first operated in 1996. The Knife River smolt trap was constructed in 1996 and first operated in 1997. Important biological data have been collected on the wild populations that spawn in the Knife River and the juveniles they produce. Insufficient time has passed to determine the smolt-adult relationship in this stream, but monitoring of both adults and smolts will continue.

D. Habitat - Efforts to maintain suitable spawning and nursery habitat in North Shore streams continue. Beaver dams and log jams often block steelhead migration to spawning and nursery areas. Efforts to identify and remove these obstructions, along with the beaver, are ongoing. Sediment control along stream banks is another major area that requires both monitoring and active management. Review of development permits, consulting on roadway construction and culvert sitings, bank stabilization, and cooperative rip-rap projects are all methods used to minimize the continued erosion of stream banks. Easement and land acquisition programs along stream corridors have increased, but private landowners must be willing to participate before negotiations can take place. Cooperative in-stream habitat improvement projects have been conducted by local angling groups and the MNDNR, with the goal of increasing smolt production. Habitat improvement projects on a number of streams are monitored to assess their benefit to smolt production, and routine maintenance continues on many of these projects.

IV. Proposed Management

A. Regulations - No major changes in harvest regulations are proposed for rainbow trout in Lake Superior and its tributaries at

this time (see page 4 for current regulations). If wild steelhead rehabilitation succeeds and a limited harvest appears feasible, the MNDNR will meet with interested citizens to develop appropriate harvest regulations. A number of sites in tributary streams, including portions of the Knife River system, have been suggested as fish sanctuaries. The MNDNR will work with the Rainbow Trout Advisory Group to determine if and where such regulations may be appropriate. All proposed regulation changes must be approved through the rule making process.

Law enforcement activities directed at the spring rainbow trout run will continue to be a high priority for the MNDNR Division of Enforcement. Discussions with officers stationed along the North Shore, additional staffing, and angler involvement in drafting the Lake Superior MNDNR Enforcement Plan (MNDNR Enforcement 2002) will focus a variety of efforts on the spring rainbow trout run. A balanced approach between education and enforcement, with increased cooperation among anglers, should result in better awareness and compliance with rainbow trout regulations.

B. Stocking - Two different rainbow trout stocking programs are proposed. The first program is an attempt to rehabilitate steelhead numbers along the Minnesota shoreline by stocking both fry and yearling life stages of Minnesota strain steelhead in selected streams. The second program is to provide a geographically limited put-grow-and-take fishery for Kamloops rainbow trout that may be phased out if the wild steelhead populations recover and can provide an acceptable harvest fishery, or if negative genetic impacts of Kamloops on wild steelhead become measurable.

Steelhead yearlings will be reared at the French River Coldwater Hatchery, and gametes for the program will be collected from unclipped Knife River steelhead captured at the Knife River trap. This program will replace the yearling steelhead program begun in 1996. A total of 40,000 yearlings will be reared annually, with financial assistance from the Lake Superior Steelhead Association. All hatchery-reared yearlings will be identified with either a non-harvest fin clip (adipose fin will not be removed) and/or some type of tag/mark if an acceptable method can be developed. For the first 5 years, all 40,000 yearlings will be stocked into the Knife River system in an attempt to increase steelhead numbers. Initially, the most effective stocking locations in the Knife River system will be determined through an experimental process. To identify effective stocking locations, approximately 25% of the hatchery-reared steelhead smolts will be stocked above the Knife River trap in tributaries with low levels of natural reproduction. The remaining portion of hatchery-reared smolts will be stocked below the trap. Differential survival will be evaluated to determine the most effective stocking location. Initial survival of smolts stocked above the trap will be determined within one year, by monitoring their downstream movement through the Knife River smolt trap.

