LAKE TROUT REHABILITATION IN LAKE HURON
2005 PROGRESS REPORT ON
CODED-WIRE TAG RETURNS

PRESENTED AT THE
GREAT LAKES FISHERY COMMISSION
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WINDSOR, ONTARIO
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Progress Report on Coded-Wire Tag Returns

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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 reproducing lake trout. Numerous hypotheses have been generated to explain the lack of progress. In addition to impacts of overfishing 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, 2002, 2003, 2004, and 2005, 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

Genetic 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. Given their extensive stocking history, this strain was selected to serve as the standard with which to compare the performance of the other strains. Eighteen consecutive year-classes (1985-2002) of Marquette-Superior trout were stocked into Lake Huron; the Marquette-Superior strain is considered to be a domesticated strain of lake trout. Beginning in 2004, an initiative began to stock a “wild” strain of Lake Superior lean lake trout into Lake Huron. Broodstock fish were obtained by catching wild lean lake trout from the Traverse Island area of Lake Superior. Beginning in spring 2004, yearlings spawned from the Traverse Island broodstock were stocked into 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 though a genetic bottleneck and lacked the heterozygocity 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 (1989-2004 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. Ten year-classes (1989-1998) 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 2005, 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 2,325,239 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, 2002, 2003, 2004, and 2005, 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 each year during 2002-2005 (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**				

[1]JL=Jenny Lk; LL=Lewis Lk; MQ=Marquette; SEN=Seneca Lk; ONT=Ontario
[2]ALL=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
[2]JR=Jordan River NFH; PC=Pendills Creek NFH

***Table 3**. Plants of lake trout marked with adipose fin clip and coded-wire tag 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
April 2003	61,100	SEN-JR	2002	YRLG	430180
April 2003	60,600	MQ-JR	2002	YRLG	430181
May 2004	59,800	SEN-JR	2003	YRLG	051878
May 2004	56,400	STW-JR	2003	YRLG	051879
May 2005	61,508	SEN-IRR	2004	YRLG	052271
May 2005	63.492	STW-IRR	2004	YRLG	052270

TOTAL 2,325,239

[1] JL=Jenny Lk; MQ=Marquette; SEN=Seneca Lk; ONT= Ontario; STW=Superior Traverse Island Wild
[2] IRR=Iron River NFH; JR=Jordan River NFH; PC=Pendills Creek NFH

Table 4*. Plants of lake trout marked with adipose fin clip and coded-wire tag 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
June 2003	41,010	Sturgeon Pt.	LL-JR	2002	YRLG	051389
May 2003	37,752	Adams Pt.	LL-JR	2002	YRLG	051391
May 2003	38,201	Middle Is.	LL-JR	2002	YRLG	051390
June 2003	41,293	Pt. Aux Barques	LL-JR	2002	YRLG	430232
June 2004	41,318	Sturgeon Pt.	LL-JR	2003	YRLG	051870
May 2004	39,999	Adams Pt.*	LL-JR	2003	YRLG	051872
May 2004	39,999	Middle Is.**	LL-JR	2003	YRLG	051871
June 2004	39,393	Pt. Aux Barques	LL-JR	2003	YRLG	051869
June 2005	39,915	Sturgeon Pt.	LL-JR	2004	YRLG	052395
April 2005	40,410	Adams Pt.	LL-JR	2004	YRLG	052394
April 2005	40,380	Middle Is.	LL-JR	2004	YRLG	052393
June 2005	37,674	Pt. Aux Barques	LL-JR	2004	YRLG	052396

TOTAL 1,586,665

[11] LL= Lewis Lake
[2] JR= Jordan River NFH
[3] Enhanced quality/size
[4] Standard quality/size
*Shore plant at Calcite due to inclement weather.
**Shore plant at Presque Isle Harbor due to inclement weather.

2005 LAKEWIDE CODED-WIRE TAG RECOVERIES

In total, 664 CWTs were recovered in 2005 from lake trout in waters of Lake Huron; 192 by CORA, 315 by OMNR, 41 by FWS, 16 by USGS, 34 by MDNR, and 66 were recovered from the Michigan sport fishery. About 30% of the 2005 catch was represented by the 1999 year-class. Two 19-year-old lake trout (Seneca Lake strain) from the 1986 year-class stocked on Six Fathom Bank were present in the catch. Also, two 18-year-old lake trout (Seneca Lake strain) from the 1987 year-class stocked on Six Fathom Bank were in the 2005 catch. In addition, the 2000 year-class accounted for 29% of the 2005 catch. The return data will be discussed for each study separately in the following sections of this report and these data represent total lakewide recovery of the individual lots.

In 2005, the 1999 year-class of Seneca Lake lake trout was well represented in the catch; these fish were stocked in the Northern Refuge and on Yankee Reef. Additionally, the 2000 year-class of Seneca Lake lake trout was well represented in the catch; these fish were also stocked in the Northern Refuge and on Yankee Reef (see Table 4). Another significant contribution to the 2005 catch was made by 1997 year-class of Seneca Lake lake trout.

Recoveries from Six Fathom Bank – In total, only 27 coded-wire tags were recovered in 2005 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 2005. This relatively low number of coded-wire tag recoveries reflected the lack of stocking lake trout on Six Fathom Bank since 1998 (Table 1). The percentage recovered by age in 2005 was 33.3% age 8, 14.8% age 9, 11.1% age 10, 14.8% age 11, 3.7% age 12, 11.1% age 13I, 3.7% age 17, 3.7% age 18, and 3.7% age 19. Total returns by strain in 2005 (all ages combined) were 11.1% Lake Ontario, 14.8% Marquette-Superior, 51.9% Seneca Lake, and 22.2% Lewis Lake. 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, 1987-2005.

