Lake Michigan Steelhead Fisheries Management Plan 1999

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
FISHERIES MANAGEMENT AND HABITAT PROTECTION
LAKE MICHIGAN FISHERIES TEAM
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LAKE MICHIGAN STEELHEAD FISHERIES MANAGEMENT PLAN 1999

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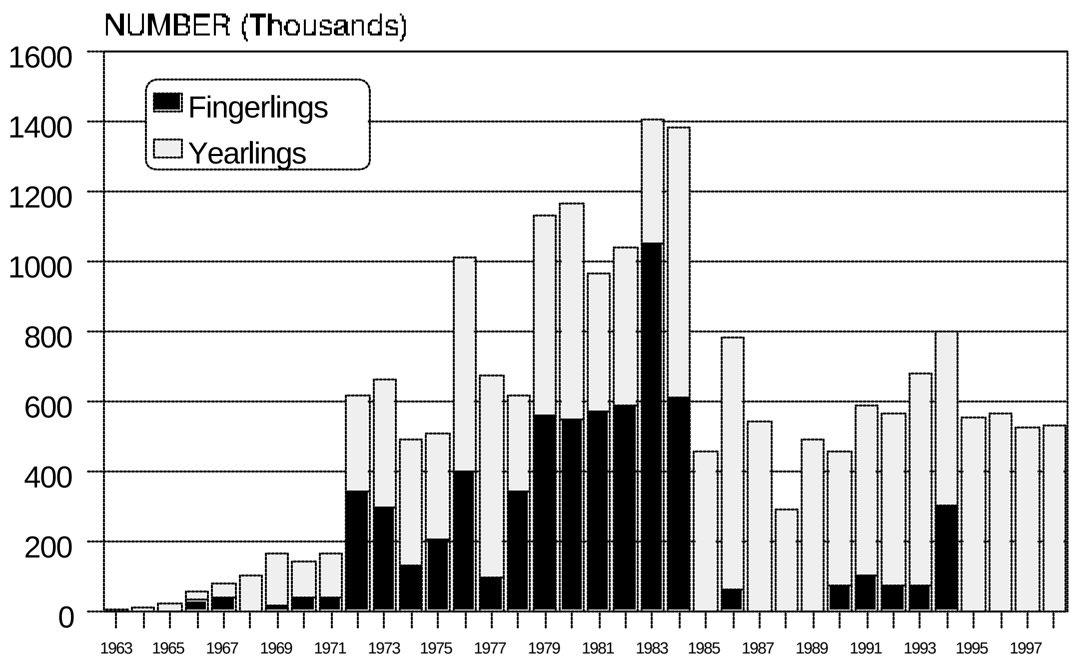
INTRODUCTION

Wisconsin began it's Lake Michigan rainbow/steelhead trout fishery in 1963 when rainbow trout were stocked in a Door County stream (Daly 1968). During the years following the original stocking, many changes in the fishery have occurred, including changes in the strains and the age of fish stocked (Figure 1). The early 1980's brought increased stocking, but the number of harvested steelhead remained stable (Figure 2). Also during this time period, catch rates declined to near record low levels (Figure 3).

Figure 1. Annual stocking of rainbow (steelhead) trout into the Wisconsin waters of Lake Michigan, 1963-1998



Concerns about a declining steelhead fishery prompted the Wisconsin Department of Natural Resources to form a steelhead committee to evaluate the program and make recommendations to improve the fishery (WDNR 1988). The 1988 Lake Michigan Steelhead Fishery Management Plan (LMSFMP) made recommendations in three areas: developing new stocking strategies, improving rearing facilities and increasing stream access for anglers.

The first section of this report will follow the format of the 1988 LMSFMP. Each problem and tactic is reviewed to evaluate what has been accomplished during the past decade of steelhead management and to determine if the objective of the LMSFMP has been met. The second section of the report is the 1999 Lake Michigan Steelhead Fishery Management Plan (LMSFMP 1999). The structure of this plan is similar to the 1988 LMSFMP and makes recommendations that will continue to improve the rainbow/steelhead fishery of Lake Michigan.

Figure 2. Annual harvest of rainbow (steelhead) trout by anglers fishing the Wisconsin waters of Lake Michigan, 1969-1998.

