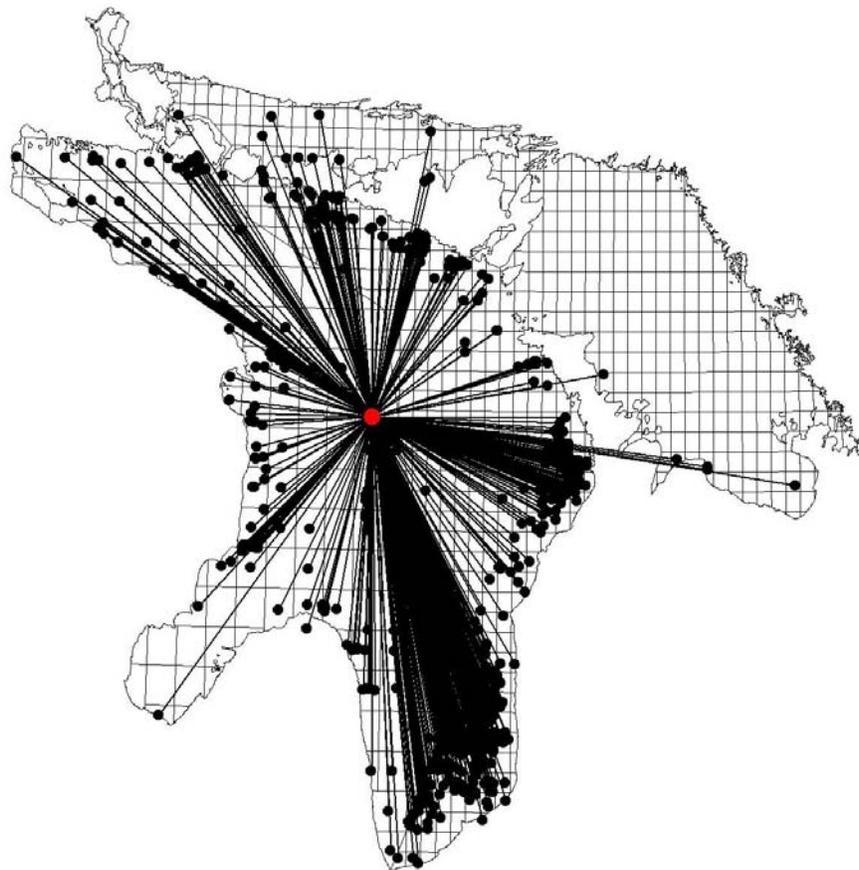


**LAKE TROUT REHABILITATION IN LAKE HURON
2002 PROGRESS REPORT ON
CODED-WIRE TAG RETURNS**



PRESENTED AT THE
GREAT LAKES FISHERY COMMISSION
LAKE HURON COMMITTEE MEETING
MILWAUKEE, WISCONSIN
MARCH 17, 2003

Lake Huron Committee
March 17, 2003

**Lake Trout Rehabilitation in Lake Huron--2002
Progress Report on Coded-Wire Tag Returns**

Prepared by:

Chuck Madenjian and Timothy Desorcie
U. S. Geological Survey
Great Lakes Science Center
1451 Green Road, Ann Arbor, Michigan 48105
chuck_madenjian@usgs.gov
timothy_desorcie@usgs.gov

Jerry McClain and Aaron Woldt
U.S. Fish and Wildlife Service
Alpena Fishery Resources Office
145 Water Street, Alpena, Michigan 49707
jerry_mcclain@fws.gov
aaron_woldt@fws.gov

Contributors:

Mark Ebener
Biological Services Division
Chippewa-Ottawa Resource Authority
186 East 3 Mile Road
Sault Ste. Marie, Michigan 49783
mebener@northernway.net

James Johnson and Ji He
Michigan Department of Natural Resources
Alpena Great Lakes Research Station
160 East Fletcher St.
Alpena, Michigan 49707
johnsonje@michigan.gov
hej@michigan.gov

Lloyd Mohr
Ontario Ministry of Natural Resources
611 Ninth Avenue East
Owen Sound, Ontario. N4K 3E4
lloyd.mohr@mnr.gov.on.ca

Presented at: Great Lakes Fishery Commission
Lake Huron Committee Meeting
Milwaukee, Wisconsin
March 17, 2003

Provisional data, not to be cited without permission.

BACKGROUND

Stocking of hatchery-reared lake trout was initiated in Lake Huron in 1973 following the implementation of sea lamprey (*Petromyzon marinus*) control. A single genotype (Marquette-Superior strain) was available to the hatchery program in the years 1973-1984 and the effort failed to establish stocks of naturally producing lake trout. Numerous hypotheses have been generated to explain the lack of progress. In addition to impacts of over fishing and sea lamprey wounding, genetic inadequacies and general fitness of the hatchery fish being stocked in Lake Huron were believed to be areas of major concern.

In March 1983, the Lake Huron Committee (LHC) of the Great Lakes Fishery Commission (GLFC) established the Lake Huron Technical Committee (LHTC) to plan a coordinated, lakewide lake trout rehabilitation strategy. The technical committee drafted a provisional rehabilitation plan in 1985 and amended it in 1986. In 1985, a multi-agency cooperative study was initiated to compare the relative performance of two alternative lake trout strains to that of the Marquette-Superior strain. A stocking strategy was initiated in the fall of 1985 to evaluate the performance of paired releases of Seneca Lake, Marquette-Superior, and Jenny Lake strains of lake trout. All lake trout used in this experiment were externally marked with an excised adipose fin and implanted with binary coded-wire tags (CWTs) and released into areas subjected to different selective pressures. In northern Lake Huron, lake trout were stocked off Drummond Island in the Northern Refuge where the hatchery fish would be subjected to heavy sea lamprey predation. In central Lake Huron, lake trout were stocked in the waters surrounding the Six Fathom Bank reef where hatchery fish would experience moderate sea lamprey predation and no commercial or sport fishing pressure. The objective of these studies is to monitor the performance of alternative lake trout strains in Lake Huron. Strain performance is being measured in terms of growth, sea lamprey wounding, survival, contribution to the spawning stock, and contribution to wild progeny. The overall goal of this program is the selection of preferred strains that will help facilitate the recovery of lake trout in Lake Huron.

Beginning in 1992, and again in 1994, 1996, 1998, and 2002, additional lots of Lewis Lake fish were stocked in the nearshore waters of western Lake Huron to begin quantifying the movement and dispersal patterns of hatchery fish. All movement fish were fin clipped (Ad) and implanted with CWT to enable detailed evaluation of recovered data. Tag recoveries will help biologists understand immigration and emigration between management zones and aid in the calculation of mortality rates and Harvest Limits (HLs).

Post-release assessment of all Ad clipped lake trout stocked in Lake Huron is accomplished through the collaborative efforts of the Great Lakes Science Center (GLSC), Michigan Department of Natural Resources (MDNR), Chippewa-Ottawa Resource Authority (CORA), Ontario Ministry of Natural Resources (OMNR), the Alpena Fishery Resources Office (FRO), three National Fish Hatcheries (NFH), and sport fishing groups.

Lake Trout Strain Program

Genetics strains - Historically, as many as 12 sub-populations or strains of lake trout stocks may have inhabited Lake Huron, each reflecting various degrees of adaptation to their local environment. However, with the exception of two remnant stocks in Georgian Bay, these variations have been lost forever. Restoration efforts over a 12-year period (1973-1984) using Marquette-Superior lake trout failed to establish stocks of naturally reproducing trout. Moreover, the use of a single genetic strain of lake trout may have actually hampered restoration efforts since Lake Superior fish evolved in a different environment and may not perform well in Lake Huron. Lack of progress to date does not preclude rehabilitation since the high quality physicochemical conditions that were responsible for the wide variety of lake trout inhabiting Lake Huron still exist. Thus, the potential remains for establishing one or more genetic strains of lake trout that are better suited for survival in specific Lake Huron environments. To evaluate the restoration potential of these different strains, matched plantings of CWT lake trout were initiated. At present, the performance of five strains of lake trout is being monitored as part of the Lake Huron lake trout restoration program.

The **Marquette-Superior** strain or "lean" lake trout is native to the cold deep waters of Lake Superior. Hatchery broodstocks were first developed in 1950 from remnant stocks that survived sea lamprey predation. Prior to 1985, all of the lake trout stocked in Lake Huron were Marquette-Superior fish. The Marquette-Superior strain has served as the "backbone" of the federal hatchery system for more than four decades, and this strain is still stocked in all the Great Lakes. Given their extensive stocking history, this strain was selected to serve as the standard with which to compare the performance of the other strains. Seventeen consecutive year-classes (1985-2001) of Marquette-Superior trout have been stocked in Lake Huron.

In 1889, Lewis and Shoshone Lakes in Yellowstone National Park were stocked with progeny reared from eggs originating in northern Lake Michigan (around Manistique, MI). Lake trout abundance soon increased through natural reproduction to the point where Lewis Lake fish were used to stock other high mountain lakes (e.g. Jenny Lake). However, concerns relative to over sampling and uncertainty of collecting gametes from high mountain lakes in the fall resulted in the development of two federal brood stock programs; first, the **Jenny Lake** program at Jackson Hole, Wyoming NFH in the early 1980's, and later in the mid 1980s, the **Lewis Lake** program at Saratoga, Wyoming NFH. Genetic testing of the Jenny Lake and Lewis Lake strains in the early 1980's indicated that the former had gone through a genetic bottleneck and lacked the heterozygosity possessed by the latter. When the Jenny Lake brood stock held at Jackson Hole NFH became infected with BKD and were destroyed in 1990, no effort was made to replace this strain. In 1989, the Lewis Lake brood stock matured at Saratoga NFH and began to supply eggs for the Lake Huron Program (1989-2001 year-classes). Because of the shortage of Lewis Lake fish, the 1989 stocking of Wyoming strain trout consisted of a mixture of Jenny Lake (eggs provided for the program were obtained from the Story, Wyoming state fish hatchery) and Lewis Lake fish.

One year-class (1985) of Jenny Lake x Lewis Lake out-cross and four year-classes (1986-1989) of Jenny Lake trout were stocked at Six Fathom Bank. Thirteen year-classes (1989-2001) of Lewis Lake strain fish have been stocked on offshore reefs. The introduction of Lewis Lake strain fish to the Lake Huron program could prove helpful since they are probably genetically more like the original northern Lake Michigan lake trout than any other lake trout left in the United States.

Lake trout from **Seneca Lake**, New York, were also included in the Lake Huron program in an attempt to inject sea lamprey resistant strains into the system. Unlike their Great Lakes counterparts who quickly succumbed to this parasite, lake trout in Seneca Lake have coexisted with sea lamprey for centuries. Moreover, Seneca Lake strain fish had been successfully stocked in Lake Champlain, New York in the early 1960s where they are reported to have survived and reproduced in the presence of sea lamprey. While no details were provided, New York biologists attributed their survival to the possibility that either this strain was less susceptible to attack or more resistant to sea lamprey predation.