If the Knife River rehabilitation program is successful, and the estimated number of both wild and hatchery-reared steelhead returning to the Knife River adult trap exceeds an average of 1,000 per year, during 3 consecutive years, the MNDNR will meet with the Rainbow Trout Advisory Group to reevaluate and reduce or discontinue the yearling stocking program in the Knife River. Any yearlings not stocked into the Knife River will be stocked into streams agreed upon by the MNDNR and the Rainbow Trout Advisory Group. If the yearling program is not successful, average return to the Knife River trap is less than 1% for 3 consecutive year-classes, or becomes cost prohibitive, the MNDNR will meet with the Rainbow Trout Advisory Group to reevaluate and potentially discontinue the program.

All adults returning to the Knife River trap that were derived from stocked steelhead yearlings will either be passed directly above the Knife River trap so they can spawn on their own, or be transported to the French River hatchery where gametes will be taken and reared to the fry stage. All fry originating from adults produced in the Knife River yearling program will be stocked back into the Knife River system. Hatchery survival from egg to fry ranges from 60-80%, while survival from egg to fry in the wild seldom exceeds 5-

10%**.** Evaluations will be conducted to determine what method may be most productive at producing smolts. Initially, a combination of passing clipped adults above the Little Knife River trap, and stocking hatchery-produced fry in the main Knife River will be used, until one method proves more successful.

The fry stocking program for other streams will also utilize Minnesota strain steelhead as a source of gametes. The French River will continue to be stocked only with fry from wild adults returning to the French River. To produce a dependable source of fry for stocking in other Minnesota streams, the MNDNR will attempt to establish a captive "wild" brood stock. The brood stock will be created by collecting downstream migrants (both age 1+ and age 2+) from the Knife River smolt trap that will be reared at the French River Coldwater Hatchery. This is an innovative program that has not yet been evaluated. The goal is to produce 500,000 fry annually to be stocked every other year in selected streams (Table 1)**.**

It is estimated that approximately 200 pair of adults will be necessary to produce the fry quota for this program. If successful, the number of fry produced might be increased. Brood stock will continually be replaced from wild Knife River fish as described above. If the creation of brood stock is not achievable or becomes cost prohibitive, the program will be reevaluated and potentially discontinued. Criteria to reevaluate the program include: 1) unmanageable disease outbreak in captive brood stock; 2) survival from green egg to swim-up fry averages less than 50% for 3 consecutive years; 3) swim-up fry production averages less than 500,000 for 3 consecutive years; or 4) program becomes cost prohibitive.

The Kamloops stocking program will continue. However, because of the potential negative genetic consequences of inter-breeding with wild steelhead (Close 1999; Miller In Review; Negus 1999), Kamloops stocking will not be expanded outside the present stocked area, and increased efforts will be made to reduce straying. Kamloops yearlings will be reared at the French River Coldwater Hatchery, and gametes for the program will be collected from adults that return to the French River trap. In an attempt to increase stream fishing opportunities, Kamloops stocking will be discontinued in Chester Creek, and the quota of 7,500 will be added to the Lester River (Table 2). In an attempt to reduce Kamloops straying, all fish will be stocked directly into the stream, when flow conditions permit. If the combined return of adult Kamloops to the anglers and to the spawn taking operation at French River averages less than 1% for 3 consecutive years, the Kamloops program will be reevaluated. Also, in relation to rehabilitation of wild steelhead, the Kamloops program will be reevaluated and possibly phased out or discontinued if: 1) genetic introgression is demonstrated and measurable; 2) steelhead abundance rebounds to produce an acceptable fishery where Kamloops are not stocked; or 3) steelhead continue to decline only in areas with heavy Kamloops stocking. A phase-out of Kamloops stocking will not occur without discussions between the Rainbow Trout Advisory Group and the MNDNR.

Table 1. Lake Superior steelhead fry stocking quotas, frequency, locations, and priority in Minnesota.