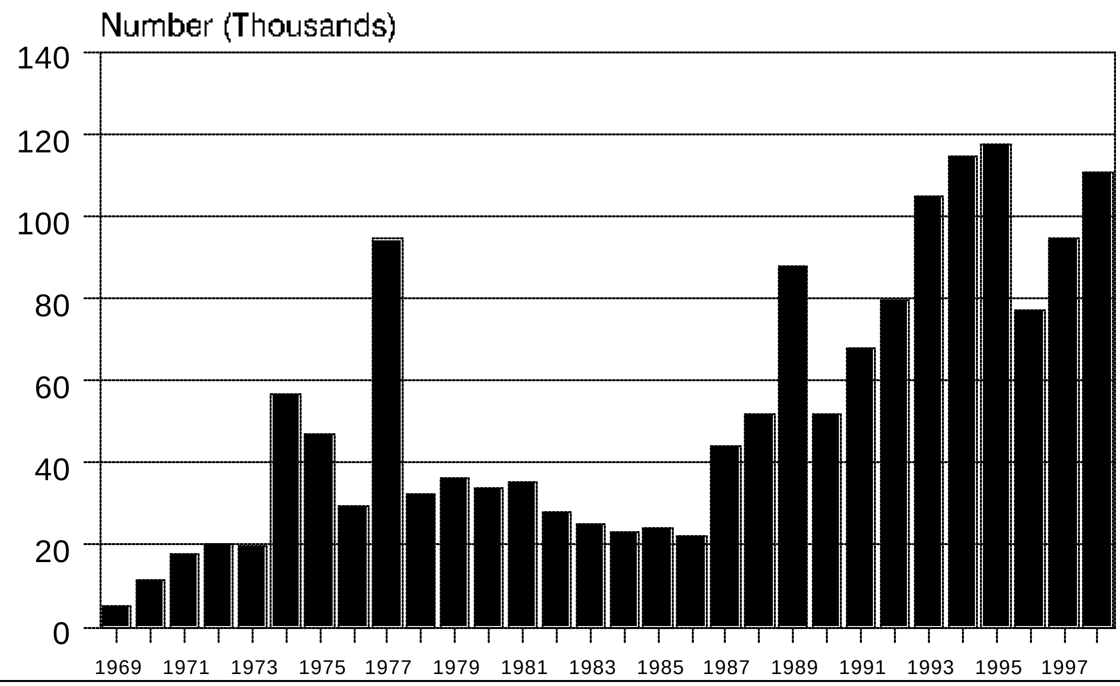
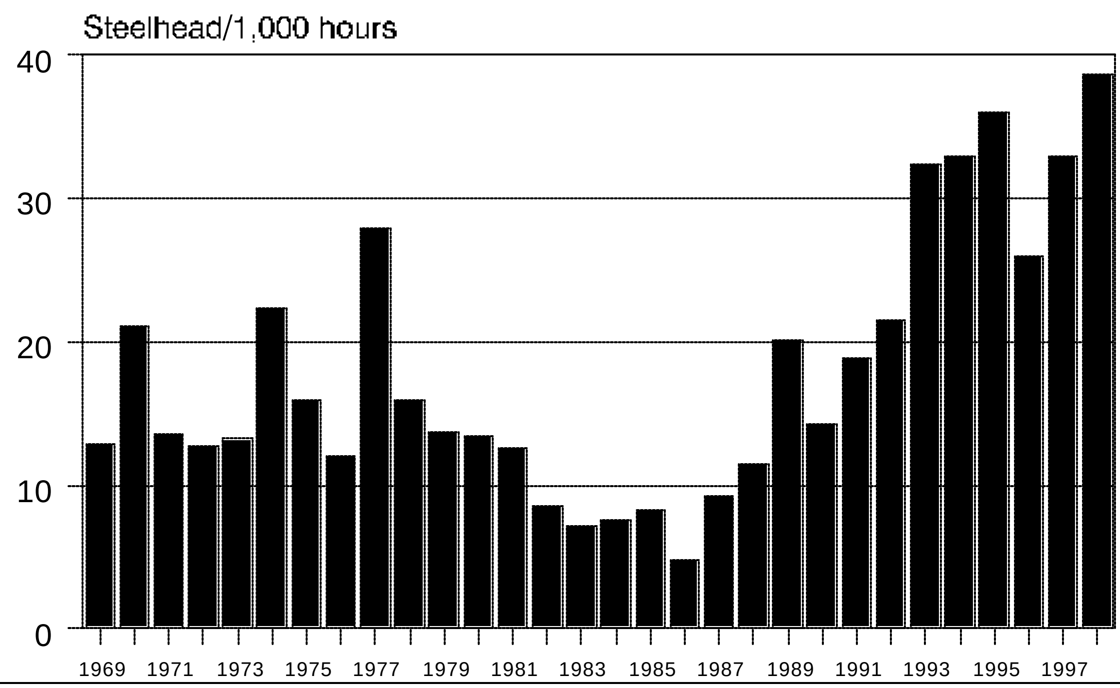


Figure 3. Annual harvest rate of rainbow (steelhead) trout by anglers fishing the Wisconsin waters of Lake Michigan, 1969-1998.



GOALS AND ACCOMPLISHMENTS OF THE 1988 STEELHEAD MANAGEMENT PLAN

The goal of the LMSFMP was to improve steelhead fishing in Lake Michigan and it's tributaries to sustain an annual harvest.

OBJECTIVE: To increase the annual harvest of steelhead from 25,000 to 50,000.

Problem 1: Return to creel is inadequate to reach the objective of 50,000 fish harvested.

<u>Tactic 1:</u> Stock proper strains

Three steelhead strains, Skamania, Chambers Creek, and Ganaraska were chosen by Wisconsin for it's Lake Michigan steelhead program. Although similar in appearance, each strain has unique characteristics that make it important to the overall steelhead program. It was hoped that these strains would provide a good return to the creel and provide more fishing opportunities throughout the year for anglers in tributary streams.