Recoveries from the Northern Refuge – In total, 186 coded-wire tags were recovered in 2005 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 2005. The percent return by age was 0.5% age 1, 2.7%

age 3, 9.7% age 4, 21.0% age 5, 17.2% age 6, 19.9% age 7, 9.1% age 8, 8.6% age 9, 5.4% age 10, 2.2% age 11, 1.6% age 13, 0.5% age 16, 1.1% age 17, and 0.5% age 18. Total recovery by strain (all ages combined) was 0% Jenny Lake, 2.2% Lake Ontario, 71.5% Seneca Lake, and 26.3% Marquette-Superior. Significant trends in strain specific survival rates continued to be evident in 2005 and will be discussed in more detail in the Summary of Northern Refuge Recoveries, 1987-2005.

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 vulnerable to all fisheries gear. In 2005, these year-classes of lake trout stocked relatively close to shore accounted for only 48 coded-wire tag recoveries. More specifically, the 1991, 1993, 1995, and 1997 year-classes of these lake trout stocked close to shore accounted for 0, 2, 16, and 30 coded-wire tag recoveries, respectively, during 2005. Most of the 48 returns during 2005 were provided by the Michigan sport fishery (39.6%) and by the nearshore survey conducted by the Michigan DNR (27.1%). Since 1993, 5,184 CWTs have been returned from the first four year-classes stocked in this study. Of this total, 1,283 (24.7%) represented the 1991 year-class, 1,193 (23.0%) the 1993 year-class, 1,414 (27.3%) the 1995 year-class, and 1,294 (25.0%) the 1997 year-class. Additional discussion of these recoveries will be presented in the Summary of Lake Trout Movement, 2005.

Recoveries from the quality-at-release study – Since 1997, 2,708 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 2,708 lake trout represent the total catch from commercial, assessment, and sport fisheries. Of the 2,708 lake trout recovered, 1,414 individuals were from the 1995 year-class and 1,294 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 (χ^2=80.9; df=1; P<0.0001). Likewise, for the 1997 year-class, survival of the enhanced-quality yearlings was significantly higher than that for the standard-quality yearlings (χ^2=67.5; df=1; P<0.0001). To date, survival of the enhanced-quality yearlings, pooling data for both the 1995 and 1997 year-classes, is 1.61 times higher than that for the standard-quality yearlings. Note that 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 1.40, 1.39, 2.29, and 1.81 for stockings at Adams Point, Middle Island, Sturgeon Point, and Pt. Aux Barques. For the 1997 year-class, survival rate ratios were 1.40, 1.75, 1.30, and 2.03 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, but the difference narrowed during 2002-2005 (Figure 2). The difference in mean total length between the two quality-at-release groups of the 1997 year-class averaged about 25 mm during 1999-2005, although the difference between the two groups decreased slightly between 1999 and 2005 (Figure 2). The narrowing of the difference between the two different quality groups of fish for both the 1995 and 1997 year-classes could have been due to a greater extent of maturation in the enhanced-quality fish, although other factors were also likely involved. 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.

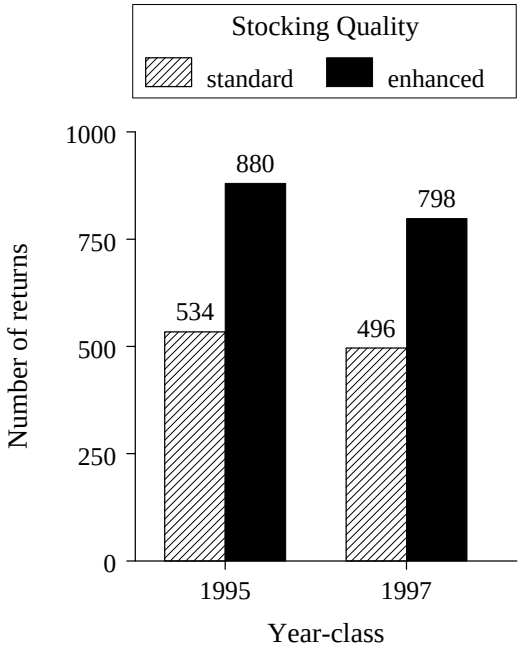

Figure 1. *Number of returns, through 2005, of standard-quality and enhanced-quality lake trout stocked into Lake Huron during 1996 and 1998 as yearlings. Refer to Table 4 for more details on stocking history.*

2005 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 2005. 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.