Hatchery broodstocks (Seneca Lake strain) were developed for the lower Great Lakes at the Allegheny, Pennsylvania NFH during the mid-1970s from eggs supplied by the New York State Department of Conservation. In the early 1980s a second broodstock program for supplying Seneca Lake strain fish for the upper Great Lakes was started at Iron River NFH and provided four year-classes (1985-1988) of this strain for the paired plant study. Unfortunately, these fish became infected with Epizootic Epitheliotropic Disease (EED) and were destroyed in February of 1988. Following the loss of this brood stock and until the mid-1990's, the availability of Seneca Lake strain fish was not adequate to meet all the needs in the upper and lower Great Lakes and impacted the strain experiments in Lake Huron. Fortunately, Pendills Creek/Hiawatha NFH has developed a disease-free brood stock that is now producing eggs and should meet all existing needs for Seneca Lake fish in Lake Huron.

The **Lake Ontario** strain of lake trout was introduced into the strain evaluation experiment because of the shortage of Seneca Lake fish. This strain was developed from gametes taken from feral Lake Ontario lake trout in mid-1980s. Fin clips were used to assist biologists in identifying what were presumed to be mature male and female Seneca lake trout. However, subsequent testing of the captive Lake Ontario brood stock has shown that some genetic contamination from Clearwater Lake and Marquette-Superior lake trout occurred during the selection. Only three year-classes (1989, 1991-1992) of Lake Ontario strain lake trout were stocked in Lake Huron

Mid-lake stocking - The Six Fathom Bank/Yankee Reef area was established as a high priority special rehabilitation area in the multi-agency Management Plan. However, the portion of this offshore area known as Six Fathom Bank was upgraded to full Refuge status by the Michigan Department of Natural Resources in 1996. In fall 1997, the Ontario Ministry of Natural Resources also closed their waters adjacent to the refuge to all commercial and sport harvest of lake trout. The prohibition of all harvest of lake trout from the waters within the Six Fathom Bank Refuge will help provide the protection necessary to increase survival and further our goal of restoring lake trout stocks in Lake Huron.

Stocking lake trout on mid-lake reefs and the subsequent evaluation is an important element in the lakewide program for restoring self-sustaining populations of lake trout. The stocking of marked fish in these areas was designed to test the hypothesis that if lake trout are stocked in sufficient numbers as yearlings and are provided maximum protection from fishing, they will reproduce successfully and enough lake-produced progeny will survive to maturity to generate self-sustaining populations. To date, five strains of lake trout (Marquette-Superior, Jenny Lake, Lewis Lake, Seneca Lake and Lake Ontario) have been stocked on Six Fathom Bank. Through 2002, 2,509,918 coded-wire tagged lake trout have been stocked on this historically important spawning reef (Table 1).

A lake trout stocking experiment was initiated at the Yankee Reef complex in 1999. The objective of the experiment was to stock high densities of hatchery fish for three years, then discontinue stocking and monitor to determine whether this practice of "pulse stocking" would be successful in establishing a reproducing population of lake trout at that site. Only two year-classes (1992 and 1997) of hatchery lake trout had been stocked at Yankee Reef prior to the initiation of this experiment. In 1999, 233,500 Seneca Lake and 117,100 Lewis Lake yearling lake trout were stocked at Yankee Reef with the 1998 year-class lakewide fin clip (LV). In 2000, 344,990 Seneca Lake lake trout (1999 year-class) were stocked at this site, with 192,280 of the total receiving a CWT to aid in evaluation of the experiment (Table 2). The remaining 152,710 received the lake-wide fin clip (LP). In 2001, 379,258 Seneca Lake lake trout (2000 year-class) were stocked on Yankee Reef, with 216,895 of the total receiving a CWT to aid in evaluation of the experiment (Table 2). The remaining 162,363 received the lakewide fin clip (RPLV).

Northern Refuge stocking - The Drummond Island Refuge (Northern Refuge) site was selected: 1) To establish identifiable stocks of lake trout for monitoring sea lamprey attack and resultant mortality rates. A differential response to sea lamprey predation by the respective strains (Marquette-Superior, Seneca Lake, and Lake Ontario) would provide a measure of strain specific response to sea lamprey and provide a means to evaluate the efficacy of control measures considered for the St. Mary's River in northern Lake Huron; 2) Stocking on this refuge was also a provision of the 1985 Consent Agreement between the Native American Tribes affected by the Treaty of 1836, the State of Michigan, the U.S. Government and various sport fishing groups. Since the fall of 1985, a total of 1,962,339 coded-wire tagged lake trout has been stocked at this site (Table 3).

Nearshore stocking - For some time there has been speculation that a significant amount of immigration is occurring in MH-1, complicating the calculation of mortality rates and harvest levels (HLs). Beginning in 1992, and again in 1994, 1996, 1998 and 2002, experimental lots of lake trout were stocked at four nearshore sites in western Lake Huron to begin identifying the movement and dispersal patterns of these hatchery fish. In 1992 and 1994, lots of 60,000 fish each were stocked at Point Aux Barques, Sturgeon Point, Middle Island, and Adams Point. In 1995 the NFHs altered their production program to improve the quality of lake trout being stocked in the Great Lakes. To meet this objective, fewer fish are being held in the hatcheries, and they are being fed optimum rations throughout the hatchery cycle. As a result of the change, 35 percent fewer yearling fish are available for stocking in each of the lakes. It is hoped that improved quality will result in significantly better survival, and consequently in no net loss to lakewide abundance. The proposal was made to Lake Huron Technical Committee in July 1994 and the endorsed recommendation passed on to the Lake Huron Committee where it was approved. To evaluate the change, the Technical Committee has designed a study to compare the new hatchery product with the historical "standard". To facilitate the addition of this study to the Lake Huron program, the number of lots of nearshore fish being stocked for the movement study was increased from four to eight in order to

compare the relative survival of the new treatment groups. In 1996 and 1998, approximately equal numbers (30,000) of enhanced-quality and standard-quality yearling Lewis Lake lake trout were stocked at each of the four nearshore locations (Table 4). Tag recovery from assessment, commercial, and sport fisheries aids in evaluating the hatchery program as well as determining the extent and direction of movement from the stocking site. To further investigate movement of lake trout stocked in the nearshore region, lots of approximately 40,000 fish each were stocked at Point Aux Barques, Sturgeon Point, Middle Island, and Adams Point in 2002 (Table 4).

Table 1. Plants of lake trout marked with adipose fin clip and coded-wire tag at Six Fathom Bank Refuge.

Date Stocked	Number Stocked	Strain ¹ - Hatchery ²	Year-Class	Age	Tag Code
Nov 1985	90,599	MQ-IRR	1985	FF	431617
Nov 1985	90,039	SEN-IRR	1985	FF	431616
Nov 1985	90,630	JL/LL-IRR	1985	FF	431615
May 1987	39,700	MQ-PC	1986	YRLG	431701
May 1987	39,700	MQ-PC	1986	YRLG	431702
May 1987	34,350	SEN-PC	1986	YRLG	431703
May 1987	34,350	SEN-PC	1986	YRLG	431704
May 1987	41,350	JL-PC	1986	YRLG	431705
May 1987	41,350	JL-PC	1986	YRLG	431706
July 1988	33,500	JL-PC	1987	YRLG	431802
July 1988	34,000	JL-PC	1987	YRLG	431803
July 1988	38,200	SEN-PC	1987	YRLG	431804
July 1988	36,700	SEN-PC	1987	YRLG	431805
July 1988	42,500	MQ-PC	1987	YRLG	431806
July 1988	36,400	MQ-PC	1987	YRLG	431807
June 1989	33,600	JL-PC	1988	YRLG	431836
June 1989	33,600	JL-PC	1988	YRLG	431837
June 1989	33,325	SEN-PC	1988	YRLG	431838
June 1989	33,325	SEN-PC	1988	YRLG	431839
June 1989	34,125	MQ-PC	1988	YRLG	431840
June 1989	34,125	MQ-PC	1988	YRLG	431841
June 1990	20,500	JL-PC	1989	YRLG	431753
June 1990	65,400	MQ-PC	1989	YRLG	431737
June 1990	47,000	LL-PC	1989	YRLG	431736
June 1990	61,400	ONT-PC	1989	YRLG	431739
May 1991	61,200	LL-JR	1990	YRLG	431820
May 1991	61,500	SEN-JR	1990	YRLG	431819
May 1991	62,200	MQ-JR	1990	YRLG	431818
June 1992	61,500	ONT-JR	1991	YRLG	431919
June 1992	63,500	MQ-JR	1991	YRLG	431918
June 1992	63,500	LL-JR	1991	YRLG	431907
June 1993	68,500	LL-JR	1992	YRLG	431957
June 1993	64,300	MQ-JR	1992	YRLG	431959
June 1993	58,000	ONT-JR	1992	YRLG	431960
June 1994	39,100	MQ-JR	1993	YRLG	432003
June 1994	43,800	LL-JR	1993	YRLG	432004
June 1994	37,900	SEN-ALL	1993	YRLG	604750
June 1995	62,475	LL-JR	1994	YRLG	432015
June 1995	62,250	SEN-JR	1994	YRLG	431955
June 1995	60,175	MQ-JR	1994	YRLG	431956
June 1996	58,800	SEN-JR	1995	YRLG	432033
June 1996	52,900	MQ-JR	1995	YRLG	432035
June 1996	56,250	LL-JR	1995	YRLG	432036

June 1997	58,200	MQ-JR	1996	YRLG	432048
June 1997	59,900	LL-JR	1996	YRLG	432049
June 1997	59,900	SEN-JR	1996	YRLG	432050
April 1998	59,600	SEN-JR	1997	YRLG	432133
April 1998	60,900	LL-JR	1997	YRLG	432130
April 1998	53,800	MQ-JR	1997	YRLG	432134

TOTAL 2,509,918

¹JL=Jenny Lk; LL=Lewis Lk; MQ=Marquette; SEN=Seneca Lk; ONT=Ontario

²ALL=Allegheny NFH; IRR=Iron River NFH; JR=Jordan River NFH; PC=Pendills Creek NFH

Table 2. Plants of lake trout stocked for high-density experiment at Yankee Reef.

Date Stocked	Number Stocked	Strain ¹ – Hatchery ²	Year-Class	Age	Tag Code
April 1999	117,100	LL-JR	1998	YRLG	Lakewide LV
April 1999	119,500	SEN-JR	1998	YRLG	Lakewide LV
June 1999	114,000	SEN-PC	1998	YRLG	Lakewide LV
April 2000	120,210	SEN-PC	1999	YRLG	Lakewide LP
April 2000	32,500	SEN-JR	1999	YRLG	Lakewide LP
April 2000	192,280	SEN-JR	1999	YRLG	430225
April 2001	216,895	SEN-JR	2000	YRLG	430184
April 2001	162,363	SEN-JR	2000	YRLG	Lakewide RPLV

TOTAL 1,074,848

¹ LL=Lewis Lk; SEN=Seneca Lk

²JR=Jordan River NFH; PC=Pendills Creek NFH

Table 3. Plants of lake trout marked with adipose fin clips and coded-wire tags at the Northern Refuge.