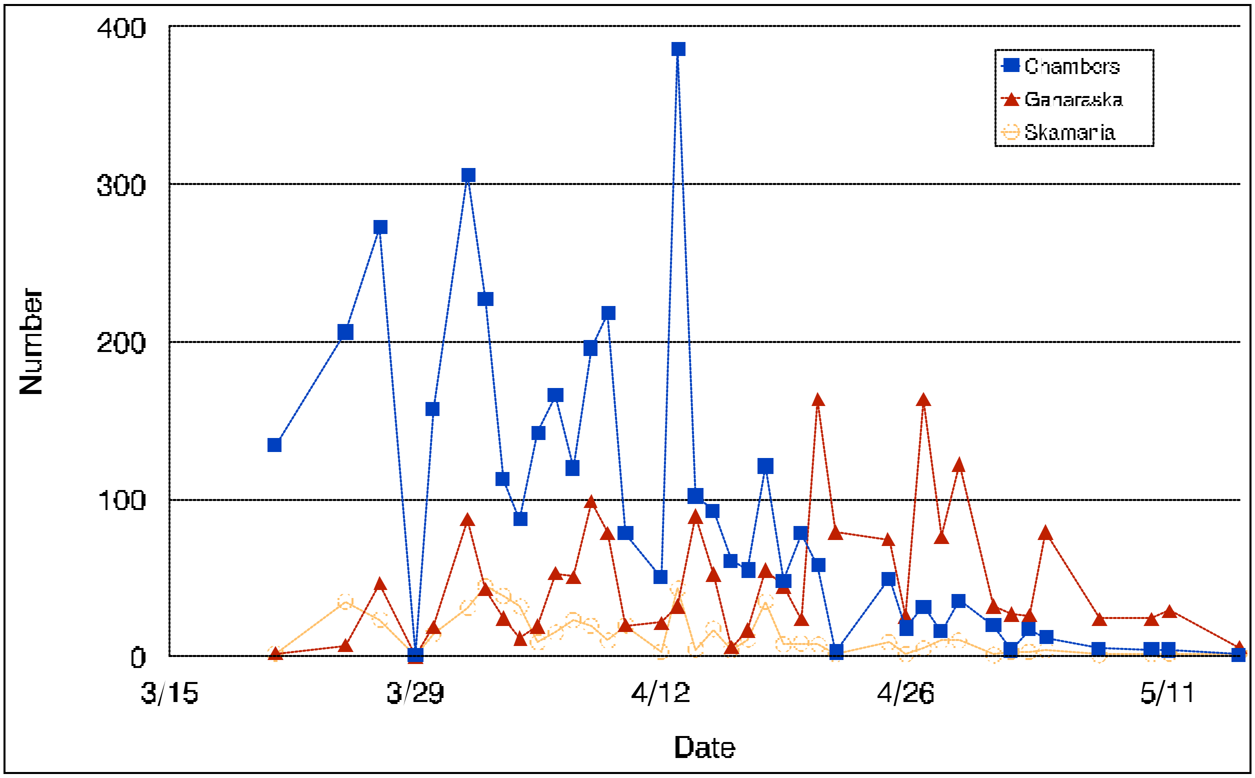
Skamania are summer/fall run steelhead that originated in Washington. Spawning migrations begin in early summer and peak in September. Skamania spawn in January and February, with the majority of spawning fish four or five years of age. An average four year old fish from an Indiana stream was 710 mm (28 inches) in length and 3.6 kg (8 pounds) in weight.

Chambers Creek strain steelhead also originally from Washington, were chosen because they begin their migration into streams in late fall and are available to stream anglers until early May. Peak spawning is in early April with the majority of fish being four or five years of age. An average four year old returning to a New York stream was 670 mm (26.5 inches) in length and 2.8 kg (6 pounds) in weight.

The Ganaraska strain, originally from the west coast and naturalized in Lake Ontario, was chosen because it is a spring run strain that would be available in streams until late May. Peak spawning is in late April, with the majority of the spawning fish five or six years of age although four through ten year old fish may be present in the stream. An average five year old Ganaraska spawning in an Ontario stream weighed 1.5 kg (3.3 pounds).

Steelhead size and age at return has differed from those observed by Wisconsin's egg sources. Data collected at the C.D. "Buzz" Besadny Anadromous Fisheries Facility (BAFF) from 1992 through 1997 (Hogler and Surendonk 1998), indicates that Skamania returned at similar age, but slightly larger in size than those observed in Indiana (Table 1). A five year old Skamania was 753 mm (29.6 inches) in length and weighed 3.7 kg (8.2 pounds). Chambers Creek strain fish return at an earlier age but larger in size than observed by New York. Most spawning adult fish were three or four years of age, with a four year fish being 732 mm (28.8 inches) in length, and weighing 3.6 kg (7.9 pounds). Similarly Ganaraska have returned to BAFF earlier in age and larger in size than observed in Ontario. Age three and four fish made up the majority of spawning fish, with a four year old having an average length of 680 mm (26.8 inches) and weighing 3.1 kg

(6.8 pounds). Similar sizes and ages were reported from the Root River Steelhead Facility



(RRSF) by Eggold (1998a) during the same time period.

Table 1. Comparison of age and size of return of steelhead from Wisconsin's egg sources and those observed at the Besadny Anadromous Fisheries Facility (BAFF), 1991-1997.

Strain		Egg Source	BAFF
Skamania (Indiana)	Age of Return Length at Return Weight at Return	4 and 5 710 mm 3.6 kg	4 and 5 753 mm 3.7 kg
Chambers Creek (New York)	Age of Return Length at Return Weight at Return	4 and 5 670 mm 2.8 kg	3 and 4 732 mm 3.6 kg
Ganaraska (Lake Ontario)	Age of Return Length at Return Weight at Return	5 and 6 -- 1.5 kg	3 and 4 680 mm 3.1 kg

The three strains chosen for Wisconsin's steelhead program have performed as expected by increasing return to the creel. Angler harvest of steelhead since the inception of

LMSFMP has ranged from a low of 51,711 in 1990, to a high of 117,508 in 1995 (Eggold 1998b). Harvest has greatly exceeded the annual goal of 50,000 steelhead.

The other goal of this tactic was to improve the stream fishery for anglers by increasing angling opportunities. We hoped that by stocking three strains of steelhead that migrated at different times, fish would be available to stream anglers for many more months of the year. Run time data collected at BAFF (Hogler and Surendonk 1998) indicate that steelhead return at distinct time periods during the year (Figure 4). However, the fall Chambers Creek steelhead run appears to be substantially less now than in the early years of the program, with most of the fish returning in early spring instead of early winter. The Ganaraska run peaks in late April as predicted, with fish available through May. Skamania returns have been extremely variable depending greatly on stream flow. Runs have started as early as July in years with good flow and cool temperatures, and as late as September when stream conditions were not favorable. Steelhead are available to stream anglers from August through the following May during most years, meeting the goal set by the LMSFMP of improving the stream fishery.

Figure 4. Average spring run time of steelhead by strain at the Besadny Anadromous Fisheries Facility during the time period 1992 through 1997.

Tactic 2: Stock the proper size of smolts, at the proper time in the proper streams.