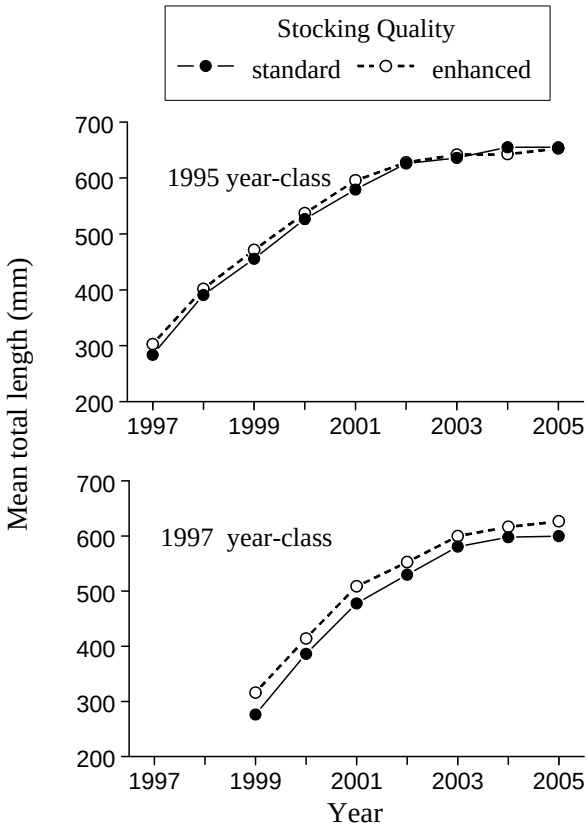

Figure 2. *Mean total length of standard-quality and enhanced-quality lake trout stocked into Lake Huron during 1996 and 1998 as yearlings. Refer to Table 4 for more details on stocking history.*

Spring assessment – The spring assessment for lake trout on Six Fathom Bank and Yankee Reef was conducted in June during 2005. In total, 35 lake trout were caught in 8,100 feet of graded mesh gill nets (2-6 inch) fished at Six Fathom Bank during 2005, and 20 lake trout were caught in 5,400 feet of graded mesh gill nets (2-6 inch) fished at Yankee Reef during 2005. Thus, CPUEs at Six Fathom Bank and Yankee Reef were 4.3 and 3.7 lake trout/1000 ft. of gill net. Of the 35 lake trout caught on Six Fathom Bank, 11 had an adipose fin clip. Of the remaining 24 fish, 19 lake trout had a fin other than the adipose fin clipped and 5 (14.3%) lake trout were unclipped. This marks the second consecutive year since the spring survey was initiated at Six Fathom Bank in 1992 that the proportion of unclipped lake trout (presumably wild) exceeded background levels (<5%). We recovered 9 CWTs from the 11 lake trout with an adipose fin clip. Of the 20 lake trout caught on Yankee Reef, 7 fish had an adipose fin clip and 12 fish had a fin other than the adipose fin clipped; only one lake trout had no clipped fins. A CWT was recovered from each of the 7 fish with an adipose fin clip.

The overall offshore CPUE for the 16 CWT fish captured at Six Fathom Bank and Yankee Reef in 2005 was 1.2 lake trout/1000ft. By comparison, pooled spring catch (CPUE) of CWT fish at Six Fathom Bank and Yankee Reef was 2.1 in 2004, 4.5 in 2003, 17.6 in 2002, 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. Thus, CPUE has continued to decline since 2002. This decline may be attributable, at least in part, to the termination of lake trout stocking on Six Fathom Bank in 1998 (see Table 1). The CPUEs by strain, all ages combined, were 0.2 Lewis Lake/1000 feet, 0.1 Marquette-Superior/1000 feet, 0 Lake Ontario/1000 feet, and 0.8 Seneca Lake/1000 feet. Based on data from the 16 CWTs recovered in 2005, offshore sea lamprey wounding rates (AI-III marks per 100 fish) by strain, regardless of age, were 133.3 for Lewis Lake, 100.0 for Marquette-Superior, and 9.1 for Seneca Lake. About 88% of the total CWT-fish catch were fish of ages 5-8. Only 12% of the CWT fish were of age 10 or greater.

Spring YOY surveys – A 3-meter beam trawl was fished at Six Fathom Bank on June 7 and July 12-13 and at Yankee Reef on June 10 and July 15, 2005 to detect the presence of age-0 lake trout. The area swept by the beam trawl at Six Fathom Bank was 0.7 ha in June and 1.7 ha in July. The area swept at Yankee Reef was 0.4 ha in June and 0.9 ha in July. During 2005, beam trawling at Six Fathom Bank and Yankee Reef failed to capture any age-0 lake trout fry.

Fall spawning survey - Six Fathom Bank Refuge – Due to inclement weather, the fall spawning survey on the Six Fathom Bank Refuge was not conducted during 2005.

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 12-13, 2005. Overall CPUE for spawning aggregations at Yankee Reef was 42.5 fish/1000' of net. This catch rate is low when compared to past year overall CPUEs of 121.2 in 2004 (2 night set), 112.5 in 2002, 136.2 in 2001 and 95.4 in 2000 when the fall surveys were initiated at this offshore location. Total CPUE for the two sites sampled was 20.0 and 35.5 fish/1000' of net at the northern and southern sites respectively. A total of 34 fish were captured in the two sets and of that total, 13 adipose clipped fish provided 11 CWT. Of the 11 CWTs recovered, 4 were from fish stocked at Yankee Reef, 3 from fish stocked at Six Fathom Bank, 3 from fish stocked at the Northern Refuge and 1 from fish stocked at Sturgeon Point. Strain composition of the trout identified by recovered CWTs was 72.7% Seneca Lake and 27.3% Lewis Lake.

Mean age of all lake trout captured at Yankee Reef in 2005 was 7.2 compared to 7.1 in 2004, 7.1 in 2002, 7.0 in 2001 and 6.3 in 2000. Age distribution of all fish captured at Yankee Reef represented age 5-10 and of the 34 lake trout aged from the fall survey, 21 were males (61.8%) with a mean age of 7.0 (5-10) and 13 were females (38.2%) with a mean age of 7.4 (5-10) (Figure 3).

