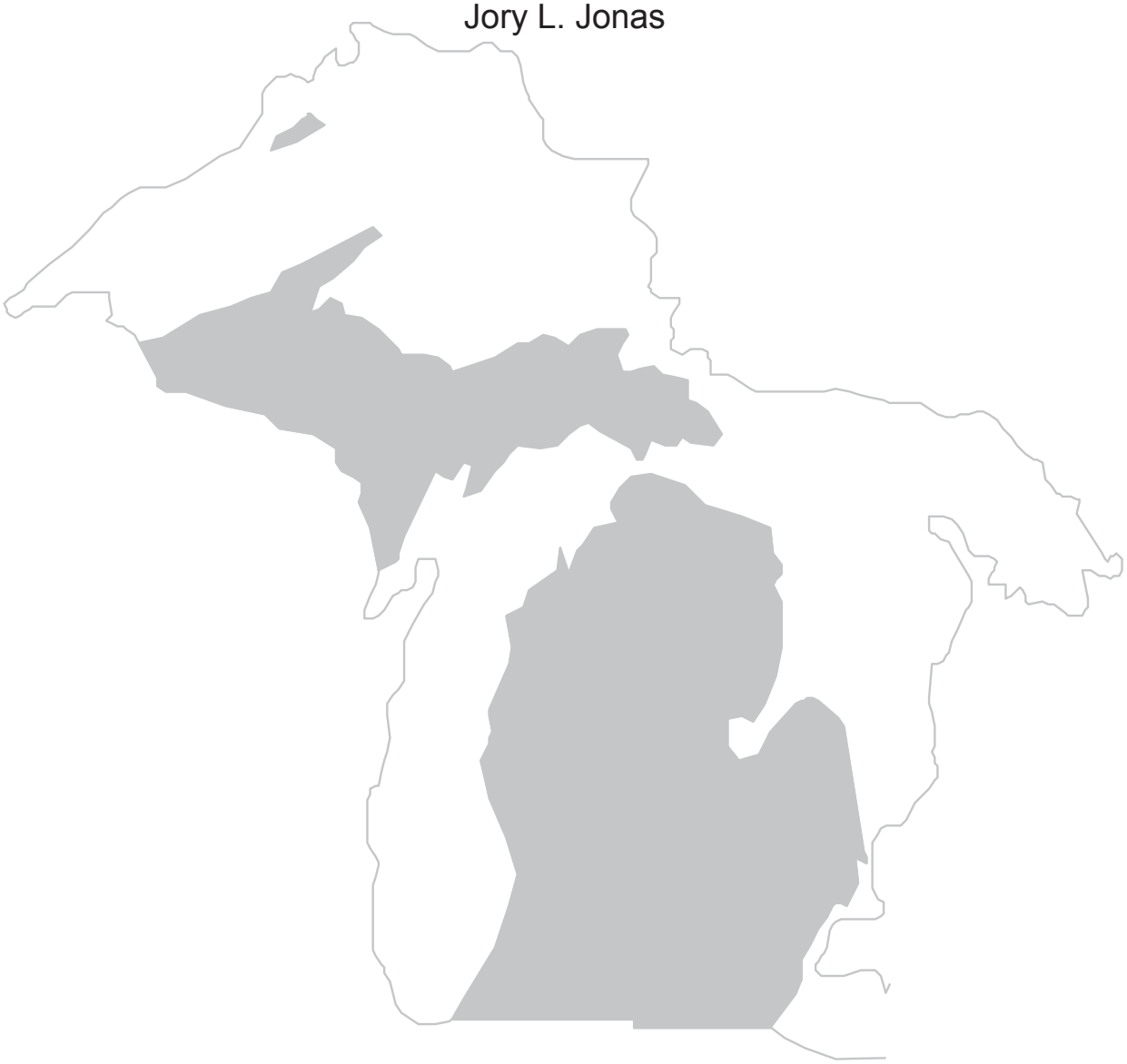
STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

FR06 July 2015

History of the Little Manistee River Weir and Fall Chinook Salmon Egg-take, 1991–2007

Janice M. Sapak
and
Jory L. Jonas



www.michigan.gov/dnr/

FISHERIES DIVISION
FISHERIES REPORT 06

Suggested Citation Format

Sapak, J. M., and J. L. Jonas. 2015. History of the Little Manistee River weir and fall Chinook salmon egg-take. Michigan Department of Natural Resources, Fisheries Report 06, Lansing.

For information or assistance on this publication, contact:

MICHIGAN DEPARTMENT OF NATURAL RESOURCES,
Fisheries Division
PO BOX 30446
LANSING, MI 48909
517-373-1280

TTY/TDD: 711 (Michigan Relay Center)

This information is available in alternative formats.