Date Stocked	Number Stocked	Strain ¹ – Hatchery ²	Year-Class	Age	Tag Code
Nov 1985	52,791	SEN-IRR	1985	FF	431618
Nov 1985	51,303	MQ-IRR	1985	FF	431626
Nov 1987	94,963	SEN-IRR	1987	FF	431755
Nov 1987	92,603	MQ-IRR	1987	FF	431756
June 1989	72,600	MQ-PC	1988	YRLG	431834
June 1989	74,400	SEN-PC	1988	YRLG	431835
June 1990	18,500	ONT-PC	1989	YRLG	431750
June 1990	38,150	ONT-PC	1989	YRLG	431740
June 1990	71,700	MQ-PC	1989	YRLG	431738
June 1990	10,350	JL-PC	1989	YRLG	431754
May 1991	55,500	SEN-JR	1990	YRLG	431809
May 1991	71,500	MQ-JR	1990	YRLG	431810
June 1992	57,000	ONT-JR	1991	YRLG	431908
June 1992	70,000	MQ-JR	1991	YRLG	431909
June 1993	69,500	MQ-JR	1992	YRLG	431958
June 1993	60,700	ONT-JR	1992	YRLG	431961
June 1995	63,254	SEN-JR	1994	YRLG	431946
June 1995	65,426	MQ-JR	1994	YRLG	432040
May 1996	64,500	MQ-JR	1995	YRLG	432046
May 1996	66,400	SEN-JR	1995	YRLG	432047

April 1997	67,400	SEN-JR	1996	YRLG	432113
April 1997	67,900	MQ-JR	1996	YRLG	432032
April 1998	63,600	SEN-JR	1997	YRLG	432131
April 1998	61,700	MQ-JR	1997	YRLG	432114
April 1999	58,200	SEN-JR	1998	YRLG	430153
April 1999	60,500	MQ-JR	1998	YRLG	430152
April 2000	56,055	SEN-JR	1999	YRLG	430223
April 2000	61,341	MQ-JR	1999	YRLG	430224
April 2001	62,632	SEN-JR	2000	YRLG	430132
April 2001	60,754	MQ-JR	2000	YRLG	430131
April 2002	59,017	SEN-JR	2001	YRLG	430235
April 2002	62,100	MQ-JR	2001	YRLG	430234

TOTAL 1,962,339

¹ JL=Jenny Lk; MQ=Marquette; SEN=Seneca Lk; ONT= Ontario

² IRR=Iron River NFH; JR=Jordan River NFH; PC=Pendills Creek NFH

Table 4. Plants of lake trout marked with adipose fin clips and coded-wire tags along the western shore of Lake Huron.

Date Stocked	Number Stocked	Site Stocked	Strain ¹ – Hatchery ²	Year-Class	Age	Tag Code
June 1992	64,500	Sturgeon Pt.	LL-JR	1991	YRLG	431921
June 1992	64,800	Adams Pt.	LL-JR	1991	YRLG	431920
June 1992	60,000	Middle Is.	LL-JR	1991	YRLG	431922
June 1992	58,500	Pt. Aux Barques	LL-JR	1991	YRLG	431923
June 1994	60,000	Sturgeon Pt.	LL-JR	1993	YRLG	432011
June 1994	59,400	Adams Pt.	LL-JR	1993	YRLG	432013
June 1994	61,400	Middle Is.	LL-JR	1993	YRLG	432014
June 1994	62,100	Pt. Aux Barques	LL-JR	1993	YRLG	432012
June 1996	27,800	Sturgeon Pt. ³	LL-JR	1995	YRLG	432052
June 1996	28,300	Sturgeon Pt. ⁴	LL-JR	1995	YRLG	432056
June 1996	30,000	Adams Pt. ³	LL-JR	1995	YRLG	432054
June 1996	30,000	Adams Pt. ⁴	LL-JR	1995	YRLG	432058
June 1996	31,400	Middle Is. ³	LL-JR	1995	YRLG	432053
June 1996	30,500	Middle Is. ⁴	LL-JR	1995	YRLG	432057
June 1996	30,400	Pt. Aux Barques ³	LL-JR	1995	YRLG	432051
June 1996	29,500	Pt. Aux Barques ⁴	LL-JR	1995	YRLG	432055
June 1998	28,500	Sturgeon Pt. ³	LL-JR	1997	YRLG	430145
June 1998	25,700	Sturgeon Pt. ⁴	LL-JR	1997	YRLG	430140
June 1998	29,000	Adams Pt. ³	LL-JR	1997	YRLG	430144
June 1998	26,900	Adams Pt. ⁴	LL-JR	1997	YRLG	430142
June 1998	29,000	Middle Is. ³	LL-JR	1997	YRLG	430143
June 1998	28,600	Middle Is. ⁴	LL-JR	1997	YRLG	430141
June 1998	26,000	Pt. Aux Barques ³	LL-JR	1997	YRLG	430146
June 1998	30,200	Pt. Aux Barques ⁴	LL-JR	1997	YRLG	430139
June 2002	39,375	Sturgeon Pt.	LL-JR	2001	YRLG	430230
May 2002	38,903	Adams Pt.	LL-JR	2001	YRLG	430228
May 2002	39,066	Middle Is.	LL-JR	2001	YRLG	430229
June 2002	39,477	Pt. Aux Barques	LL-JR	2001	YRLG	430231

TOTAL 1,109,321

¹ LL= Lewis Lake

² JR= Jordan River NFH

³ Enhanced quality/size

⁴ Standard quality/size

2002 LAKEWIDE CODED-WIRE TAG RECOVERIES

In total, 1,766 CWTs were recovered in 2002 from lake trout in waters of Lake Huron; 464 by CORA, 323 by OMNR, 468 by FWS and USGS, 214 by MDNR, and 297 were recovered from the Michigan sport fishery. A few 17-year-old lake trout from the 1985 year-class stocked at Six Fathom Bank and the Northern Refuge are still present in the catch. Additionally, a substantial number of returns representing the 1995 and 1997 year-classes stocked for the movement study were available from the respective fisheries for analysis. Return data will be discussed for each study separately in the following sections of this report and represents total lakewide recovery of the individual lots.

In 2002, the 1995 and 1997 year-classes of Lewis Lake lake trout were well represented in the catch. Seneca Lake (1995, 1996, and 1997 year-classes) and Marquette-Superior (1997 year-class) lake trout also contributed substantially to the set of coded-wire tagged lake trout caught in 2002.

Recoveries from Six Fathom Bank – In total, 541 coded-wire tags were recovered in 2002 from lake trout stocked at Six Fathom Bank since 1985. This number represents total lakewide recoveries from all agencies, regardless of location, season, or gear in 2002. The percentage recovered by age was 29.9% age V, 20.5% age VI, 25.5% age VII, 12.9% age VIII, 2.4% age IX, 2.4% age X, 3.0% age XI, 0.7% age XII, 0.4% age XIII, 1.1% age XIV, 0.2% age XV, 0.6% age XV, and 0.4% age XVII. Total returns by strain in 2002 (all ages combined) were 4.6% Lake Ontario, 22.9% Marquette-Superior, 31.4% Seneca Lake, 40.9% Lewis Lake, and 0.2% Jenny Lake x Lewis Lake cross. Once again significant differences between strains in the age at return were observed and will be discussed in the Summary of Six Fathom Bank Recoveries, 1987-2002.

Recoveries from the Northern Refuge - In total, 346 coded-wire tags were recovered in 2002 from lake trout stocked in the Northern Refuge since 1985. This number represents total lakewide recoveries from all agencies, regardless of location, season, or gear in 2002. The percent return by age was 9.0% age III, 31.2% age IV, 24.0% age V, 11.3% age VI, 14.5% age VII, 6.3% age VIII, 1.1% age X, 0.3% age XI, 0.8% age XII, 0.6% age XIII, 0.3% age XIV, 0.3% age XV, and 0.3% age XVII. Total recovery by strain (all ages combined) was 0% Jenny Lake, 2.0% Lake Ontario, 65.3% Seneca Lake, and 32.7% Marquette-Superior. Significant trends in strain specific survival rates continued to be evident in 2002 and will be discussed in more detail in the Summary of Northern Refuge Recoveries, 1987-2002.

Recoveries from the nearshore movement study - The 1991, 1993, 1995, and 1997 year-classes of Lewis Lake strain lake trout stocked for evaluation of movement patterns and improved quality of hatchery fish are now vulnerable to all fisheries gear, and the 1995 and 1997 year-classes contributed heavily to the 2002 catch. The 1991 and 1993 year-classes represented only 0.1 and 4.5% of the 2002 catch of nearshore movement lake trout, whereas the 1995 and 1997 year-classes represented 26.6 and 68.8% of the 2001 catch. In 2002, 673 coded-wire tags were recovered from lake trout stocked for the nearshore movement study. Further, returns from lake trout tagged for the nearshore movement study represented about 38% of the total lakewide CWT returns in 2002. Most of these 673 returns were provided by nearshore surveys conducted by the Michigan sport fishery (33.7%) and by the Michigan DNR (27.2%). Lakewide returns from each of the four stocking sites were as follows: 27.5% from Adams Point, 27.8%

from Middle Island, 19.5% from Sturgeon Point, and 25.2% from Pt. Aux Barques. Since 1993, 4,527 CWTs have been returned from the first four year-classes stocked in this study. Of this total, 1,277 (28.2%) represented the 1991 year-class, 1,154 (25.5%) the 1993 year-class, 1,268 (28.0%) the 1995 year-class, and 828 (18.3%) the 1997 year-class. Additional discussion of these recoveries will be presented in the Summary of Lake Trout Movement, 2002.