Management Area/Stream	Tributary Number	Stocking Quota	Stocking frequency[1]	Stocking location[2]	Priority
Duluth Area					
Amity	S-5-1	70,000	E	2.4	2
Lester	S-5	100,000	O	12.9	3
Talmadge	S-7	30,000	E	3.7	2
French[3]	S-11	200,000	A	8.5	1
Stewart	S-19-1	100,000	E	7.7	1
Silver	S-21	50,000	O	6.6	3
Gooseberry	S-26	50,000	O	13.0	2
Finland Area					
Split Rock	S-29	100,000	O	3.9	2
East Beaver	S-35	100,000	E	3.6	2
Baptism	S-38	100,000	O	6.0	2
Cross	S-52	50,000	E	4.0	1
Grand Marais Area					
Temperance	S-53	100,000	E	0.6	1
Cascade	S-64	50,000	E	3.6	1
Brule	S-75	100,000	O	5.0	2

[1] A – Annual; O – Odd Years; E – Even Years
[2] Miles Above Mouth
[3] Fry from wild adults returning to French River.

Table 2. Lake Superior Kamloops yearling stocking quotas and locations in Minnesota.

Stream	Tributary Number	Stocking Quota
Lester	S-5	42,500
French	S-11	50,000

C. Assessment - A variety of techniques will continue to be used to assess the rainbow trout fishery and its management in Lake Superior. Continuation of the rainbow trout assessment program is essential to build on the long-term data series, so changes can be documented and trend analysis can be conducted.

An annual spring creel survey will be conducted to document fishing pressure, catch, and catch rate. A winter creel survey targeting the near shore rainbow trout fishery will be conducted once every three years. When required, the surveys can be used to evaluate angler views and perspectives on the resource, and its management. Annual juvenile steelhead assessments at index stations on North Shore tributaries will be conducted to assess natural reproduction and the contribution of stocking.

The French, Knife and Little Knife river traps will be used to assess returns of adult rainbow trout, and quantify the number of juveniles emigrating to the lake. Trap data will be compiled to determine: smolt-adult relationship; adult-smolt relationship; relationship of stocked fry to smolts; contribution of stocked fry to returning adults; return rate of stocked yearlings; and general population biology. Annual progress reports will be produced on each major assessment technique, and on the overall status of the

steelhead population. A synthesis report will be produced every five years on the French River trap results, the Knife River trap results, and the juvenile assessment program.

The continued operation of the Little Knife River trap will be critically reviewed to determine its usefulness to the assessment program and restoration efforts. The Little Knife River trap is presently being used to assess the smolt production from clipped steelhead adults passed above the adult trap. If the Little Knife trap is not being used for evaluation purposes, the grates can be removed to allow uninhibited fish passage. Experimental operation of the Knife River trap will occur over the next 2-3 years, to determine the best approach for using the viewing window and video camera to enumerate adults and potentially smolts moving through the trap. This will require that trap operation be modified by re-routing flow through the trap. Data collection using the video camera and viewing window will not occur until the abundance of adult steelhead reaches a level where sub-sampling is required (a total return of 500-600 adults per year). Much of the critical information collected, and the future information required to evaluate rehabilitation of steelhead, can only be gained by handling individual fish. The Rainbow Trout Advisory Group will be informed on the status of using the video camera.

D. Habitat - Specific locations of critical stream habitat for rainbow trout will be identified, described, and documented in GIS format for high priority tributary streams. MNDNR will work with other agencies and private landowners to implement and monitor the success of watershed scale projects, and where possible gain easement or ownership of riparian areas for fishing access and resource protection. When specific habitat projects are proposed or implemented, the required assessment operation will be included to evaluate the effectiveness of the project. If entire watershed projects are implemented, long-term trends in steelhead abundance will be monitored in an attempt to determine what affects watershed work has had on steelhead populations.

Coordination with forest managers to influence vegetation management and forestry practices in the riparian zone and sub-watersheds will continue to be an important factor in protecting and maintaining the water quality in North Shore streams. Beaver dam removal and beaver control will remain a high priority, as increasing the amount of natural habitat available for spawning and nursery areas is one of the most effective habitat programs available.