The overall catch rate (CPUE) was much lower in 2005 than in past years but is likely to have been affected by the warmer than normal water temperatures present in October 2005 and at the time of the survey (51^{o}F). Late arrival of spawning phase lake trout and lake whitefish to reefs was documented at other Lake Huron sites and leads us to believe that our mid-October assessment may have missed the peak of the lake trout spawning period in 2005. Not only would this account for the lower than normal spawner abundance but may have biased other trends being monitored by the fall spawning surveys. In 2004 a significant number of unclipped lake trout were present in the spawning population at Yankee Reef (9.8 and 16.1% at the northern and southern reefs, respectively) and represented a level considerably above what is considered background levels. This was an encouraging observation and provided optimism for progress in the lakewide rehabilitation effort. However, in 2005 no unclipped lake trout were observed in spawning fish sampled at Yankee Reef. The indication that peak spawning may have been delayed in 2005 and that our survey may have been too early to provide an accurate representation of the overall spawning population suggests that this apparent decline may not be accurate. We will continue to monitor this trend and report it in subsequent years of more "normal" environmental conditions.

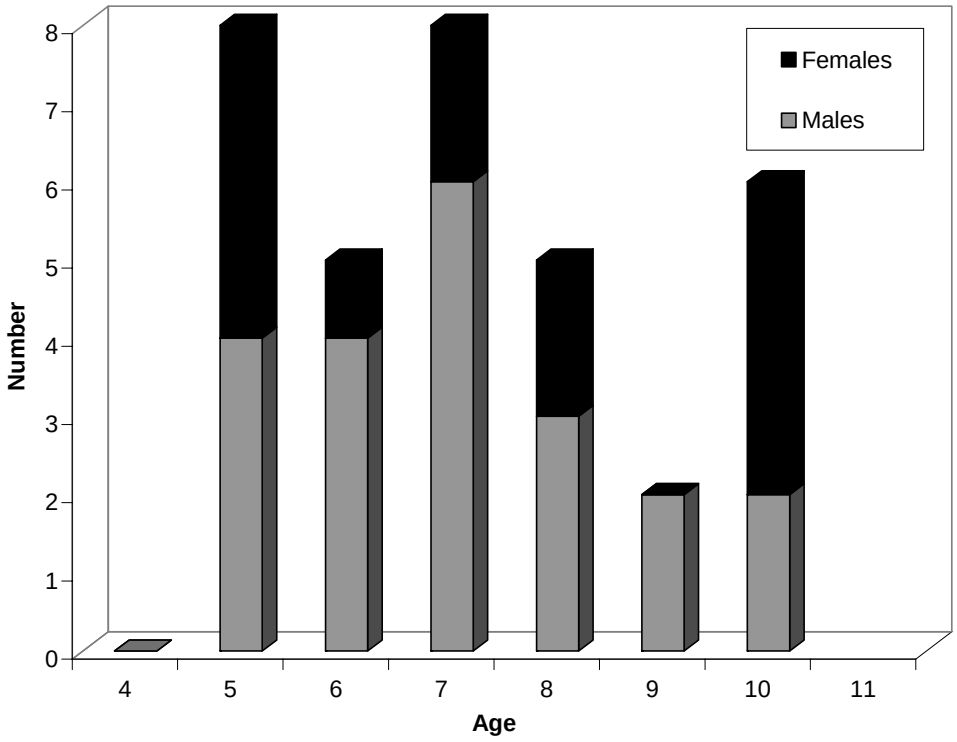

Figure 3. *Age distribution of male and female lake trout captured during spawning survey at the Yankee Reef complex, October 12-13, 2005.*

Summary of offshore recoveries, 1987- 2005 – 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 had reached relatively high levels during the late 1990s; these levels exceeded those reported for any other location in Lake Huron.

Analysis of coded-wire tag returns (1987-2005) 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 4). To date, the Seneca Lake strain is by far the most abundant strain encountered in the age 8 and older age-classes. Apparently, Seneca Lake fish survive better on these offshore reefs because for any given size they are less likely to be attacked by sea lampreys than the other strains of lake trout.