Recoveries from the quality-at-release study - Since 1997, 2,096 CWTs have been recovered from lake trout stocked into nearshore waters of Lake Huron, during 1996 and 1998, to evaluate the effect of quality of yearling lake trout reared at Jordan River NFH and released into the lake on their survival in the lake. These 2,096 lake trout represent the total catch from commercial, assessment, and sport fisheries. Of the 2,096 lake trout recovered, 1,268 individuals were from the 1995 year-class and 828 individuals were from the 1997 year-class. Analysis of the recapture data continues to indicate a strong survival advantage conferred upon the enhanced-quality yearlings compared with the standard-quality yearlings (Figure 1). For the 1995 year-class, survival of the enhanced-quality yearlings was significantly higher than that for the standard-quality yearlings ($\chi^2=90.1$; $df=1$; $P<0.0001$). Likewise, for the 1997 year-class, survival of

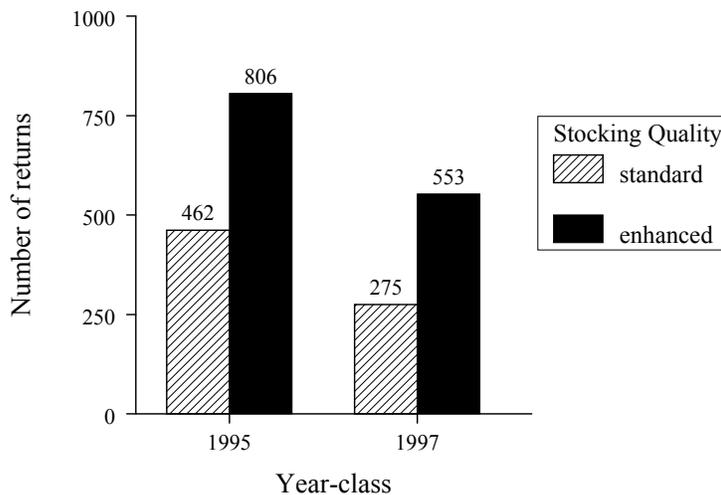


Figure 1. Number of returns, through 2002, of standard-quality and enhanced-quality lake trout stocked into Lake Huron during 1996 and 1998 as yearlings. Refer to Table 4 for more details on stocking history.

the enhanced-quality yearlings was significantly higher than that for the standard-quality yearlings ($\chi^2=90.7$; $df=1$; $P<0.0001$). To date, survival of the enhanced-quality yearlings of the 1995 year-class is 1.73 times higher than that for the standard-quality yearlings. The difference in estimated survival between the two groups of the 1997 year-class is even greater, with enhanced-quality yearlings surviving at 1.99 times the rate for standard-quality yearlings. Note that these survival rate ratios were calculated by adjusting the ratio of CWT returns by the number of lake trout stocked (see Table 4). Ratio of survival rate of enhanced-quality yearling with survival rate of standard-quality yearlings varied with stocking location. For the 1995 year-class, survival rate ratios were 1.44, 1.48, 2.65, and 1.94 for stockings at Adams Point, Middle Island, Sturgeon Point, and Pt. Aux Barques. For the 1997 year-class, survival rate ratios were 1.61, 2.30, 1.57, and 2.92 for stockings at Adams Point, Middle Island, Sturgeon Point, and Pt. Aux Barques. Mean total length of enhanced-quality lake trout from the 1995 year-class had remained about 15 mm greater than that for the standard-quality lake trout during 1998-2001, however in 2002 enhanced-quality fish were only 2 mm, on the average, greater in total length than standard-quality fish (Figure 2). This narrowing of the difference in mean total length was possibly due

to a greater extent of maturation in the enhanced-quality fish. The difference in mean total length between the two quality-at-release groups of the 1997 year-class has averaged about 30 mm during the past four years (Figure 2). Once again, it must be stressed that the results of this study have application only for the effects of the program change at Jordan River NFH. These data should not be interpreted as applicable to similar program changes at Pendills Creek and Iron River NFHs. Similar evaluations should be undertaken for those two facilities independently.

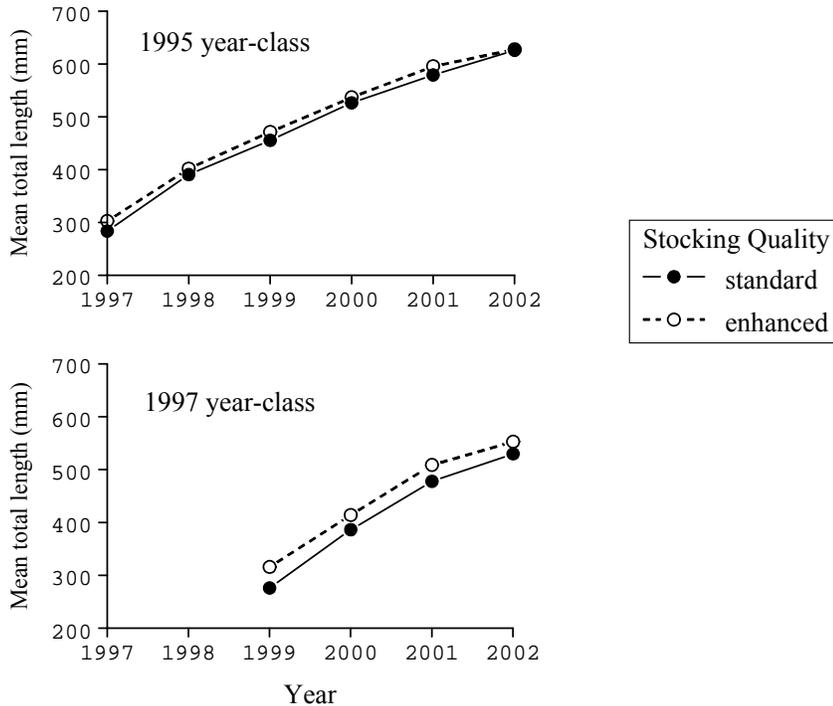


Figure 2. Mean total length of standard-quality and enhanced-quality lake trout stocked into Lake Huron during 1996 and 1998 as yearlings. Refer to Table 4 for more details on stocking history.

2002 ASSESSMENT OF THE OFFSHORE LAKE TROUT STOCKS

Since June 1986, the Great Lakes Science Center (GLSC) has conducted spring assessments of lake trout, burbot, and prey fish stocks in the Six Fathom Bank lake trout refuge. Assessment of the spawning stock to determine relative abundance and sexual maturity of lake trout on Six Fathom Bank was initiated in October 1991 and continued through 2002. During the 1993-99 period, these fall surveys were conducted as a cooperative project with GLSC and FWS personnel aboard the FWS vessel *M/V Togue*. Beginning in 2000, this responsibility was assumed by the FWS-Alpena FRO. Assessment of lake trout on Yankee Reef, located 15 miles southwest of Six Fathom Bank, was added in 1992 to determine if immigration of coded-wire tagged lake trout from Six Fathom Bank was occurring. Beginning in the fall of 2000, the FWS initiated spawning surveys at Yankee Reef to monitor the effects of high density stocking at that reef complex in 1999-2001. In 1993, fry surveys were added to the spring assessments conducted by the GLSC in an effort to identify lake trout nursery areas and determine if reproduction was occurring.

Spring assessment- The spring assessment for lake trout on Six Fathom Bank and Yankee Reef was conducted in June during 2002. In total, 337 lake trout were caught in 8,100 feet of graded mesh gill nets (2-6 inch) fished at Six Fathom Bank during 2002, and 124 lake trout were caught in 5,400 feet of graded mesh gill nets (2-6 inch) fished at Yankee Reef during 2002. Thus, CPUEs at Six Fathom Bank and Yankee Reef were 41.6 and 23.0 lake trout/1000 ft. of gill net. Of the 337 lake trout caught on Six

Fathom Bank, 223 had an adipose fin clip. We recovered 210 CWTs from the 223 lake trout with an adipose fin clip. We also recovered an additional 4 CWTs from lake trout either with no fin clips or fin clips other than the adipose fin clip. Thus, 214 CWTs were recovered from Six Fathom Bank lake trout. Of the 124 lake trout caught on Yankee Reef, 27 had an adipose fin clip. We recovered 22 CWTs from the 27 lake trout with an adipose fin clip. We also recovered an additional 2 CWTs from lake trout either with no fin clips or fin clips other than the adipose fin clip. Thus, 24 CWTs were recovered from Yankee Reef lake trout.

The overall offshore CPUE for the 238 CWT fish captured at Six Fathom Bank and Yankee Reef in 2002 was 17.6 lake trout/1000ft. Pooling spring catch at Six Fathom Bank and Yankee Reef, CPUE was 14.3 in 2001, 22.7 in 2000, 11.5 in 1999, 12.2 in 1998, 3.1 in 1997, 2.2 in 1996, and 12.4 in 1995. The CPUEs by strain, all ages combined, were 6.4 Lewis Lake/1000 feet, 4.5 Marquette-Superior/1000 feet, 1.1 Lake Ontario/1000 feet, and 5.6 Seneca Lake/1000 feet. Based on data from the 238 CWTs recovered in 2002, offshore sea lamprey wounding rates (AI-III marks per 100 fish) by strain, regardless of age, were 21.8 for Lewis Lake, 49.2 for Marquette-Superior, 60.0 for Lake Ontario, and 12.0 for Seneca Lake. Nearly 77% of the total CWT-fish catch were fish of ages 5-7. Nevertheless, 26 CWT fish (about 11% of the total CWT catch) were of ages 10-15.

Spring YOY surveys – A beam trawl was fished at Six Fathom Bank on June 2 and June 18 and Yankee Reef June 21, 2002 to look for the presence of age-0 lake trout. No age-0 lake trout fry were captured at either location.

Fall spawning survey- Six Fathom Bank Refuge – Graded mesh gill nets with 100-foot panels of 4.5, 5.0, 5.5 and 6.0 inch stretched measure mesh were set cross-contour on tops of reefs in the northern, central, and southern regions of Six Fathom Bank Refuge, October 17-18, 2002. For the first time since the fall surveys started, the highest catch of lake trout occurred at the northern reef. Catch per unit of effort (CPUE) on the northern, central, and southern reefs was 152.5, 105 and 105, respectively, per 1000 feet of net. Overall CPUE for spawning aggregations was 120.8 as compared to 64.0 in 2000, 128.0 in 1998, 97.0 in 1996, 162.0 in 1995, 56.4 in 1994, 94.0 in 1993, 40.0 in 1992 and 7.0 in 1991. Average age of lake trout captured at Six Fathom Bank during the fall spawning survey has been relatively constant since 1994 but increased slightly in 2000 and 2002. Average ages of lake trout captured in 1992, 1993, 1994, 1995, 1996, 1998, 2000 and 2002 were 6.1, 6.4, 6.7, 6.7, 6.8, 6.7, 7.1 and 7.4 respectively. Mean age of each strain in 2002 was 6.4 for Marquette-Superior, 6.8 for Lewis Lake, 8.9 for Seneca Lake and 11.1 for Ontario. The 1989, 1991 and 1992 year classes of Lake Ontario strain lake trout continue to be present in the catch. Of the sixteen age 9 and older lake trout, nine were Ontario strain, five were Lewis Lake and 2 were Seneca Lake strain (Figure 3). The predominance of Seneca Lake and Ontario strains in age 9 and older cohorts continues to illustrate their superior ability to withstand or avoid sea lamprey predation and reach age classes important for spawning populations. Seneca Lake strain lake trout from the first plant at Six Fathom Bank (1985 year class) were no longer present in the 2002 catch.

Of the 145 lake trout caught on Six Fathom Bank Refuge during October 2002, we recovered 112 CWTs. Of the 112 lake trout with a CWT, 101 had been stocked at Six Fathom Bank, 4 were stocked at Sturgeon Point, 2 from Middle Island, 1 each from the Northern Refuge and Pt. Aux Barques, and 3 from Lake Michigan.

CPUE remained highest in the Lewis Lake strain in 2002 as this strain continues to survive very well through the early years of sexual maturity and represented 74.3% of the total catch in 2002. CPUE for the Lewis Lake, Marquette-Superior, Seneca Lake and Lake Ontario strains in 2002 were 67.5, 9.2, 8.3 and 8.3 lake trout per 1000 feet of gill net. For the first time, the Jenny Lake strain fish was not represented in the spawning population surveyed. The predominance of Lewis Lake strain lake trout in the October 2002 assessment and their expanding age structure indicates that they are continuing to perform well, relative to contribution to the spawning stock at the Six Fathom Bank Refuge. Of the 137 lake trout aged from the fall survey, 115 were males (83.9%) with a mean age of 7.3 (4-12) and 22 were females (16.1%) with a mean age of 8.1 (6-15) (Figure 4).