V. Rationale/Justification

This plan has evolved from the results of implementing the NSSP, and modifications that occurred in the LSMP. Since 1992, the decline in the number of wild steelhead has stabilized, and although annual variations may be large, catch rates from the spring fisheries in most streams have increased over the low levels of the early 1990s (Figure 1) (Ostazeski 2003). Based on the information collected over the last 10 years, steps are being proposed in this plan to increase the rehabilitation rate of wild steelhead populations in selected areas. In addition, the plan allows for continuation of the Kamloops program in a geographically limited area until wild steelhead populations recover and can provide an acceptable harvest fishery, or until negative genetic impacts of Kamloops on wild steelhead become measurable. We continue to pursue the goal of a wild, self-sustaining steelhead fishery, but recognize the desire by many anglers to take a more active management approach in selected areas to determine if the rate of rehabilitation can be enhanced.

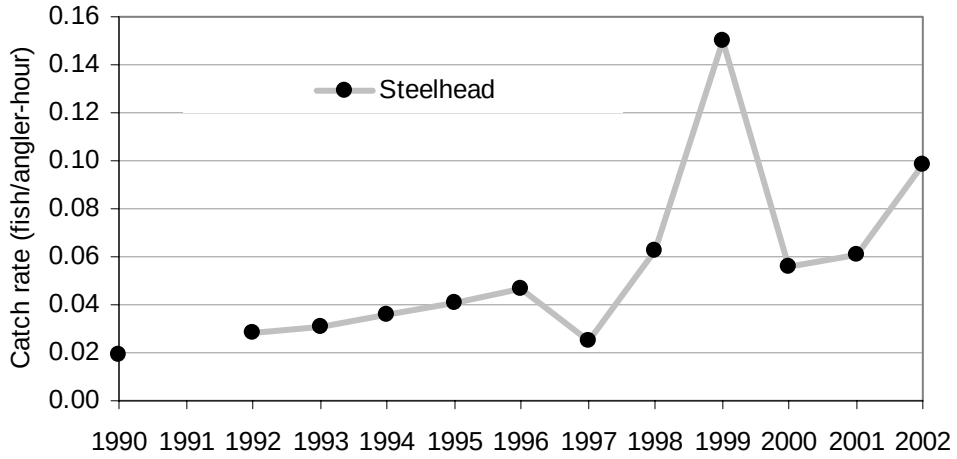

Figure 1. Catch rates for steelhead strain rainbow trout from spring anadromous creel surveys 1990-2002. No creel survey was conducted in 1991.

Much of the information gained over the last 10 years has directed the strategies proposed in the RTMP. These strategies include:

- Continuing to implement restrictive harvest regulations to protect the wild steelhead, while allowing harvest from the hatchery-based Kamloops program.

- Stock steelhead fry above barriers to supplement natural reproduction of steelhead. Information gained from the smolt trap on the French River indicates that smolts produced from stocked fry are 10 times more likely to survive than hatchery-reared yearlings. The creation of a "wild" brood stock should supply a stable source of gametes for fry production. The latter is an experimental program that will require some modifications to optimize, but has the potential to increase smolt production.

- Stock yearling steelhead to bolster the Knife River run, as it is the one major stream where the numbers of adult steelhead have not significantly rebounded. While survival of hatchery-reared yearlings has been disappointing, if a large number of yearlings are stocked in one stream the number of adults returning to spawn is likely to increase. Wild downstream migrants captured in the Knife River smolt trap suggest that returning adults will increase in 2003 and 2004, but will decline significantly in 2005 and 2006. The option of not stocking the stream and letting wild steelhead recover without intervention is genetically safer for wild steelhead and may have a higher chance of success, even though it may take longer. Despite being produced from wild Knife River gametes, experimental evidence suggests that stocked yearlings, and the adults derived from these yearlings, will be less fit than the wild steelhead in the Knife River system. Any reduced fitness could be heritable and retard or significantly decrease the chance for long-term rehabilitation of steelhead in the Knife River. Reduced fitness of stocked steelhead has been