Stock at the Proper Size

Research on steelhead indicate the critical size for stocking steelhead is 75 g to 113 g (4 to 6 fish/pound) and 191 mm (7.5 inches) in length (Seelbach 1985). The LMSFMP set these reported critical sizes as goals for Wisconsin's steelhead program. Stocking size has not approached the goals set by the LMSFMP. Skamania were the closest to LMSFMP goals with an average length of 161 mm (6.4 inches) and weight of 33 g (13.8 fish/ pound) when stocked (Table 2). Chambers Creek yearlings were stocked with an average length and weight of 159 mm (6.3 inches) and 32 g (14.2 fish/pound) respectively. Ganaraska were stocked at the smallest size with an average length of 142 mm (5.6 inches) and a weight of 20 g (22.7 fish/pound). Harvest numbers indicate that despite stocking fish at a smaller than goal size, returns have exceeded the goals of the LMSFMP.

Stock at the Proper Time

Stocking time has been more variable than stocking size. Stocking time depends greatly on growth rates of fish (water temperature and feeding rate), space availability at the hatchery (crowding), and stream conditions (ice, flow, and temperature). Steelhead have been stocked as early as January and as late as May. Average stocking time (the time between the first and last stockings) for each strain is generally between the last week of March and the second week of April. Skamania are stocked first, because of their larger size, followed by Chambers Creek and Ganaraska (Table 2). The average stocking date is April 3 for Skamania and April 10 for Chambers Creek and Ganaraska.

Table 2. Average stocking date, length and weight for steelhead, 1986 through 1998. The 1988 Lake Michigan Steelhead Fishery Management Plan goal was 191 mm in length, and 91 g in weight at time of stocking for steelhead.

	Chambers Creek			Ganaraska			Skamania		
Year	Average Stocking Date	Average Length (mm)	Average Weight (g)	Average Stocking Date	Average Length (mm)	Average Weight (g)	Average Stocking Date	Average Length (mm)	Average Weight (g)
1986	Mar. 29	154	30				Mar. 11	152	35
1987	Mar. 27	151	28				Mar. 25	176	45
1988	Apr. 20	164	36	Apr. 23	139	19	Apr. 4	172	42
1989	Mar. 23	158	34	May 4	121	25	Mar. 26	154	33
1990	Apr. 14	162	35	Mar. 16	163	36	Apr. 7	169	40
1991	Apr. 11	161	35	Apr. 6	154	36	Apr. 12	164	37
1992	Apr. 2	146	26	Apr. 12	142	24	Apr. 6	164	37
1993	Apr. 23	165	37	Apr. 26	136	21	Apr. 26	162	33
1994	Apr. 5	159	34	Apr. 6	135	20	Apr. 2	176	47
1995	Apr. 7	168	40	Apr. 23	139	22	Mar. 16	155	31
1996	Apr. 15	161	35	Mar. 17	137	20	Mar. 30	149	27
1997	Apr. 5	147	27	Apr. 4	147	26	Mar. 28	139	31
1998	Apr. 1	155	27	Apr. 1	132	19	Mar. 20	152	29
Avg.	Apr. 10	159	32	Apr. 10	142	22	Apr. 3	161	33

Stock Proper Numbers

The LMSFMP set a stocking goal of 500,000 yearling steelhead to improve the steelhead fishery and enhance the overall Lake Michigan salmonid fishery. Since 1988 when all three strains were introduced, Wisconsin has stocked approximately 500,000 yearling steelhead per year (Table 3). Shortfalls of yearlings in one strain were replaced if possible by yearlings of the other strains. Additional steelhead have been stocked as fingerlings and yearlings because of the availability of surplus fish in the hatchery system (Burzynski 1997).

Table 3. Stocking numbers for 1997 and 1998 yearling steelhead. Model output numbers are taken from the Lake Michigan Steelhead Fishery Management Plan (1988) and number stocked are taken from Wisconsin's Lake Michigan Salmonid Stocking Program Publication.

Management Area	Model output	Number stocked 1997	Number stocked 1998

Brood Rivers			
Kewaunee River	105,000	116,828	112,012
Root River	105,000	105,487	103,230
SUBTOTAL	**210,000**	**222,315**	**215,242**
Class 1			
Oconto River	22,200	30,940	22,866
Manitowoc/Branch River	22,200	41,303	22,386
Peshtigo River	22,200	22,448	23,016
Milwaukee River	22,200	32,862	33,053
East Twin River	22,200	22,255	26,737
Menominee River	22,200	21,763	22,823
Ahnapee River	22,200	22,479	22,528
Sheboygan River	22,200	38,887	22,338
West Twin River	22,200	22,394	26,846
SUBTOTAL	**199,800**	**255,331**	**222,593**
Class 2			
Pigeon River	6,500	6,517	6,699
Stoney Creek	6,500	6,643	7,005
Oak Creek	6,500	6,572	7,490
Heins Creek	6,500	6,788	6,825
Sauk Creek	6,500	6,588	6,799
Little River	6,500	6,555	6,726
Whitefish Bay Creek	6,500	13,281	13,007
Pike River	6,500	6,572	6,636
Fischer Creek	6,500	6,500	6,663
Hibbards Creek	6,500	6,788	6,825
Silver Creek	6,500	6,500	6,663
Reibolts Creek	6,500	0	0
Menomonee River	6,500	6,500	6,795
Kinnickinnic River	6,500	6,500	6,795
SUBTOTAL	**91,000**	**103,604**	**94,928**
TOTAL	**500,800**	**558,650**	**532,763**

Stock in the Proper Streams

The tactic outlined in the LMSFMP called for Skamania and Chambers Creek strain steelhead to be stocked in Class I streams that provided over winter habitat and remained open to Lake Michigan throughout the year. Typically these are large river systems and include: the Oconto, Manitowoc, Menominee, Milwaukee, East and West Twin, Ahnapee, and Sheboygan Rivers. Each river is allocated 11,100 Skamania and 11,100 Chambers Creek strain steelhead.

Class II streams lack over-wintering habitat, or became sand blocked. These streams include the Pigeon River, Stoney Creek, Oak Creek, Heins Creek, Sauk Creek, Little River, Whitefish Bay Creek, Pike River, Fischer Creek, Hibbards Creek, Silver Creek, Reibolts Creek, Menomonee River and Kinnickinnic River. Each Class II tributary is stocked with 6,500 Ganaraska.