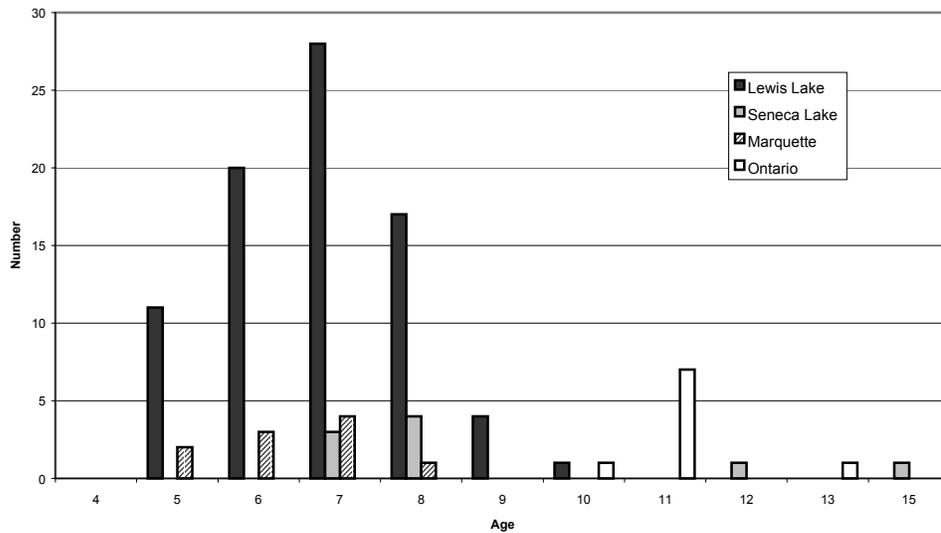


Figure 3. Age and strain of coded-wire tagged lake trout captured during spawning survey at the Six Fathom Bank, October 17-18, 2002

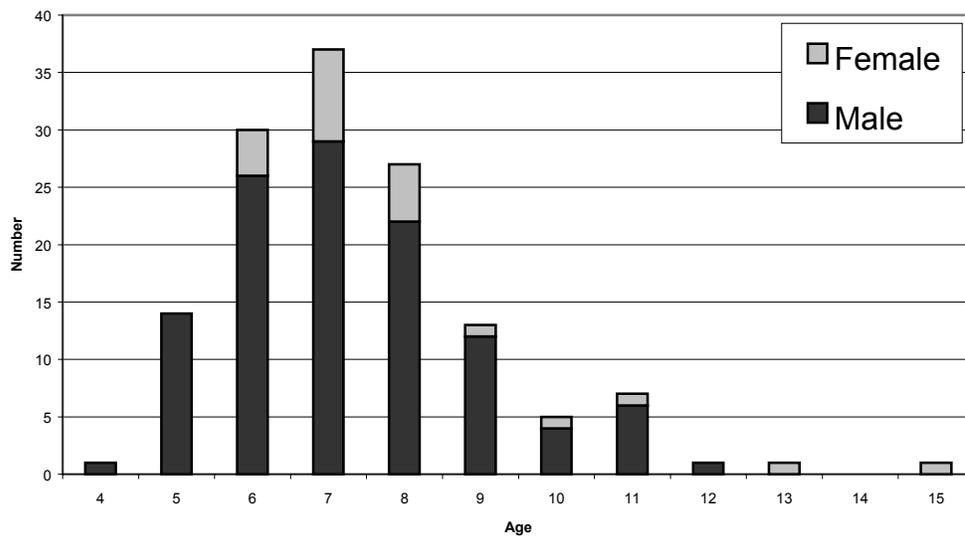


Figure 4. Age distribution of male and female lake trout captured during spawning survey at the Six Fathom Bank Refuge, October 17-18, 2002.

Fall spawning survey- Yankee Reef - Graded mesh gill nets with 100-foot panels of 4.5, 5.0, 5.5 and 6.0 inch stretched measure mesh were set cross-contour at two sites on this reef complex October 23-24, 2002. Overall CPUE for spawning aggregations at Yankee Reef was 112.5 fish/1000' of net in October 2002 compared with 136.2 fish/1000' in 2001 and 94.5 fish/1000' in 2000. Total CPUE for the two sites sampled was 85.0 and 140.0 fish/1000' of net at the northern and southern sites respectively. A total of 90 fish were captured in the two sets and of that total, 36 CWTs were recovered. Of the 36 CWTs

recovered, 32 were from fish stocked at Six Fathom Bank. Of the four remaining CWTs, one each had been stocked at Adams Point, Sturgeon Point and Pt.Aux Barques, and one fish originating from stocking in Lake Michigan. Strain composition of the trout identified by recovered CWTs was 63.9% Lewis Lake, 22.2% Marquette-Superior and 13.9% Seneca Lake.

Mean age of all lake trout captured at Yankee Reef in 2002 was 7.1 compared with 7.0 in 2001 and 6.3 in 2000. Age distribution of all fish captured at Yankee Reef represented age 4-11 and of the 88 lake trout aged from the fall survey, 61 were males (69.3%) with a mean age of 7.2 (5-11) and 27 were females (30.7%) with a mean age of 6.9 (4-10) (Figure 5). The 1992 year class stocked as fall fingerlings were still relatively abundant in the catch as age 9 fish in 2001 and accounted for 22.9% of the total catch during the fall spawning survey. However, this same cohort represented only 7.8% of the catch at Yankee Reef in 2002 as age 10 fish.

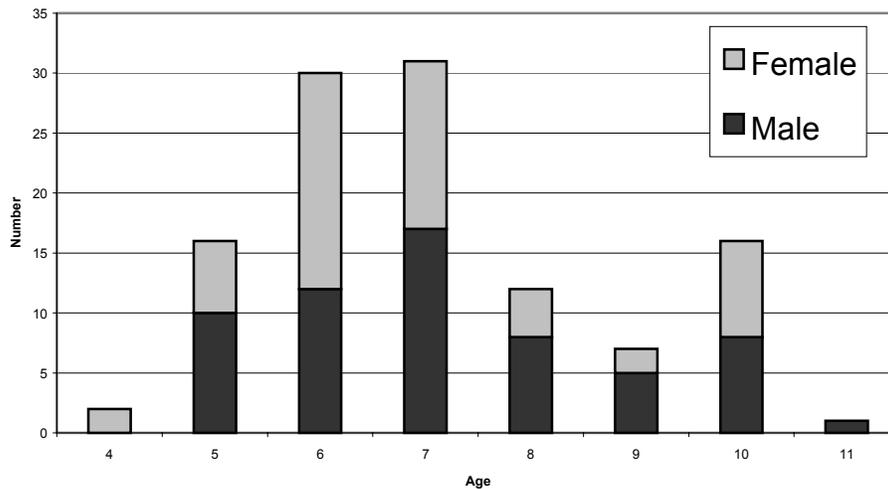


Figure 5. Age distribution of male and female lake trout captured during spawning survey at the Yankee Reef complex, October 23-24, 2002.

Summary of offshore recoveries, 1987 - 2002 - Biological data on growth, movement, diet, and wounding of all strains stocked at this offshore reef complex have been collected since 1986. A number of significant events have been documented since the initiation of the strain comparison studies and have been reported over the past few years. Male and female lake trout in spawning condition were first observed in the fall of 1991, just six years after the initial stocking. Surveys in 1994 and 1995 produced the first evidence that offshore stocks can successfully reproduce and that progeny can survive past the swim-up stage. Aggregations of spawning lake trout on this historically important reef complex have continued to expand with CPUE exceeding those reported for any other location in Lake Huron.

Analysis of coded-wire tag returns (1987-2002) from fish stocked at Six Fathom Bank has continued to show superior survival of the Seneca Lake strain when compared with the other test strains. The age distribution of the respective strains best illustrates the superior performance of the Seneca Lake strain in terms of being able to survive beyond the age of first maturity (Figure 6). To date, the Seneca Lake strain is by far the most abundant strain encountered in the age VIII and older age-classes. Perhaps Seneca Lake fish survive better on these offshore reefs because for any given size they are less likely to be attacked and they are more likely to survive a sea lamprey attack than the other strains of lake trout.

Evidence of differential sea lamprey wounding trends - The genetic strain and size of lake trout appears to influence the frequency of attacks (AI-III) by sea lamprey in central Lake Huron (Figure 7). Very few wounds or scars were found on Seneca Lake strain trout < 532 mm TL and although wounding increases

in successively larger size categories, its rate of increase is lower compared with the other strains. Wounding rates for lake trout greater than 734 mm TL were based on relatively small samples sizes for all strains other than Seneca Lake strain. Numbers of lake trout > 734 mm TL sampled were 8 for Jenny Lake strain, 9 for Lewis Lake strain, 50 for Lake Ontario strain, 55 for Marquette-Superior strain, and 275 for Seneca Lake strain. The early avoidance of sea lamprey attack combined with lower overall wounding rates suggest that the Seneca Lake strain may possess one or more strain-related behavioral attributes that effectively increase their chances for survival. These greater wounding rates in lake trout strains other than the Seneca Lake strain probably have a significant influence on survival and strain specific trends observed in age-class distribution (Figure 6).

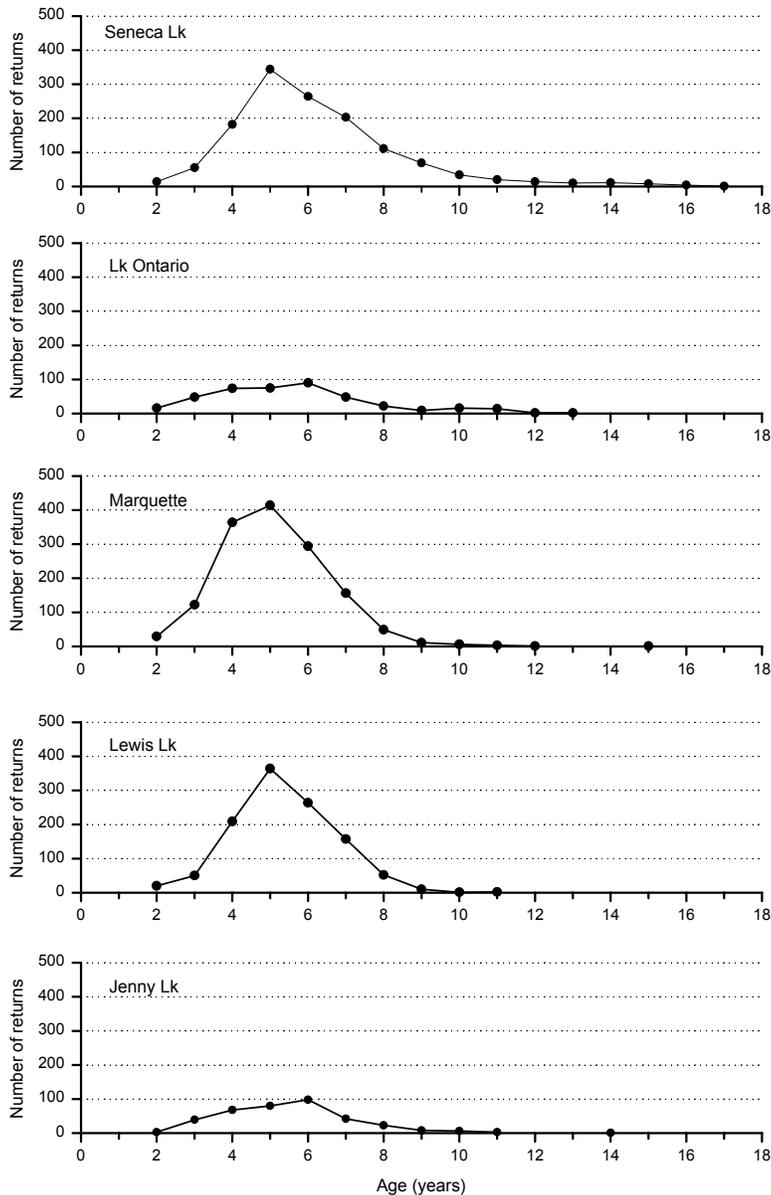


Figure 6. Age distribution of 1987-2002 lakewide returns of coded-wire tags from lake trout stocked at Six Fathom Bank Refuge, Lake Huron.