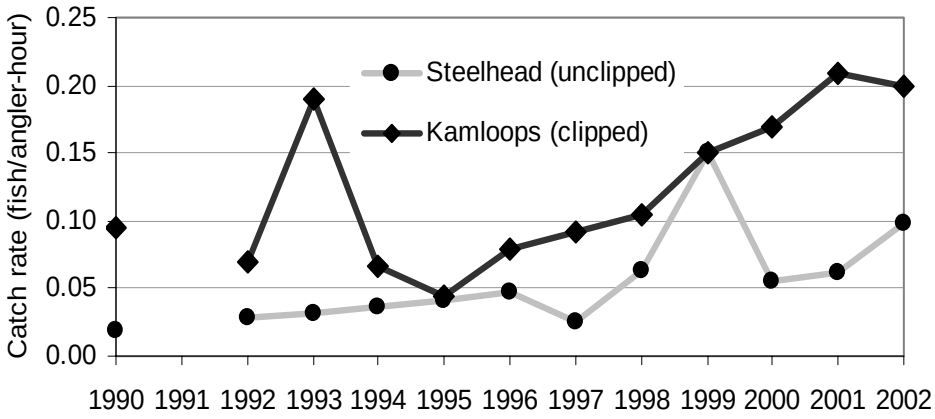

Figure 2. Catch rates for steelhead and Kamloops strain rainbow trout from spring anadromous creel surveys 1990-2002. No creel survey was conducted in 1991.

demonstrated in a number of other studies (Reisenbichler and McIntyre 1977; Miller 1990). Despite this risk, many anglers feel there may be an even larger risk in allowing the present population of steelhead to decline further.

- Continue the Kamloops stocking program at its present level, while acknowledging that there is a significant genetic risk to wild steelhead. The major risk is that Kamloops may spawn and hybridize with wild steelhead, which reduces the number of wild steelhead, and increases the potential for hybrids. There is also significant risk that surviving hybrids could reproduce and cause genetic introgression, which decreases fitness of the overall steelhead population. Despite this risk, many anglers would like the Kamloops program to continue or expand. Over one-half of the angling pressure in the spring fishery is directed at Kamloops, and the catch rates of Kamloops over the last three years is generally double that of steelhead (Figure 2). In addition, winter creel surveys show that fishing pressure for Kamloops surpasses spring fishing pressure for all rainbow trout strains. Presently, Kamloops are the only rainbow trout that can be harvested in Minnesota's portion of Lake Superior. The Kamloops fishery is a relatively low cost hatchery program that provides a fall, winter, and early spring shore fishery for rainbow trout where it otherwise would not exist.

  Many studies on West Coast steelhead and salmon have described the negative consequences that domesticated hatchery fish have on wild fish stocks (Bisson et al. 2002). Based on studies conducted by MNDNR research biologists and university scientists, hybridization between Kamloops and wild steelhead is a risk, and would likely be detrimental to wild steelhead rehabilitation efforts through dilution of steelhead gametes. Specific studies have shown that:

  - When in close proximity, Kamloops and steelhead will interbreed and produce hybrid juveniles in the wild (Close 1999).
  - Kamloops eggs have higher mortality than steelhead eggs under natural stream conditions (Negus 1999).
  - Steelhead fry are much more wary than Kamloops when startled (Negus 1999).

- Relative survival of stocked steelhead fry to age one in North Shore streams was 5 times greater than survival of Kamloops fry to age one (Miller In Review).
- Juvenile steelhead have a significantly higher survival rate than hybrid juveniles (steelhead-Kamloops cross) under natural stream conditions (Miller In Review).