The third class of streams were the designated broodstock waters. The Root and Kewaunee Rivers were to be stocked at a higher rate than other streams to insure enough steelhead returned to provide eggs and a fishery in the stream. The brood rivers were to receive 35,000 fish of each strain.

The actual number of stocked steelhead has closely followed the LMSFMP (Table 3). If shortages occurred, brood rivers received their full quota with shortfalls taken on other rivers. Surpluses were stocked into Class I streams.

Problem 2: Existing facilities may limit our ability to meet production goals to raise the three strains of steelhead in the number proposed by the LMSFMP.

<u>Tactic 1:</u> Improve production practices of all species to optimize total rearing efficiency.

The following production practices were initiated toward meeting the goal of 500,000 steelhead smolts for spring stockings: (1) The Kettle Moraine Springs Fish Hatchery transfers coho salmon production to Lake Mills Fish Hatchery as 1 to 2 million eyed eggs each fall. (2) An upgraded boiler system accelerates growth of Ganaraska strain fish to enable spring stocking during the first year of life. (3) The use of higher fat, protein and moist salmon diets improves the health of the fish. (4) Automated, timed feeding systems for fish from the fry through smolt stages preserves their wild characteristics. (5) Natural lighting is used except during handling and cleaning. (6) Reduced rearing densities improve the growth and health of steelhead. (7) Pond coverings over outdoor facilities cut direct sunlight and reduce avian predation. (8) Oxygen injection systems stabilize dissolved oxygen levels in raceways.

<u>Tactic 2:</u> Expand or improve existing facilities to meet production goals.

To achieve this tactic, several projects have been completed at Kettle Moraine to improve steelhead production. (1) Earthen ponds have been converted to 600 linear feet of raceway and feral brood stock holding space. (2) A groundwater study was conducted to determine the feasibility of developing a third high capacity well. (3) A recirculation water line has been constructed to provide increased water velocities to reduce stress in spring smolts.

In addition to the work completed at Kettle Moraine, two facilities, the Root River Steelhead Facility and Besadny Anadromous Fisheries Facility have been constructed to assist in the collection of eggs and adult broodstock from returning steelhead.

Problem 3: Angling opportunities may be limited by inadequate access to available habitat.

Tactic 1: Improve access to available habitat.

Land purchases and easements have been pursued to improve access to many miles of streams. In the Northeast Region access has been improved at Fischer Creek (Fischer Creek Park), Manitowoc River (Old Oslo Dam Site), Kewaunee River (Besadny Fish and Wildlife Area-boat landing and handicap accessible trails), Whitefish Dunes State Park (proposed handicap trails), Little River (Marinette County), Oconto River (boat ramps) and the Menominee River (boat ramps). In addition to these access sites, a fishery area along the Manitowoc and Branch Rivers was proposed.

In the Southeast Region the removal of the North Avenue dam has improved access to many stream miles for increased fishing opportunities on the Milwaukee River. Additional access was created on Sauk Creek (fishing easements) and on the Sheboygan River (boat ramps).

Tactic 2: Improve habitat accessible to existing access.

The Plan recognized the need for trout habitat and stream improvement that focused on providing cover for recently stocked juveniles and providing cover and holding areas for returning adults. To date, five projects have been completed, and are summarized below.

> Oak Creek-1990. During the summer of 1990, 26 LUNKER structures were installed in Oak Creek in Milwaukee County. In addition to these structures, 1,100 feet of stream was improved and eroded stream banks were repaired.
>
> Sauk Creek-1995. In the summer of 1995, 25 LUNKER structures were installed. Additionally, several eroding stream banks were repaired and the channel was narrowed and deepened for 2,500 feet.
>
> Kewaunee River-1995. During the summer, 4,500 feet of stream channel was deepened and had a meandering channel cut into it. Over 400 large boulders were placed in the deepened channel to provide resting locations for returning adult fish. Additionally, over one mile of eroding stream bank was stabilized with rip-rap.
>
> Milwaukee River-1997. With the removal of the North Avenue dam, many opportunities for habitat improvement were present. One hundred forty boulders, and many trees were placed upstream of the old dam site for cover and resting areas. Additionally, 24,248 feet of erodible stream bank was stabilized.
>
> Root River-1998. In a cooperative project with local sportclubs, 18 LUNKER structures were placed below the Root River Steelhead Facility to provide cover for migrating fish. Five hundred feet of stream bank around the weir return pipe was stabilized.

Tactic 3: Develop fish passage facilities to currently unavailable upstream river reaches.

Since development of the LMSFMP, only two dams, the North Avenue dam and Menomonee drop structure have been removed. Other dams have been considered for removal, but local communities have decided to maintain, repair or replace those dams.

Streams such as the Oconto and Peshtigo Rivers still have high quality headwaters suitable for natural reproduction of steelhead, but it is unlikely these dams will be removed because of the threat of sea lamprey invasion, and the need to isolate and protect native or naturalized inland trout species. The Little Scarboro, a tributary to the Kewaunee River, has a native brook trout population but does not have a barrier that prevents upstream migration of Great Lakes trout and salmon. In the years since the mid 1970's, brook trout have been reduced in number and the dominant salmonids have become steelhead and coho salmon. There are proposals to place a weir in the Little Scarboro to block upstream migration of adult Lake Michigan salmonids and remove their progeny to improve the native brook trout population. Consideration of native species must be given before dams are removed or fish passage occurs.

Summary of the 1988 Lake Michigan Steelhead Fishery Management Plan

The goal of the LMSFMP was to improve steelhead fishing on Lake Michigan and its tributaries. The measure of success was a harvest target of 50,000 steelhead per year. This goal has been surpassed every year since 1991 (Figure 2). In the years 1993 through 1995 the number of steelhead harvested has been more than twice the harvest target. This dramatic turn-around in the fishery may be credited to a management plan that clearly gave direction to the steelhead program. The strains selected, improved hatchery practices, and many management activities have made steelhead an important component of the Lake Michigan fishery. We recognized that a portion of the steelhead harvested may be stocked by other states or produced by natural reproduction in many Michigan streams.