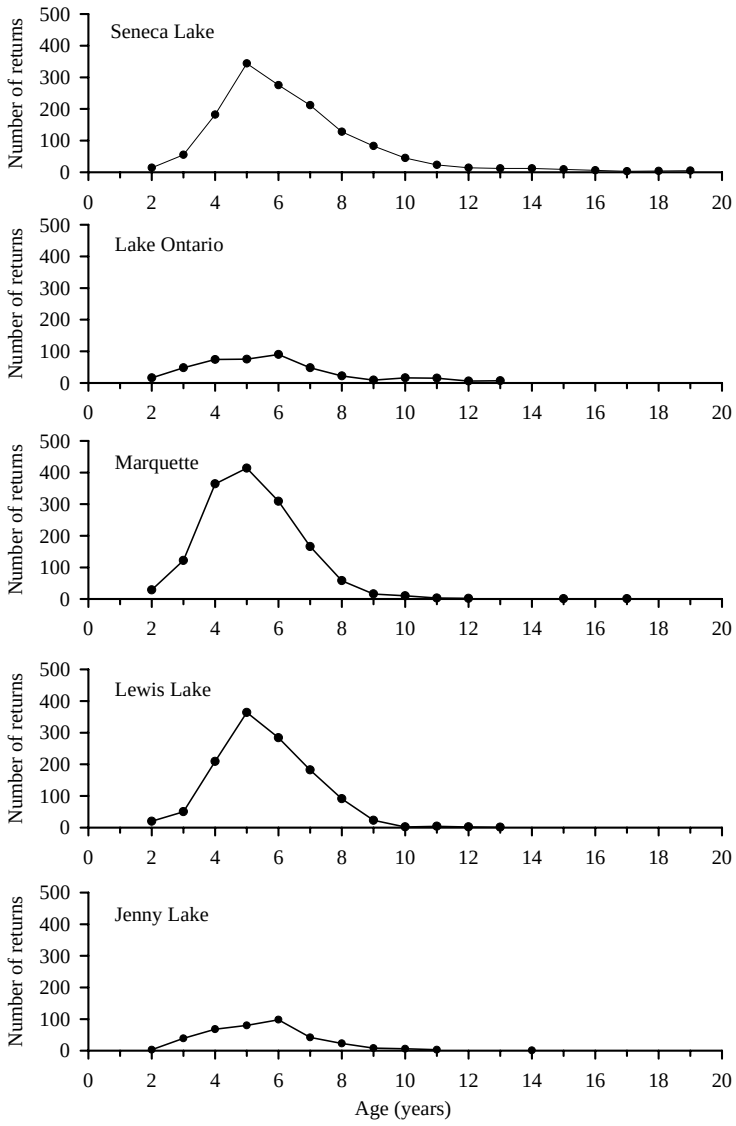

Figure 4. *Age distribution of 1987-2005 lakewide returns of coded-wire tags from lake trout stocked at Six Fathom Bank Refuge, Lake Huron.*

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 5). 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, 10 for Lewis Lake strain, 59 for Lake Ontario strain, 63 for Marquette-Superior strain, and 308 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 4).

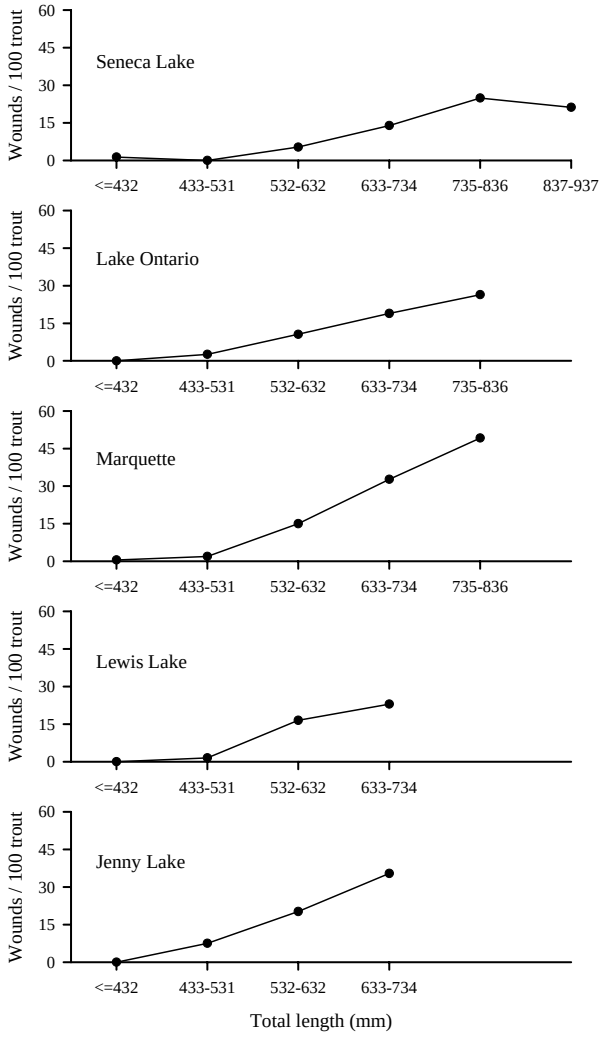

Figure 5. *Sea lamprey wounding rates (AI-III wounds per 100 fish, all seasons combined) for Six Fathom Bank lake trout in six length groups during 1987-2005. For strains other than the Seneca Lake strain, data for larger size groups were not plotted due to small sample size.*

While cohorts of the Lewis Lake and Lake Ontario strains have 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 5).

2005 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, 111 lake trout were caught in 16,200 feet of graded mesh gill nets (2-6 inch)

fished in the Northern Refuge in May of 2005. The overall CPUE was 6.9 fish/1000 ft., compared with 5.1 fish/1000 ft in 2004, 4.4 fish/1000 ft. in 2003, 11.7 fish/1000 ft. in 2002, 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 111 lake trout caught, 44 coded-wire tags were recovered. Strain composition of the lake trout containing coded-wire tags, regardless of age, was 2.3% Lewis Lake, 52.3% Marquette-Superior, and 45.4% Seneca Lake. By age, regardless of strain, 2.3% were age 1, 2.3% were age 3, 20.4% were age 4, 20.4% were age 5, 18.2% were age 6, 18.2% were age 7, 9.1% were age 8, 6.8% were age 9, and 2.3% were age 17.