While cohorts of the Lewis Lake and Lake Ontario strains have just matured to the point where similar long-term comparisons can be made, it appears that these strains are not as successful at avoiding sea lamprey wounding as is the Seneca Lake strain. Although the rate of increase in wounding rate between

532 and 734 mm was lower for the Lake Ontario and Lewis Lake strains compared with the Marquette-Superior strain, lamprey wounding rate was lower for the Seneca Lake strain than for either the Lake Ontario strain or the Lewis Lake strain over this length interval (Figure 7).

Changes in lake trout growth rate on Six Fathom Bank - Based on the spring surveys conducted on Six Fathom Bank and Yankee Reef, size-at-age of age-4, age-5, and age-6 lake trout decreased during 1991-1998, but then increased during 1998-2002 (Figure 8). Size-at-age for age-4 and age-5 lake trout trended neither upward nor downward over the 1991-2002 time period. Size-at-age of age-6 lake trout declined

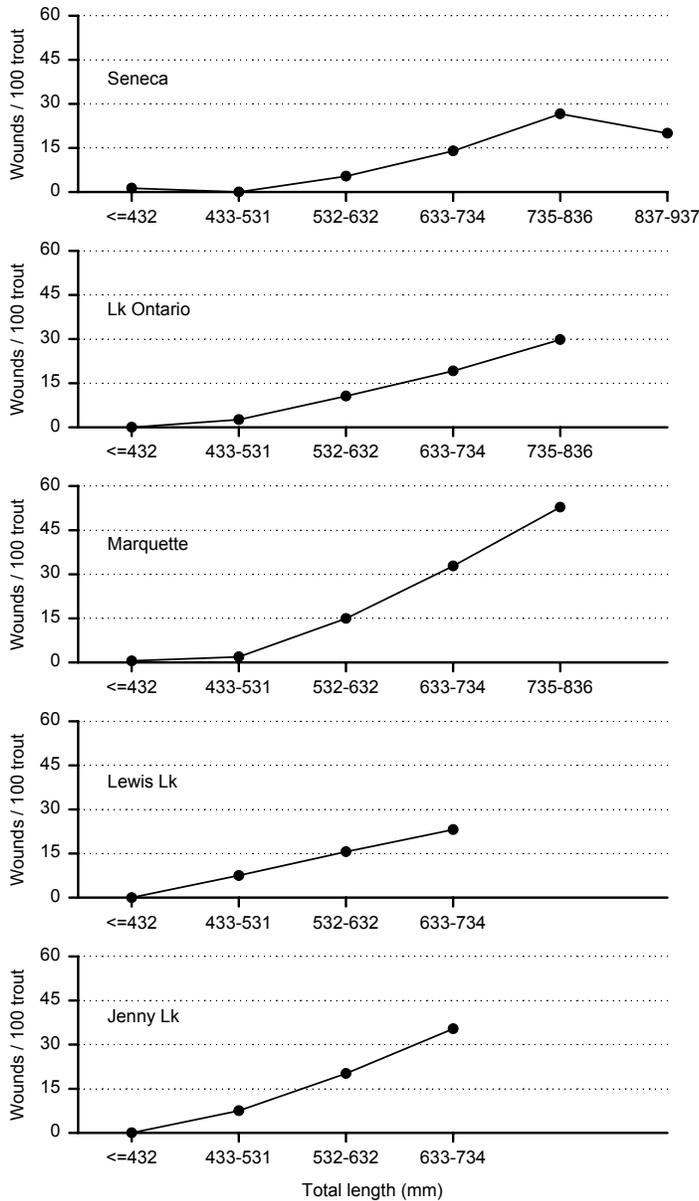


Figure 7. Sea lamprey wounding rates (AI-III wounds per 100 fish, all seasons combined) for Six Fathom Bank lake trout in six length groups during 1987-2002. For strains other than the Seneca Lake strain, data for larger size groups were not plotted due to small sample size.

slightly over the 1991-2002 time period. The downward trend in growth between 1991 and 1998 appeared to be a lakewide phenomenon, as growth rate of lake trout from the nearshore zone of Lake Huron also decreased over the same period of time. A lakewide decrease in lake trout growth rate, as well as a lakewide decrease in chinook salmon growth rate, may have reflected a lakewide decrease in the abundance of prey fish, particularly alewife and rainbow smelt, during the 1991-1998 time period. The increase in lake trout size-at-age between 1998 and 2002 was substantial (Figure 8). Moreover, chinook salmon growth rate in Lake Huron increased sharply during 1999. Perhaps the substantial increases in lake trout and chinook salmon sizes-at-age observed in 1999 were attributable to an increase in prey fish abundance between spring 1998 and spring 1999.

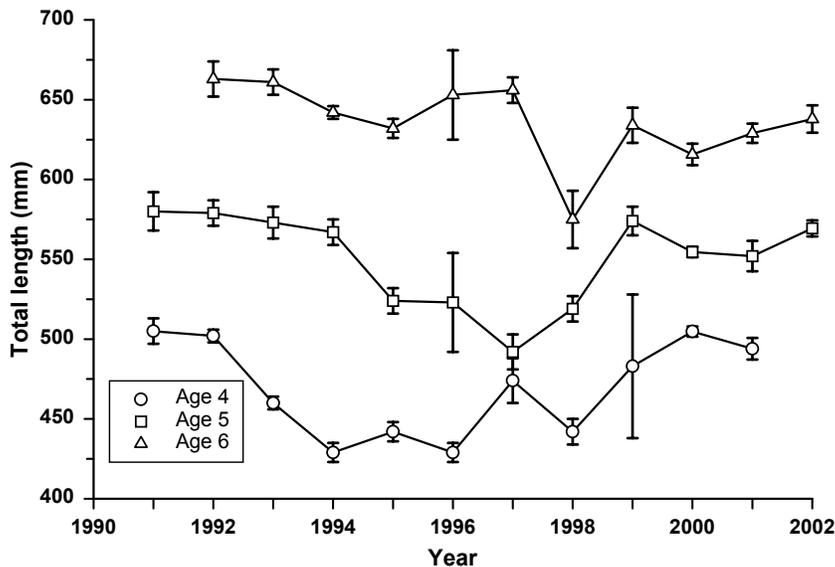


Figure 8. Length-at-age for coded-wire tagged lake trout caught during spring surveys on Six Fathom Bank and Yankee Reef, 1991-2002. Bars represent one standard error.

2002 LAKE TROUT ASSESSMENT IN THE NORTHERN REFUGE

Since 1989, the Inter-tribal Fisheries and Assessment Program has conducted spring and fall lake trout assessment in the Northern Refuge of Lake Huron. The study in this region of the lake will aid managers in evaluating the efficacy of sea lamprey control efforts in the St. Marys River and examine the relative performance of the test strains in an area of greatest sea lamprey populations.

Spring assessment – In total, 189 lake trout were caught in 16,200 feet of graded mesh gill nets (2-6 inch) fished in the Northern Refuge in May of 2002. The overall CPUE was 11.7 fish/1000 ft. in 2002, compared with 13.2 fish/1000 ft. in 2001, 3.6 fish/1000 ft. in 2000, 3.6 fish/1000 ft. in 1999, 3.5 fish/1000ft. in 1998, 3.2/1000 ft. in 1997, 14.6/1000 ft. in 1996, 6.3/1000 ft in 1995, 8.3/1000 ft. in 1994, and 2.0/1000 ft. in 1993. Of the 189 lake trout caught, 110 coded-wire tags were recovered. Strain composition of the lake trout containing coded-wire tags, regardless of age, was 0.9% Lake Ontario, 58.2% Marquette-Superior, and 40.9% Seneca Lake. By age, regardless of strain, 12.7% were age III, 51.8% were age IV, 24.6% were age V, 4.6% were age VI, 2.7% were age VII, 2.7% were age VIII, and 0.9% were age XIII.

Fall spawning surveys – In total, 317 lake trout were caught in 15,800 feet of graded mesh gill nets (2-6 inch) fished in the Northern Refuge in October 2002 to assess the spawning aggregations at this location. Fall assessment at the Northern Refuge is conducted somewhat differently than at Six Fathom Bank and Yankee Reef. Larger mesh panels (4.5-6.0 inch) are fished in shallow waters on the reefs. Smaller mesh nets are fished in deep water adjacent to the reefs. This practice increases the overall CPUE but reduces the mean age captured by strain. The overall CPUE was 20.1 fish/1000 ft. Of the 317 fish caught, 145 CWTs were recovered. For the CWT lake trout, the strain composition, regardless of age, was 0.7% Jenny Lake (mean age = 14.0), 2.1% Lewis Lake (mean age = 8.0), 3.4% Lake Ontario (mean age = 10.6), 11.7% Marquette-Superior (mean age = 4.2), and 82.1% Seneca Lake (mean age = 6.3). The average age across all strains was 6.3, compared with 4.2 in 2001, 5.8 in 2000, 6.0 in 1999, 5.4 in 1998, 6.3 in 1997, 5.3 in 1996 and 5.7 in 1995.

Returns from each cohort and strain of lake trout captured in the fall survey are illustrated in Figure 9. Although the overall catch rate of spawning aggregations at the Northern Refuge is significantly lower than at Six Fathom Bank, the superior ability of the Seneca Lake and Lake Ontario strains to survive to spawning age is evident. Only 3.3% of fish age 5 and older were Marquette-Superior strain, whereas 89.4% were Seneca Lake strain. In spite of excessive mortality resulting from large sea lamprey populations and harvest in waters adjacent to the refuge, some lake trout of ages 12-14 are present in the spawning population. Additionally, the 1989 year-class of Lake Ontario strain lake trout continues to be represented in the spawning population of lake trout within the Northern Refuge of Lake Huron. Seneca Lake and Lake Ontario strain fish accounted for 88.7% of all spawners age 7 and older. Over 63% of the CWT lake trout caught in the fall 2002 assessment on the Northern Refuge were represented by Seneca Lake lake trout of ages 5 through 7 (Figure 9).