In all studies, hybrids between steelhead and Kamloops performed at an intermediate level, with the maternal steelhead cross having higher survival than the maternal Kamloops cross. Results from the above studies suggest that when steelhead and Kamloops interbreed, the hybrid juveniles do not survive as well as pure steelhead. Steelhead gametes used to produce non-surviving hybrids, which otherwise may have created wild steelhead, are essentially "wasted." In addition, when hybrids are produced there is risk of genetic introgression with the consequences of reduced fitness for wild steelhead.

A portion of Dr. Miller's work attempted to identify Kamloops-steelhead hybrids that may already be present in Minnesota streams. Based on the sampling methods and genetic techniques used, he was unable to determine if hybrids existed because the techniques used could not identify a diagnostic marker for Kamloops. These inconclusive findings have provided for lively debate among anglers favoring Kamloops and those favoring wild steelhead.

Lacking proof of introgression or other measurable impacts of Kamloops on steelhead, outside the controlled studies referenced above, we are reluctant to discontinue the program. An alternative to elimination of the entire program is to restrict Kamloops stocking to a limited geographic area, and attempt to reduce straying from that area so the hybridization risk is minimized. Other fish management agencies on Lake Superior have expressed concern about the genetic consequences of Minnesota's Kamloops program, and support efforts to restrict or eliminate their use in Lake Superior.

- Work with other agencies and private citizens to protect, enhance, and maintain fish habitat. Continued development in the Lake Superior watershed is changing the habitat in Minnesota tributaries and in the near-shore portion of the lake. Most of these changes have negative effects on fish populations that inhabit these areas. Any effort the angling and environmental community can exert to manage development in order to protect or enhance the long-term health of these fisheries and ecosystems will be critical. Partnering with other agencies on watershed-scale projects will enhance the ability to accomplish this goal. The densities of beaver in riparian areas have increased as forest types have changed in the Lake Superior watershed. Beaver dams block fish passage, eliminating the use of large stream sections for spawning, and nursery areas by migratory fish.

Based on information gathered to date, the RTMP provides for protection and restoration of wild steelhead stocks on Minnesota's North Shore, while at the same time, addressing the diversity of angler concerns. The RTMP is oriented toward the long-term benefits for wild, self-sustaining steelhead populations. Although we have incorporated a hatchery component into the RTMP, a large hatchery-based program is not proposed, as it increases risks to wild steelhead stocks that still remain along the North Shore (Krueger et al. 1994). As stated in the NSSP, a 10 year period is the minimum amount of time required to test the results of most strategies. There will be an opportunity

for additional input in 2005, when the RTMP will be incorporated into the next version of the LSMP. Undoubtedly, there will also be some changes throughout the life of the plan as fish populations respond to the management actions or other influences. Modification of the plan will be initiated based on scientific information collected, and will occur with input from interested citizens.

As the RTMP is being finalized in late 2002, it appears the state of Minnesota, and the MNDNR may be working with fewer program dollars than in the past. Although it is difficult for both anglers and biologists to accept this reality, portions of this plan will only be implemented if the financial resources are available to carry them out. Some proposals in this plan may be delayed, or may not be implemented based entirely on the budget situation.

VI. Information Needs

Genetic related

- Examine the influence on genetics of wild Knife River steelhead from stocking hatchery-reared yearlings and fry derived from hatchery-reared adults into Knife River.

- Continue to search for diagnostic genetic markers that will identify Kamloops, and investigate the influence of Kamloops on the genetic composition of naturalized steelhead populations.

- Explore methods to reduce Kamloops straying, or minimize its effects on steelhead populations.

- Experiment with cryopreservation of steelhead sperm to maximize effective population size for production of steelhead gametes and minimize mortality of adult males by decreasing time they spend in the hatchery.

- Experiment with Kamloops to determine best method(s) to minimize passage through the Knife River trap, and determine extent of upstream movement under a variety of stream conditions.

Assessment

- Continue with trap operations to determine adult-smolt and smolt-adult relationships.

- Determine return rates for stocked yearlings.