Fall spawning surveys – In total, 276 lake trout were caught in 14,800 feet of graded mesh gill nets (2-6 inch) fished in the Northern Refuge in October 2005 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 18.6 fish/1000 ft. Of the 276 fish caught, 128 CWTs were recovered. For the CWT lake trout, the strain composition, regardless of age, was 0.8% Lewis Lake (mean age = 8.0), 3.1% Lake Ontario (mean age = 13.8), 11.7% Marquette-Superior (mean age = 5.3), and 84.4% Seneca Lake (mean age = 7.4). The average age across all strains was 7.4, compared with 6.8 in 2004, 6.4 in 2003, 6.3 in 2002, 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 6. 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 6.8% of fish age 5 and older were Marquette-Superior strain, whereas 88.9% 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 ranging from 11 to 18 are present in the spawning population. Additionally, the 1989 and 1992 year-classes of Lake Ontario strain lake trout continue to be represented in the spawning population of lake trout within the Northern Refuge of Lake Huron. Seneca Lake strain fish accounted for 90.8% of all spawners age 7 and older. About 77% of the CWT lake trout caught in the fall 2005 assessment on the Northern Refuge were represented by Seneca Lake lake trout of ages 5 through 10 (Figure 6).

Summary of Northern Refuge recoveries, 1987- 2005 – 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.

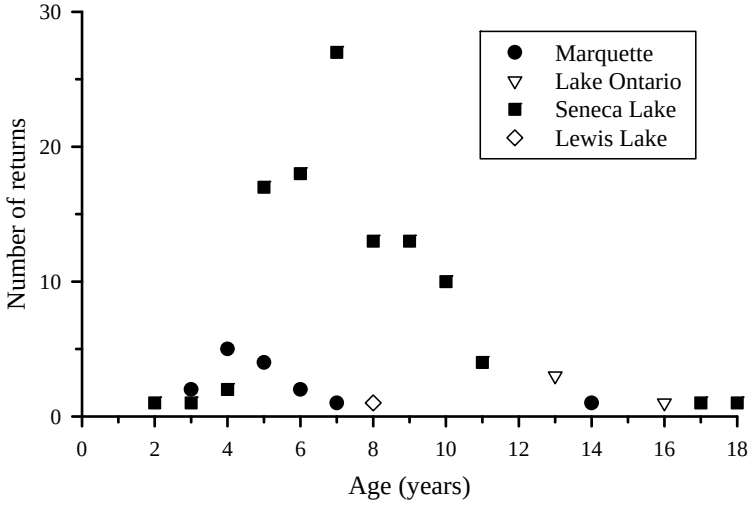

Figure 6. *Age and strain of coded-wire tagged lake trout captured during spawning surveys at the Northern Refuge, October 2005.*

Analysis of coded-wire tag returns (1987-2005) 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 7). 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 the Seneca Lake strain.

Wounding by sea lampreys in northern Lake Huron also appeared to be related to the genetic strain and size of lake trout (Figure 8). 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 8). 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, 47, 255, and 1,236 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 16, and although wounding data indicate that this strain is somewhat intermediate, in terms of sea lamprey wounding, between the Seneca Lake and Marquette-Superior strains, they have survived to age 10 at a rate comparable to that for the Seneca Lake strain. 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 continued use of these strains in the Lake Huron lake trout rehabilitation program, especially in the northern regions of the lake.

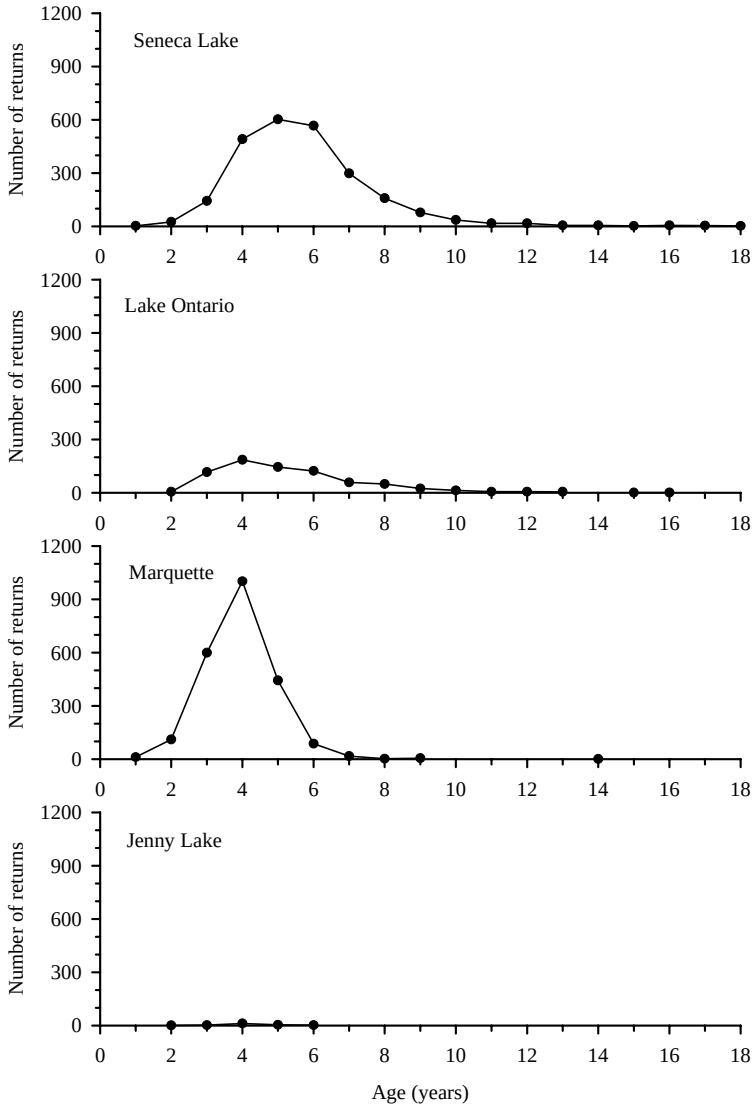

Figure 7. *Age distribution of 1987-2005 lakewide returns of coded-wire tags from lake trout stocked at the Northern Refuge, Lake Huron.*