Despite the success of the past decade of steelhead management, an updated Steelhead Management Plan is needed as a guide to continue the successes of the current program, and to continue to make improvements in the fishery.

THE 1999 LAKE MICHIGAN STEELHEAD FISHERY MANAGEMENT PLAN

The goal of this plan is to improve angling opportunities for steelhead in Lake Michigan and its tributaries.

OBJECTIVE: Maintain the annual steelhead harvest between 75,000 and 100,000 fish.

The first five tactics are a continuation of the 1988 LMSFMP. These tactics reflect the success of the current program. Changes in stocking size and time reflect the average size and time stocked since 1988. Areas that need improvement or new opportunities to improve the rainbow/steelhead fishery are identified as problems with tactics to address the issues.

<u>Tactic 1:</u> Continue stocking the current strains.

The three strains of steelhead currently stocked, Skamania, Chambers Creek and Ganaraska, continue to provide a popular Lake Michigan and stream fishery. Each strain contributes to the fishery of Lake Michigan and it's tributaries and should continue to be stocked.

<u>Tactic 2:</u> Stock the proper size of smolts, at the proper time in the proper streams.

Stock proper size smolts
Stocking size goals are set to correspond to average lengths and weights achieved since the inception of the current stocking program unless new facilities or technologies allow for greater growth. The new size goals are 160 mm (6.3 inches) in length and 33 g (14.3 fish/pound) in weight for stocked steelhead.

Stock at the proper time
The plan recognizes the variability in growth and development and in environmental conditions, but sets a target stocking time of the first week of April for steelhead of all strains destined for the brood rivers. Current hatchery space constraints limit how late into spring non-broodstock steelhead can be held before stocking, but every effort should be made to hold these fish as long as possible in order to approach size at stocking goals .

Stock the proper number of steelhead
Continue to stock 500,000 yearling per year. Facility constraints, and forage concerns on Lake Michigan limit the number of additional yearling steelhead that will be produced and stocked.

Stock the proper streams
Continue to stock steelhead in streams that provide habitat needed by recently stocked fish as well as for returning adults.

Class I streams are those that provide over winter habitat and remain open to Lake Michigan throughout the year. Typically these are large river systems and include: Oconto, Manitowoc, Menominee, Milwaukee, East and West Twin, Ahnapee, and the Sheboygan Rivers.

Class II streams lack over wintering habitat, or became sand blocked. These streams include the Pigeon River, Stoney Creek, Oak Creek, Heins Creek, Sauk Creek, Little River, Whitefish Bay Creek, Pike River, Fischer Creek, Hibbards Creek, Silver Creek, Reibolts Creek, Menomonee River and Kinnickinnic River.

Continue to stock enough steelhead in the broodstock streams to insure that production goals are met, and provide a stream fishery for local anglers.

<u>Tactic 3:</u> Update facilities and rearing techniques to improve steelhead production.

Continue to update Kettle Moraine by adding more rearing space and a building that would allow for individual matings to be raised separately. Continue to improve egg collection procedures at BAFF and RRSF.

<u>Tactic 4:</u> Continue to improve access to habitat.

Pursue easements and land acquisition on Great Lakes tributaries. Access is still limited on a number of high quality streams. Work with the Wisconsin Department of Natural Resources, Lands Division personnel and landowners to improve fishing access. Continue to develop the Manitowoc/Branch River Fishery Area.

<u>Tactic 5:</u> Continue to improve in stream habitat.

Continue to develop and complete projects that restore degraded stream habitat. These projects should improve habitat for adult and recently stocked fish. Two approved projects, one on the Oconto and one on the Milwaukee River, will place instream boulders for fish habitat and construct wing deflectors to improve water flow.

Problem 1: Near shore fishing opportunities have declined since the beginning of current stocking program. Shore and pier anglers now only account for 3% of the steelhead harvest and 4.7% of the total harvest of Lake Michigan salmonids (Eggold 1998a).

<u>Tactic 1:</u> Stock a rainbow trout strain that improves fishing for near shore anglers.

Rainbow Trout may be the most desirable salmonid to use as a near shore species for several reasons. First, many strains of rainbow are available through various sources and several are already found in the Great Lakes drainage. A strain could be selected that provides good growth, is disease resistant, is adapted to large lakes and remains near shore. Second, a strain could be selected that provides the type of near shore fishing that is desired, be it summer, fall, winter, or spring. Finally, rainbow have the ability to utilize all types of forage present. Rainbow diet is broad and could consist of other organisms, including insects, and would not relay exclusively on alewife for their primary food source.

Five strains of domestic rainbow are currently being stocked into the Great Lakes basin (Table 4). Each strain has one or more characteristics that may make it suitable for Wisconsin's nearshore water including spawning and peek harvest time and temperature tolerance to nearshore waters.

Several management issues must be discussed with the angling public before the nearshore plan is developed. These issues include: (1) a discussion of the tradeoffs that may be required to stock additional fish into Lake Michigan because of forage concerns; (2) a reduction in stocking of another species because hatchery space is limited; and (3) lake conditions (clearer water) that may make it impossible to create a salmonid nearshore fishery.

The proposed time line for introduction of a nearshore rainbow is as follows: (1) August 1999 - Include the selected strain in Lake Michigan stocking quotas for 2001. (2) 1999 - Obtain eggs from a disease free source and raise to stocking size. (3) spring 2001 - Mark fish and stock into Lake Michigan. Stocking would occur at six selected sites with 20,000 fish planted at each site for three years. (4) 2001 through 2006 - Evaluate the return rate of each year class of stocked rainbow. (5) 2007 - Write a summary report on the effectiveness of the nearshore rainbow program and determine the direction of future stockings.