- Evaluate efficacy of stocking fry derived from hatchery-reared adults versus the natural reproduction of passed hatchery-reared adults in the Knife River system.

- Evaluate the use of woody debris structures to enhance juvenile steelhead production in streams.

- Continue to document characteristics of the fisheries through regular creel surveys.

- Experiment with fish passage and camera operations at the Knife River trap, to determine most effective monitoring methods.

- When adult steelhead returns reach an appropriate level, consider relaxing restrictive harvest regulations on a cluster of streams, and monitor extensively to determine how the fish population and angling pressure responds to the expectation of increased exploitation.

- Investigate the impact of catch and release fishing on rainbow trout during the spawning run.

Community interactions

- Investigate steelhead interactions with Kamloops, other predators, and forage species.

- Examine the effects of environmental variables on rainbow trout populations.

- Determine physical habitat preference of rainbow trout in Lake Superior.

- Utilize bioenergetic modeling techniques to estimate carrying capacity of rainbow trout juveniles in North Shore streams, and their potential impact on native species.

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Appendix 1

Contributors to Rainbow Trout Management Plan

Rainbow Trout Advisory Group

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Lake County Anglers (Recreation Board)	Lino Rauzi
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Lake County Steelhead Catch and Donate	Martin Staples, Forest Johnson
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Kamloops Advocates	Ross Pearson, Pete Lundberg
Non-affiliated L.S. Angler	John Eaton

Appendix 2

Contributors to Rainbow Trout Management Plan

Minnesota Department of Natural Resources Fisheries Personnel

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Appendix 3

Objectives and accomplishments of the 1992 Steelhead Plan

1. Determine factors limiting production of adult steelhead

- Constructed traps on French and Knife rivers to determine smolt-adult and adult-smolt relationships.
- Completed project to determine limiting factors for juvenile steelhead in North Shore streams.
- Gained ability to monitor effects of catastrophic or rare events on smolts and adults using data from traps.
- Conducted stomach analysis of lake trout harvested in spring netting assessments.

2. Determine if North Shore steelhead fishery can provide quality angling by implementing principals of wild trout management

- Implemented trophy steelhead regulations (1 >28 inches), followed by catch and release only for wild steelhead.
- Discontinued stocking strains from outside Minnesota.
- Restricted Kamloops stocking - Bluebird to Chester Creek.
- Stocked only Minnesota strain fry above barriers in “short run” streams.
- Wild fish only in “long-run” streams - eliminated fry stocking.

3. Protect and improve steelhead habitat in North Shore watersheds by maintaining suitable flows, temperatures, water quality, and access to spawning and nursery areas

- Worked with other agencies on permit review process.
- Coordinated with Division of Forestry on state Best Management Practices.
- Worked with local teams on Knife River and Flute-Reed watershed projects.
- Monitored and eliminated beaver dams on Knife, Blackhoof, Nemadji, and other river systems.
- Created pictorial atlas of erosion sites on Knife River system, and mapped sites on other streams.
- Provided local counties with GIS atlas of shoreline and lower stream reaches to assist with resource decisions.
- Serve on county technical advisory committees that prioritize grants and loans for erosion control and septic projects that protect aquatic resources.
- Implemented, maintained, and assisted local clubs with in-stream habitat projects

4. Acquire additional information to address critical questions associated with steelhead management

- Used traps on French and Knife rivers to monitor steelhead runs, and collect detailed biological data.
- Conducted annual creel surveys to determine angler pressure, catch, and catch rate.
- Continued population assessments and full surveys on many anadromous streams.
- Established index stations and developed criteria to modify 1992 Steelhead Plan, if populations continued to decline.
- Collected continuous temperature and flow information on a number of streams during ice-free period.
- Constructed customized GIS maps of major watersheds.
- Conducted study to determine factors limiting juvenile steelhead survival in North Shore streams.
- Conducting study to determine impacts of adding woody debris on juvenile steelhead production in North Shore streams.

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