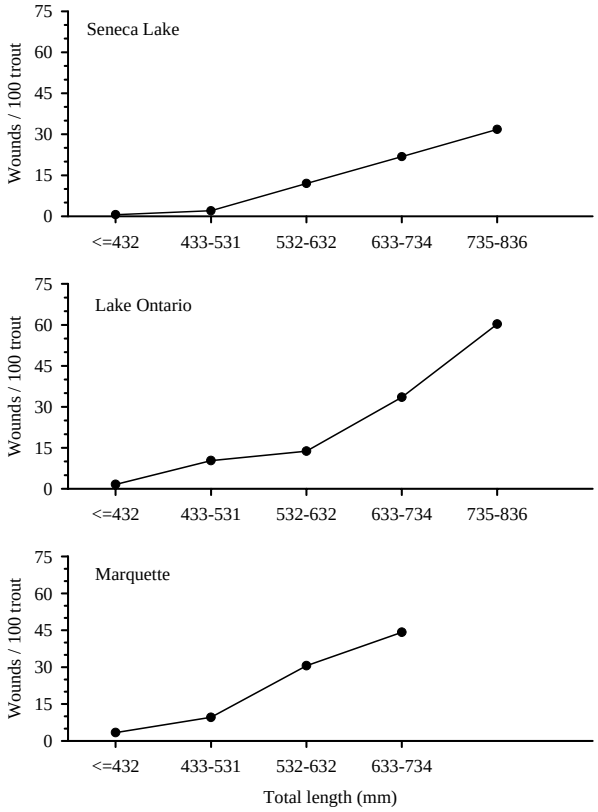

Figure 8. *Sea lamprey wounding rates (AI-III wounds per 100 fish, all seasons combined) for Northern Refuge lake trout in five length groups during 1987-2005. Wounding rate for large (> 734 mm TL) lake trout of the Marquette-Superior strain is not plotted due to small sample size.*

SUMMARY OF LAKE TROUT MOVEMENT, 2005

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 2005 assessment, sport, and commercial fisheries from all regions of Lake Huron.

Nearshore Movement Study - Since 1993, a total of 5,201 coded-wire tags has been recovered from plants of the 1991, 1993, 1995, 1997, 2001, and 2002 year-classes of these study fish. Lake trout from the 2003 and 2004 year classes have not yet appeared in lakewide sampling. In 2005, no fish from the 1991 year class were captured, and only 2 fish were captured from the 1993 year class lakewide. The 1995 and 1997 year classes are now 10 and 8 years old respectively and are becoming much less abundant in the returns as well. The 2001 to 2004 year classes are just beginning to appear as these fish recruit to fishery/survey gears. The discussion that follows is biased geographically by the effort employed at specific fishing sites (all sources). Analysis is ongoing to adjust annual returns for effort using agency survey and commercial fishery large-mesh gill net data. An analysis fitting returns per effort in the assessment and large mesh commercial gill net fishery with an exponential sigmoid model to calculate lake trout home range for each nearshore movement site is incomplete at this time.

Adams Point -A total of 1,369 coded-wire tag recoveries has been made from fish stocked at Adams Point. Returns by year class are as follows: 288, 216, 422, 435, 8, 0, 0, and 0 for 1991, 1993, 1995, 1997, 2001, 2002, 2003, and 2004 year classes respectively. Of the tags recovered, 68.8 % were from within MH-1, 18.8 % moved south to MH-2, 8.3 % to other Michigan waters, and 4.2 % to Ontario waters (Table 5). After adjusting for variable fishing effort in each grid, the average radius of dispersal by coded-wire tagged lake trout from Adams Point was 21.8 ± 1.4 miles. Distances traveled by Adams Point lake trout ranged from 5.3 to 157.5 miles. The average bearing of dispersal adjusted for effort from the Adams Point stocking site was 221 degrees (approximately SW).

Middle Island -A total of 1,190 coded-wire tag recoveries has been made from fish stocked at Middle Island. Returns by year class are as follows: 237, 232, 353, 364, 3, 1, 0, and 0 for 1991, 1993, 1995, 1997, 2001, 2002, 2003, and 2004 year classes respectively. A fairly substantial number of returns came from within MH-2 where the fish were stocked (44.8%). A total of 30.6 % of the recoveries came from fish that moved north to MH-1, 13.7 % from fish that moved south to MH-3, 4.0 % from other Michigan waters, and 6.9 % from Ontario waters (Table 5). After adjusting for variable fishing effort in each grid, the average radius of dispersal by coded-wire tagged lake trout from Middle Island was 27.6 ± 1.8 miles. Distances traveled by Middle Island lake trout ranged from 0.3 to 127.4 miles. The average bearing of dispersal adjusted for effort from the Middle Island stocking site was 263 degrees (approximately W).