Table 4. Potential rainbow trout strains found within the Great Lakes basin.

Strain	Broodstock Location	Comments
Arlee	Illinois	☐ Fall spawning. ☐ Has been stocked in Lake Michigan. ☐ Peak angler harvest spring and fall typically caught in harbors and warm water discharge areas. ☐ Perform well in hatcheries.
Eagle Lake	Michigan	☐ Fall spawning. ☐ Has been stocked in Lake Michigan. ☐ Peak angler harvest spring and fall, typically caught nearshore.
Erwin	Wisconsin	☐ Fall spawning. ☐ Currently being raised for inland stocking program. ☐ Early spawning time allows for larger stocking size.
Kamloops	Minnesota	☐ Spring spawning. ☐ Has been stocked in Lake Superior. ☐ Peak Angler harvest in the winter and spring typically caught nearshore and provides spring stream angling.
London	Ohio	☐ Fall spawning. ☐ Has been stocked in Lake Erie. ☐ Peak angler harvest in the fall, typically caught in harbors. ☐ Noted for high temperature tolerance.

Problem 2: A large number of steelhead (42%) are stocked into the two brood rivers, resulting in angler crowding on these rivers, and limited opportunities on other rivers.

Tactic 1: Reallocate steelhead stocking from brood rivers to other streams.

Steelhead that are stocked into the two brood streams, the Root and Kewaunee Rivers, serve two purposes: first, to provide eggs for the continuation of the steelhead program, and second, to provide a local stream fishery for anglers.

Current broodstock protocol (Ives 1996), requires that matings be single fish pairings and that 200 to 250 pairs of fish be used for gamete collection. Additionally, 50% of the eggs are to be collected from each steelhead facility.

Each steelhead facility has experienced a differing return rate pattern. While the return rate for Chambers Creek strain steelhead is similar at each location, the return rate for Ganaraska and Skamania strains at BAFF is approximately 50% of the return rate at the RRSF (Table 5). If multiple ages of return and return rate are combined, a table can be generated to determine the stocking rate needed to achieve the goals set by the broodstock protocol (Table 6). Options vary from just stocking enough fish to have the required adult return, to stocking triple what is needed for propagation. The current level of stocking is 35,000 steelhead of each strain each year. Several items are apparent: fewer fish need to be stocked in the Kewaunee and Root Rivers to have the minimum number of pairs return, and fewer fish need to be stocked into the Root River than the Kewaunee River to have an equal return number.

Table 5. Total return number and average return rate by strain to RRSF and BAFF. Return rates are based on the three dominant year classes that return each year. All fish are handled and aged at BAFF, while only a portion of the returning fish are handled and aged at RRSF.

	GANARASKA		CHAMBERS CREEK		SKAMANIA	
	Number Returning	Ret. Rate	Number Returning	Ret. Rate	Number Returning	Ret. Rate
Root River Steelhead Facility						
94-95	673	0.63	1728	1.7	831	0.79
95-96	1552	1.5	1182	1.17	546	0.52
96-97	1447	1.4	965	0.90	557	0.55
97-98	221	0.21	94	0.09	626	0.59
AVE.		0.94		0.97		0.61
Besadny Anadromous Fisheries Facility						
91-92	942	1.00	1,593	1.80		
92-93	737	0.70	831	0.77		
93-94	685	0.70	1,268	1.20	177	0.20
94-95	331	0.30	928	0.80	388	0.40
95-96	414	0.40	731	0.70	406	0.40
96-97	364	0.40	610	0.60	163	0.20
97-98	293	0.23	195	0.20	110	0.10
AVE.		0.53		0.88		0.26

Biologists have determined that the excellent return rates of Chambers Creek and Ganaraska steelhead to the RRSF will allow them to reallocate a portion of the stocking quota for the Root River (Table 3, 35,000 of each strain) into other regional streams. Based on return rates (Table 5) and calculating the number of spawning females needed for propagation purposes (Table 6), the Root River will be stocked with 27,000 Chambers Creek and Ganaraska and 35,000 Skamania steelhead, annually. The remainder of the old Root River stocking quota (8,000 Chambers Creek and 8,000 Ganaraska) will be divided between the other Southeast Region streams. Because of declining return rates of steelhead to BAFF, biologists are not recommending any changes to the Kewaunee River stocking quota at this time.

Table 6. Annual stocking numbers needed to achieve adequate spawning females based on 4 scenarios for the Root and Kewaunee Rivers. Additional fish would be stocked to provide a stream fishery.

		Minimum		Double		Triple		Quadruple	
	Return Rate	Return number	Number stocked	Return number	Number stocked	Return number	Number stocked	Return number	Number stocked
Root River									
GANARASKA	0.0094	252	8930	504	17873	756	26808	1008	35745
CHAMBERS CREEK	0.0097	252	8666	504	17333	756	25966	1008	34666
SKAMANIA	0.0061	252	13770	504	27533	756	41333	1008	55066
Kewaunee River									
GANARASKA	0.0053	252	14500	504	31700	756	47500	1008	63400
CHAMBERS CREEK	0.0088	252	9550	504	19100	756	28700	1008	38200
SKAMANIA	0.0026	252	32333	504	64666	756	97000	1008	129333

Stocking numbers determined by obtaining return number / return rate.
Base return number based on 63 females needed * 2 (half are ripe) * 2 (half are female)
Double, triple and quadruple return numbers based on 63 females needed * 2,3 or 4 * 2 (half are ripe) * 2 (half are female)

Problem 3: Current strain allocation of Class I and Class II steelhead streams does not optimize stream fishing opportunities.

<u>Tactic 1:</u> Redistribute steelhead strains in Class I and II steelhead streams to improve stream angling opportunities.

The 1988 LMSFMP divided Wisconsin's tributary streams into two classes. Class I streams are those streams that have sufficient year-round depth, flow and habitat to over winter adult fish. Class II steelhead streams are smaller tributaries that have limited habitat and may have their mouths blocked with sand during portions of the year.