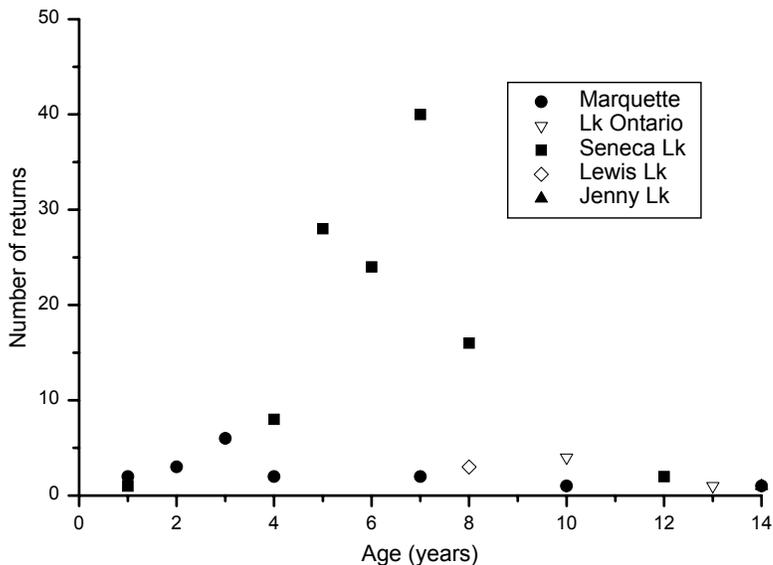


Figure 9. Age and strain of coded-wire tagged lake trout captured during spawning surveys at the Northern Refuge, October 2002.

Summary of Northern Refuge recoveries, 1987 - 2002 - Progress on establishing identifiable stocks of specific strains of lake trout for monitoring sea lamprey wounding and on evaluating the efficacy of sea lamprey control efforts in the St. Marys River is on schedule. Marquette-Superior, Seneca Lake, and Lake Ontario strain lake trout in and adjacent to the Northern Refuge have been monitored since 1986. Six years after the initial stocking of 180,000 fall fingerling lake trout (1985 year-class), male and female trout in spawning condition were observed congregating over nearshore reefs in the refuge.

Analysis of coded-wire tag returns (1987-2002) from fish stocked at the Northern Refuge has indicated superior performance of the Seneca Lake strain when compared with the other test strains. The age distribution of the respective strains best illustrates the superior performance of the Seneca Lake strain in terms of being able to survive beyond the age of first maturity (Figure 10). In this region of Lake Huron, female lake trout reach full maturity at age 8. To date, the Seneca Lake strain is by far the most abundant strain represented in fish older than age 6. Differences in strain-related survival are apparent in lake trout stocked in this region of Lake Huron. Spring surveys tend to capture younger lake trout that in many cases are predominantly Marquette-Superior strain fish. Conversely, fall spawning surveys represented by older fish are chiefly composed of Seneca Lake and Lake Ontario strains.

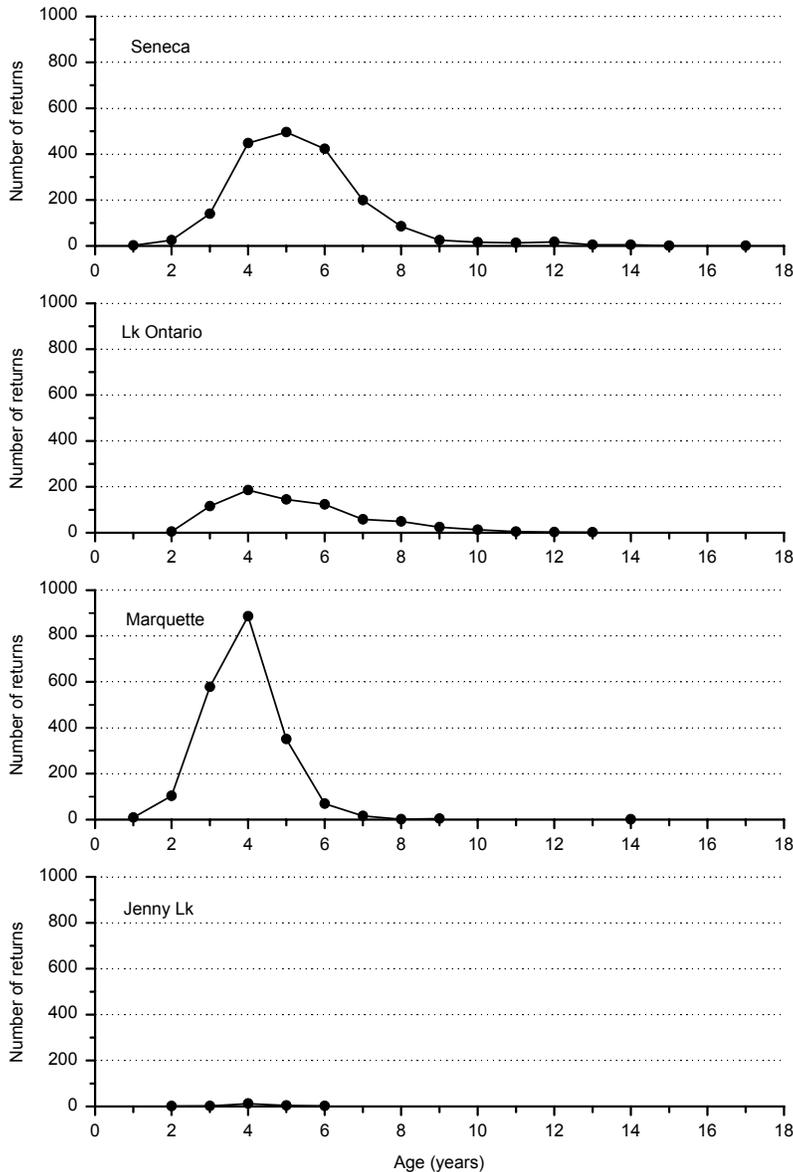


Figure 10. Age distribution of 1987-2002 lakewide returns of coded-wire tags from lake trout stocked at the Northern Refuge, Lake Huron.

Wounding by sea lampreys in northern Lake Huron also appeared to be related to the genetic strain and size of lake trout (Figure 11). Marquette-Superior strain lake trout are attacked earlier (size and age) and to a greater degree than are either the Seneca Lake or Lake Ontario strains. The earlier wounding and apparent high mortality among this strain suggests that sea lamprey may be a major factor limiting this strain's ability to survive to spawning age and, ultimately, produce wild progeny (Figure 11). The number of CWT returns for lake trout > 632 mm TL of the Jenny Lake and Marquette-Superior strains was relatively low. Numbers of CWT returns for lake trout > 632 mm TL were 1, 37, 246, and 860 for the Jenny Lake, Marquette-Superior, Lake Ontario, and Seneca Lake strains. The oldest Lake Ontario strain fish stocked at the Northern Refuge are now age XIII, and although wounding data indicate that this strain is somewhat intermediate, in terms of sea lamprey wounding, between the Seneca Lake and

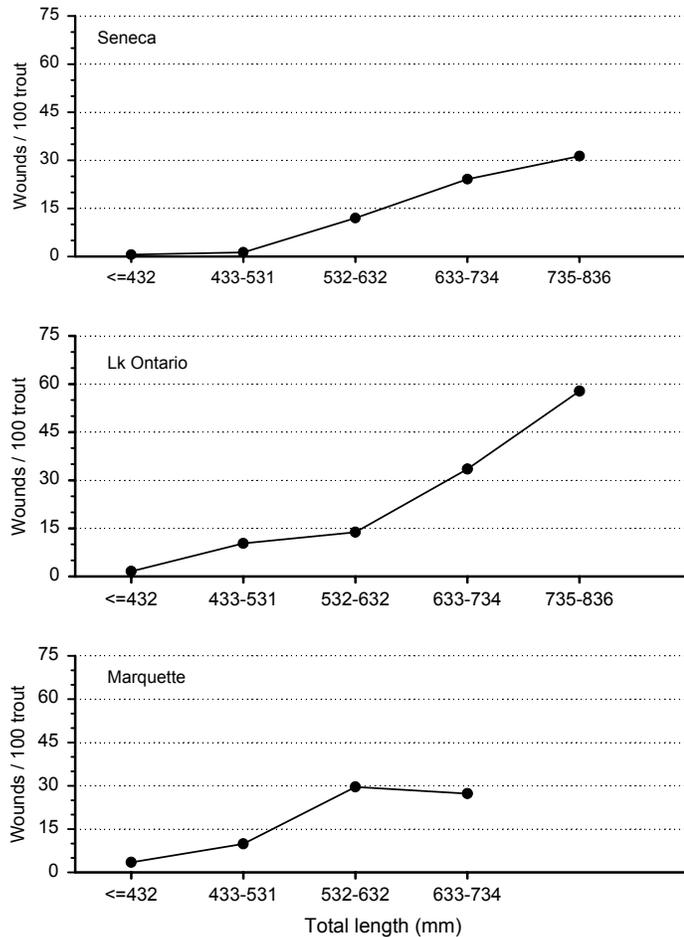


Figure 11. Sea lamprey wounding rates (AI-III wounds per 100 fish, all seasons combined) for Northern Refuge lake trout in five length groups during 1987-2002. Wounding rate for large (> 734 mm TL) lake trout of the Marquette-Superior strain is not plotted due to small sample size.

Marquette-Superior strains, they are surviving to age XIII at comparable rates to the Seneca Lake strain. While continued monitoring of the three cohorts stocked in the Northern Refuge will be required to make a final determination, it appears that the avoidance and/or resistance characteristics reported for the Seneca Lake strain may be possessed by this strain, albeit not as pronounced as for the Seneca Lake strain, as well. The ability of the Seneca Lake and Lake Ontario strains to reach sexual maturity in the presence of large sea lamprey populations provides compelling evidence for increased use of these strains in the Lake Huron lake trout rehabilitation program, especially in the northern regions of the lake.

SUMMARY OF LAKE TROUT MOVEMENT, 2002

In an effort to quantify post-stocking movements, coded-wire tagged lake trout have been stocked at strategic locations along the western shore of Lake Huron. Study objectives were to: 1) determine the extent of migration to MH-1 from MH-2 and beyond, 2) better define movement for improved delineation of management units, and 3) better define seasonal inshore/offshore movement patterns of feral lake trout. Beginning in 1995, adequate numbers of coded-wire tag recoveries were available from these study groups to begin the evaluation of movement patterns. In this report we have updated the analysis with return data from 2002 assessment, sport, and commercial fisheries from all regions of Lake Huron.

Nearshore Movement Study - Since 1993, a total of 4,508 coded-wire tags has been recovered from plants of the 1991, 1993, 1995 and 1997 year-classes of these study fish. The 1991 and 1993 year classes are now 11 and 9 years old, respectively, and are becoming much less abundant in the returns, representing only 0.15 and 4.45% of the 2002 catch of nearshore movement lake trout. Conversely, the 1995 and 1997 year classes contributed heavily to the 2002 catch and represented 26.60 and 68.80% of the 2002 catch of nearshore movement lake trout. The discussion that follows is biased geographically by the effort employed at specific fishing sites (all sources). Analysis is underway to adjust returns for effort using agency survey and commercial fishery large-mesh gill net data. Results will be reported in next year's report.