Sturgeon Point - A total of 1,239 coded-wire tag recoveries has been made from fish stocked at Sturgeon Point. Returns by year class are as follows: 479, 254, 250, 256, 0, 0, 0, and 0 for 1991, 1993, 1995, 1997, 2001, 2002, 2003, and 2004 year classes respectively. Although fish stocked at Sturgeon Point continue to move north to MH-1 and MH-2 (4.6 and 26.1 %, respectively), 33.9 % remain within MH-3, 17.0 % emigrate to other Michigan waters, and 18.4 % end up in southern Ontario waters mostly in the OH-4 commercial fishery (Table 5). After adjusting for variable fishing effort in each grid, the average radius of dispersal by coded-wire tagged lake trout from Sturgeon Point was 32.3 ± 1.2 miles. Distances traveled by Sturgeon Point lake trout ranged from 0.6 to 101.5 miles. The average bearing of dispersal adjusted for effort from the Sturgeon Point stocking site was 230 degrees (approximately SW).

Point Aux Barques - A total of 1,403 coded-wire tag recoveries has been made from fish stocked at Point Aux Barques. Returns by year class are as follows: 279, 491, 389, 239, 4, 1, 0, and 0 for 1991, 1993, 1995, 1997, 2001, 2002, 2003 and 2004 year classes respectively. Like the Sturgeon Point fish, many of the tagged Point Aux Barques lake trout are sampled in Canadian waters. Recoveries from these lots of fish in the Ontario assessment and commercial fisheries in the southern main basin accounted for 36.7 % of the returns (Table 5). A total of 13.0 % of the returns came from fish that had moved north, 28.6 % remained in MH-4, and 21.7 % of the fish moved southward in Michigan waters. After adjusting for variable fishing effort in each grid, the average radius of dispersal by coded-wire tagged lake trout from Point Aux Barques was 24.0 ± 2.9 miles. Distances traveled by Point Aux Barques lake trout ranged from 4.3 to 137.2 miles. The average bearing of dispersal adjusted for effort from the Point Aux Barques stocking site was 216 degrees (approximately SW).

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**	**Ontario waters**
MH-1*	926 (68.8)	253 (18.8)	78 (5.8)	20 (1.5)	13 (1.0)	0 (0.0)	56 (4.2)
MH-2*	355 (30.6)	520 (44.8)	159 (13.7)	33 (2.8)	13 (1.1)	1 (0.1)	80 (6.9)
MH-3*	55 (4.6)	310 (26.1)	402 (33.9)	124 (10.4)	72 (6.1)	6 (0.5)	218 (18.4)
MH-4*	9 (0.7)	42 (3.1)	128 (9.3)	393 (28.6)	267 (19.4)	31 (2.3)	504 (36.7)

Six Fathom Bank Movement/Dispersal - A total of 5,922 identifiable coded-wire tags from fish stocked at Six Fathom Bank has been recovered in lakewide activities since 1987. Stocking of coded-wire tagged lake trout ceased on Six Fathom Bank in 1998, and as a result only 45 tagged lake trout from Six Fathom Bank were recovered in 2005 lakewide sampling efforts.

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. Coded-wire tagged lake trout from Six Fathom Bank are recovered in large numbers in nearly every region of Lake Huron, including the North Channel and Georgian Bay. This pattern suggests substantial dispersal of Six Fathom Bank fish to other regions of Lake Huron. However, it should be understood that significantly more effort is employed outside Six Fathom Bank than within. After adjusting for fishing effort, the average radius of dispersal by coded wire tagged lake trout from Six Fathom Bank is 17.2 ± 0.7 miles, suggesting the majority of the fish stocked on this large mid-lake reef remain there. Distances traveled by Six Fathom Bank lake trout ranged from 0.1 to 109.2 miles. There were no apparent trends in strain specific dispersal patterns from Six Fathom Bank. An analysis fitting returns per effort in the assessment and large mesh commercial gill net fishery with an exponential sigmoid model to calculate lake trout home range is incomplete at this time.

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.

Northern Refuge Movement/Dispersal - A total of 5,908 identifiable coded-wire tags from fish stocked in the Northern Refuge has been recovered since 1987. 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.

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. Nearly half of the total recoveries of fish stocked in the Northern Refuge were from within the boundaries of the refuge. In the past, very few tag returns came from outside the North Channel or northern main basin. This was mainly due to the high levels of sea lamprey induced mortality and commercial fishing mortality in northern Lake Huron. However, 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. As a result, there seems to be an increasing trend in survival and dispersal of lake trout from the Drummond Island area. Significant numbers of Drummond Island stocked coded-wire tag returns now come from the central and southern main basin of Lake Huron. Hopefully this signals progress towards recovery in northern Lake Huron, and the Northern Refuge can provide an epicenter for recovery in an area identified as historically important for spawning stocks. An analysis fitting returns per effort in the assessment and large mesh commercial gill net fishery with an exponential sigmoid model to calculate lake trout home range is incomplete at this time.

Yankee Reef Movement/Dispersal - A total of 455 identifiable coded-wire tags from fish stocked on Yankee Reef has been recovered since 2001, with 228 of the total recoveries sampled in 2005. Coded wire tagged lake trout were stocked on Yankee Reef in 2000 and 2001 as part of a pulse stocking evaluation. Locations of tag returns range from Rogers City to near Sarnia. More returns are needed to better describe

dispersal from this mid-lake reef area.