Reallocating stocking numbers and strain distribution would improve the steelhead fishing in smaller tributaries. This can be accomplished by reducing broodstock stream numbers, or by reallocating the strains and number per strain that are currently stocked in Class I and II streams. Because current data suggests that Chambers Creek strain fish return mostly in spring, it is recommended that Class I streams be stocked with 6,000 Chambers Creek, 5,100 Ganaraska, and 11,110 Skamania (Table 7). The total number stocked into Class I streams would remain at 22,200 steelhead. In Class II streams it is recommended to stock equal numbers of Ganaraska and Chambers Creek steelhead while maintaining current stocking number (Table 8). This reallocation will increase fishing opportunities in Class I and II streams by lengthening the time steelhead are present in the stream. To this base allocation level for Class I and II streams additional steelhead could be added if reallocation from broodstock river occurs.

Table 7. Past stocking rates and reallocated stocking rates for Class I steelhead streams by strain.

Stream	1988 Allocation Chambers	1988 Allocation Skamania	1988 Allocation Ganaraska	1999 Allocation Chambers	1999 Allocation Skamania	1999 Allocation Ganaraska
Menominee	11,100	11,100	0	6,000	11,100	5,100
Oconto	11,100	11,100	0	6,000	11,100	5,100
Peshtigo	11,100	11,100	0	6,000	11,100	5,100
Ahnapee	11,100	11,100	0	6,000	11,100	5,100
Manitowoc	11,100	11,100	0	6,000	11,100	5,100
East Twin	11,100	11,100	0	6,000	11,100	5,100
West Twin	11,100	11,100	0	6,000	11,100	5,100
Sheboygan	11,100	11,100	0	6,000	11,100	5,100
Milwaukee	11,100	11,100	0	6,000	11,100	5,100
Total	99,900	99,900	0	54,000	99,900	45,900

Table 8. Past stocking rates and reallocated stocking rates for Class II steelhead streams by strain.

Stream	1988 Allocation Ganaraska	1988 Allocation Chambers	1999 Allocation Ganaraska	1999 Allocation Chambers
Little River	6,500	0	3,250	3,250
Heins Creek	6,500	0	3,250	3,250
Hibbards Creek	6,500	0	3,250	3,250
Whitefish Bay Creek	13,000	0	6,500	6,500
Stony Creek	6,500	0	3,250	3,250
Silver Creek	6,500	0	3,250	3,250
Fischer Creek	6,500	0	3,250	3,250
Pigeon River	6,500	0	3,250	3,250
Sauk Creek	6,500	0	3,250	3,250
Kinnickinnic River	6,500	0	3,250	3,250
Menomonee River	6,500	0	3,250	3,250
Oak Creek	6,500	0	3,250	3,250
Pike River	6,500	0	3,250	3,250
Total	91,000	0	45,500	45,500

Problem 4: Return numbers have decreased on the Kewaunee River while return has remained stable on the Root River. Both broodstock rivers need stable returns to ensure adequate gametes for production needs.

Tactic 1: Design and implement a study on the Kewaunee River to determine the affect of stocking location on return rate.

Currently steelhead are stocked approximately 4 miles above the dam at BAFF. During their downstream migration, steelhead are exposed to predation, warm stream temperatures and low water which may trap them above the dam. This study would include all three strains for three years using marked fish. Each year, one lot would be stocked above the dam and another stocked below the dam for each strain. During spawning migrations, all fish would be checked for marks and the stocking location determined. Return rates would be compared for the three year classes of the study and a management recommendation made on stocking location.

Tactic 2: Survey the lower Kewaunee River below BAFF to determine if other factors in the river contribute to the low return of adults.

Shallow areas in rivers expose fish to higher levels of bird predation than deeper sections. If return rate is affected by stocking location, design a habitat project that would deepen several shallow, featureless areas of the lower Kewaunee River. These deeper areas would have increased flow and depth reducing the number of stocked salmonids lost to bird predation.

Problem 5: A well-defined spawning protocol for steelhead is not followed.

Tactic 1: Follow the Anadromous Feral Broodstock Protocol to maintain desired genetic traits.

Steelhead migrations are triggered by a number of environmental factors including flow, water temperature and day length as well as genetics. To maintain our goal of August through May steelhead angling in Lake Michigan tributaries it is critical to maintain the genetic diversity of each strain. The Anadromous Feral Broodstock Protocol (Ives 1996) will be the goal for steelhead spawning. Keystones of the protocol include: one to one matings, a minimum number of spawning pairs (250 pairs of adults) and spawning throughout the run to maintain the genetic diversity of stocked steelhead.

Tactic 2: Develop an operational spawning protocol that will guide gamete collection at both steelhead facilities during spring and fall spawning migrations that addresses biological and fisheries management requirements.

Environmental factors may vary between the Root and Kewaunee Rivers causing migrations during different time periods making gamete collection difficult. During typical years, spring migrations at RRSF begin two weeks earlier than at BAFF and summer rain events can be local causing migrations at one facility and not the other. Further complicating egg collection is the distinction between run time or the time a strain is in the river, and spawning time or when fish are ripe. Early migrating fish may be held in ponds with later arrivals until ripe making the distinction between "early", "mid", and "late" migratory fish difficult. The management goal is for long migratory run time, but because of differing maturation rates it is difficult to collect gametes throughout the run. The ability to hold adults, and collect and raise small batches of fish would make the goals of the Anadromous Feral Broodstock Protocol achievable, but because of current hatchery space limitations a modified operational protocol must be followed. This protocol would include: (1) collection of extra eggs at RRSF to insure that quotas are met would be allowed, but these eggs should be discarded if BAFF is able to collect 50% of the quota; (2) that every effort should be made to spawn throughout the migratory run; and (3) collection of Skamania adults to be held at Kettle Moraine until ripe should occur at whatever facility has returning fish. If runs are adequate at both facilities, then 50% should come from each facility.

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