Adams Point -A total of 1,216 coded-wire tag recoveries has been made from fish stocked at Adams Point (Figure 12). Of the four sites stocked for this study, Adams Point fish tended to remain more closely associated with the stocking location than the other three. Of the tags recovered, 64.2 % were from within MH-1, 24.0 % moved south to MH-2, 8.3 % to other Michigan waters and 3.6 % to Ontario waters (Table 5). There were no apparent patterns in age specific movement of tagged lake trout from Adams Point; however, 2-year-old lake trout from Adams Point were captured as far as 34 miles from the stocking site. This suggests stocked fish move away from the stocking site at a young age. The average distance moved (\pm 2SE) between stocking and capture for Adams Point lake trout was 27.6 ± 2 miles.



Figure 12. Dispersal pattern of coded-wire tagged Lewis Lake strain lake trout stocked at Adams Point, as defined by location of tag recovery, 1993 -2002.

Middle Island -A total of 1,013 coded-wire tag recoveries has been made from fish stocked at Middle Island (Figure 13). More extensive movement from stocking site is observed with Middle Island fish. A

fairly substantial number of returns came from fish that had moved north to MH-1 (33.2 %), 14.0 % from fish that moved south to MH-3, 4.2 % from other Michigan waters and 6.8 % from Ontario waters.

A total of 39.7 % of the returns came from within MH-2 where they were stocked (Table 5). There were no apparent patterns in age specific movement of tagged lake trout from Middle Island; however, 2-year-old lake trout from Middle Island were captured as far as 60 miles from the stocking site. The average distance moved (\pm 2SE) between stocking and capture for Middle Island lake trout was 38.3 ± 2.2 miles.



Figure 13. Dispersal pattern of coded-wire tagged Lewis Lake strain lake trout stocked at Middle Island, as defined by location of tag recovery, 1993 -2002.

Sturgeon Point - A total of 1,067 coded-wire tag recoveries has been made from fish stocked at Sturgeon Point (Figure 14). Although fish stocked at Sturgeon Point continue to move north to MH-1 and MH-2 (4.8 and 26.0%, respectively), 34.5 % remain within MH-3, 16.9 % to other Michigan waters and, for the first time, a substantial number of returns begin showing up in southern Ontario waters from the commercial fishery in OH-4 (Table 5). Location is, again, influenced by areas of greatest effort, both from the Michigan sport fishery and the Ontario commercial fishery. There were no apparent patterns in age specific movement of tagged lake trout from Sturgeon Point; however, 2-year-old lake trout were captured as far as 97 miles from the stocking site. The average distance moved (\pm 2SE) between stocking and capture for Sturgeon Point lake trout was 40.5 ± 2.1 miles.

Point Aux Barques - A total of 1,212 coded-wire tag recoveries has been made from fish stocked at Point Aux Barques (Figure 15). The southeasterly movement pattern that began developing with Sturgeon Point fish is most apparent with the Point Aux Barques fish. Recoveries from these lots of fish in the Ontario assessment and commercial fisheries in the southern main basin accounted for 37.7 % of the returns where grid of capture was reported. Only 12.8 % of the returns came from fish that had moved north and most of those recoveries are associated with the sport fishery in the Oscoda to Harrisville area. The sport fishery in the thumb region provided 26.2 % of the returns and represent fish that remained within the management unit in which they were stocked (Table 5). There were no apparent patterns in age specific movement of tagged lake trout from Point Aux Barques; however, 2-year-old lake trout were captured as far as 76 miles from the stocking site. The average distance moved (\pm 2SE) between stocking and capture for Point Aux Barques lake trout was 31.3 ± 1.4 miles.

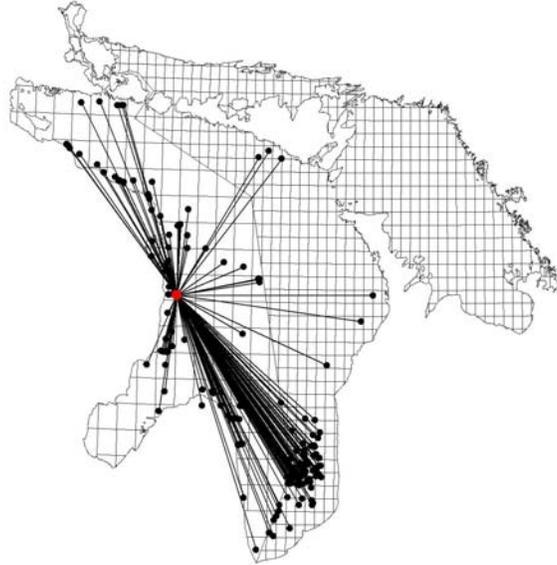


Figure 14. Dispersal pattern of coded-wire tagged Lewis Lake strain lake trout stocked at Sturgeon Point, as defined by location of tag recovery, 1993 -2002.

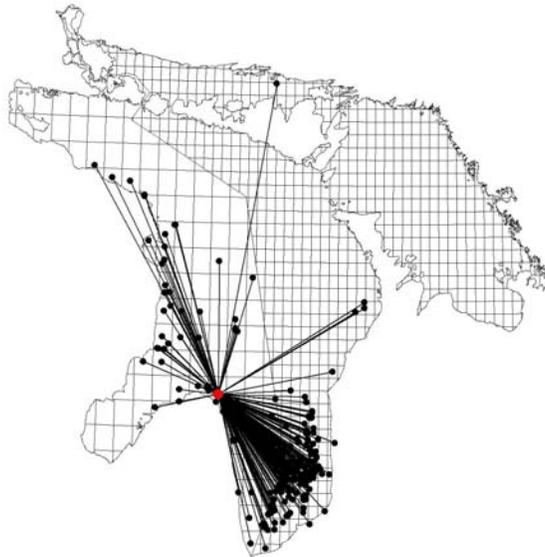


Figure 15. Dispersal pattern of coded-wire tagged Lewis Lake strain lake trout stocked at Point Aux Barques, as defined by location of tag recovery, 1993 -2002.

Six Fathom Bank Movement/Dispersal - A total of 5,451 identifiable coded-wire tags from fish stocked at Six Fathom Bank has been recovered in lakewide activities since 1987 (Figure 16). Previous reports have discussed significant trends in strain specific performance that indicate superior performance by the Seneca Lake strain. In an effort to examine potential bias associated with differential dispersal patterns of the strains, we have examined coded-wire tag return data in regard to the intensity and location of those recoveries. At this point no attempt has been made to adjust these returns by the degree of effort at the respective sites. However, it should be understood that significantly more effort is employed outside Six Fathom Bank than within. Over one-third (42.7 %) of the total tag returns, regardless of strain, have come from within the boundaries of Six Fathom Bank, while 57.3 % have been recovered at other locations considered outside the site. This would tend to indicate that, while there is substantial dispersal

of Six Fathom Bank fish to other regions of Lake Huron, a majority of the fish stocked on the reef remain there. In terms of differences in strain specific dispersal patterns there appears to be no difference between strains in the degree to which they move away from the stocking site.

Table 5. Movement matrix illustrating returns of CWT from yearling lake trout stocked at four nearshore locations (*) in Lake Huron to aid in quantifying direction of movement.

	MH-1	MH-2	MH-3	MH-4	MH-5	MH-6	NC 1-3	OH 1-5	GB-2
MH-1*	759 (64.2)	284 (24.0)	68 (5.8)	15 (1.3)	13 (1.1)	1 (0.1)	2 (0.2)	39 (3.3)	1 (0.1)
MH-2*	324 (33.2)	408 (41.8)	137 (14.0)	27 (2.8)	13 (1.3)	1 (0.1)	2 (0.2)	64 (6.6)	0 (0.0)
MH-3*	48 (4.8)	262 (26.0)	348 (34.5)	94 (9.3)	72 (7.1)	5 (0.5)	0 (0.0)	179 (17.8)	0 (0.0)
MH-4*	5 (0.4)	38 (3.2)	109 (9.2)	309 (26.2)	249 (21.1)	24 (2.0)	1 (0.1)	444 (37.6)	1 (0.1)

One of the general premises for stocking Six Fathom Bank as a high priority rehabilitation area was that if sufficient stock density was achieved, the area would act as an epicenter for lakewide lake trout rehabilitation. Lake trout stocked at Six Fathom Bank since 1985 are being recovered in all regions of the main Lake Huron basin. A noticeable increase in recovery of Six Fathom Bank fish in the spring and fall surveys at Yankee Reef indicates a possible density dependent response in the population at Six Fathom Bank. This dispersal pattern offers considerable encouragement for the future of lake trout rehabilitation in Lake Huron, especially if future generations of naturally produced trout are realized at Six Fathom Bank.

There were no apparent patterns in age specific movement of tagged lake trout from Six Fathom Bank; however, 2-year-old lake trout were captured as far as 113 miles from the stocking site. The average distance moved (\pm 2SE) between stocking and capture for Six Fathom Bank lake trout was 40.8 ± 1.0 miles.



Figure 16. Dispersal pattern of coded-wire tagged Lewis Lake strain lake trout stocked at Six Fathom Bank Refuge, as defined by location of tag recovery, 1993 -2002.

Northern Refuge Movement/Dispersal - A total of 4,610 identifiable coded-wire tags from fish stocked in the Northern Refuge has been recovered since 1987 (Figure 17). Trends indicating superior survivability of the Seneca Lake strain at Six Fathom Bank are even more striking in the Northern Refuge. Spawning age fish in the Northern Refuge are generally 90 - 95% Seneca Lake/Ontario strain (89.5% in 2001).

A significant proportion of the total tag returns from fish stocked in the Northern Refuge has come from U.S. (Tribal) and Canadian commercial fisheries. Areas of greatest commercial fishing pressure are adjacent to the boundaries of the Northern Refuge. Dispersal patterns of Northern Refuge fish indicate that most of the fish remain in northern Lake Huron and are closely associated with the extensive shoal areas surrounding the Drummond-Cockburn-Manitoulin Islands chain. Half (50.1%) of the total recoveries of fish stocked in the Northern Refuge were from within the boundaries of the refuge. Very few tag returns have come from outside the North Channel or northern main basin. In the past, this was mainly due to the high levels of sea lamprey induced mortality and commercial fishing mortality. The treatment of the St. Mary's River by sea lamprey control agents and the reduction of commercial fishing effort under the Year 2000 Consent Decree have greatly reduced mortality rates on lake trout in northern Lake Huron in recent years. Hopefully, these efforts will provide a much needed boost to lake trout populations in this region of the lake, and the Northern Refuge can provide an epicenter for recovery in an area identified as historically important for spawning stocks.

There were no apparent patterns in age specific movement of tagged lake trout from the Northern Refuge; however, 2-year-old lake trout were captured as far as 86 miles from the stocking site. The average distance ($\pm 2SE$) moved between stocking and capture for Northern Refuge lake trout was only 15.5 ± 0.6 miles.



Figure 17. Dispersal pattern of coded-wire tagged Lewis Lake strain lake trout stocked at the Northern Refuge, as defined by location of tag recovery, 1993 -2002.