Table of Contents

List of Figures

List of Tables

Michigan Department of Natural Resources
Fisheries Report 06, 2015

History of the Little Manistee River Weir and Fall Chinook Salmon Egg-Take, 1991–2007

Janice M. Sapak

Michigan Department of Natural Resources, Platte River State Fish Hatchery, 15210 U.S. Highway 31, Beulah, Michigan 49617

Jory L. Jonas

Michigan Department of Natural Resources, Charlevoix Fisheries Research Station, 96 Grant Street, Charlevoix, Michigan 49720

Abstract.–The Little Manistee River weir was initially built in 1967 to trap returning adult salmon and trout for the purpose of collecting eggs in support of stocking efforts. It is now one of the largest and most advanced egg take and harvest facilities in the State of Michigan. The weir is the primary broodstock and egg collection site for Chinook salmon and steelhead in Michigan. Chinook salmon populations in the river are continually supplemented by annually stocking spring fingerlings. Steelhead populations are naturalized and self-sustaining. Chinook salmon account for nearly 75% of the fish recovered during fall harvest weir operations. Coho represent 17% of the fish handled with steelhead (8%) and brown trout (<1%) contributing to a lesser degree. The length, weight and condition (K_{TL}) of nearly all species has trended downward since 2003 and egg sizes of Chinook salmon are reaching near record lows. Observations of lamprey wounding on Chinook and coho salmon have been higher in recent years and correspond with observations for lake trout in adjacent Great Lakes waters. The facility continues as the primary site for Chinook salmon and steelhead gamete collections. As such, long-term trends in run size, health and condition of these key populations should be monitored closely to determine if management interventions or alternative strategies are required to ensure success of salmon rearing and stocking programs.

Introduction

The Little Manistee River weir was initially built to trap returning adult salmon and trout to collect eggs in support of Chinook (*Oncorhynchus tshawyscha*) and coho (*Oncorhynchus kisutch*) salmon, and steelhead (*Oncorhynchus mykiss*) stocking efforts. In response to severe declines in Great Lakes fisheries which were experienced throughout the 1950s and 1960s, the Michigan Department of Natural Resources (MDNR) committed substantial efforts to restore and enhance the depleted resource. One of the most substantial contributions in this regard was the introduction of Pacific salmon which served to balance predator-prey dynamics as well as increase and diversify fishing opportunities (Keller et al 1989). Pacific salmon were first introduced in 1967 and harvest weirs were constructed shortly thereafter in anticipation of spawning runs. Construction of the Little Manistee River weir began in 1967 and continued through 1968. It is located approximately 5 miles upstream from Manistee Lake in Manistee County near the village of Stronach. The original facility was

comprised of a blocking weir, fish ladder, pumphouse, dirt holding ponds, and a harvest facility (Figure 1). Modifications in the early 1970's included the addition of cement holding ponds, hydraulic crowders, a standby generator, and a recovery tank. More recent modifications have occurred to strengthen the blocking weir support structure and provide additional equipment storage facilities.

Stocking Practices

Chinook Salmon

Spring fingerling Chinook salmon have been the most heavily stocked fish in the Little Manistee River since 1967. Historically, the very first introduction of Chinook salmon fry occurred in Lake Michigan sometime between 1873 and 1880. Apparent survival of these fish was poor (Keller et al. 1990). The first successful introductions of spring fingerling Chinook salmon occurred in 1967, and a portion of these fish were stocked in the Little Manistee River. Gametes had originated from both the Columbia River in Oregon (Tule strain) and Washington's Green River Hatchery (Puget Sound strain). After three years, runs of Chinook salmon in the Little Manistee River became self-sufficient for gamete collection and no longer required input from West Coast fish. To this day, the Little Manistee River remains as the primary broodstock and egg collection site for Chinook salmon in Michigan.

Early in their stocking history from 1967 to 1978, about 345,000 Chinook fingerlings were stocked annually in the Little Manistee River (Table 1). Stocking levels then increased to 660,000 from 1979 to 1998, and were reduced to an average of 508,000 annually from 1999 to 2005. More recent concerns over forage availability in Lake Michigan resulted in a further reduction and an average of 377,000 Chinook salmon fingerlings have been stocked annually since 2006.

Coho Salmon

Yearling coho salmon O*ncorhynchus kisutch* were first stocked into the Little Manistee River in 1967 (Table 1). Coho salmon eggs were initially collected from the Columbia River at the Bonneville Dam, Oregon during fall of 1964. Eyed eggs were transferred to Michigan fish hatcheries and approximately 659,000 smolts were stocked into Lake Michigan in the spring of 1966. A second group of coho salmon eggs were obtained in 1965, from the Cascade River, Oregon and Toutle River, Washington. In 1967, 1.7 million smolts were stocked into four Lake Michigan streams including the Little Manistee River (433,000 smolts). Coho salmon stocking continued through 1992 with about 334,000 yearling smolts stocked annually. In 1993, coho salmon stocking was discontinued on the Little Manistee River due to concerns about potential transmission of Bacterial Kidney Disease (BKD) to native steelhead. Coho salmon were diagnosed as carriers of the bacteria and managers were concerned about overlap with the important naturalized broodstock of steelhead present in the river (Withler and Evelyn 1990). Additionally, coho salmon egg-take operations at the Little Manistee River weir were not very efficient, with low survival of adults in the holding ponds, resulting in poor quality eggs in hatcheries.

Steelhead

Fingerling and yearling steelhead were stocked in the Little Manistee River for a short period of time from 1981 to 1984 and more recently in 1997 (Table 1). The purpose of these stocking efforts was to facilitate the evaluation of strains and assess the survival of hatchery verses wild smolts (Fielder, 1987 and Seelbach, 1985). Steelhead were first introduced into Lake Michigan as fry in

1880. These fish originated from eggs collected from the McLoud River in California. Over the next 40 or 50 years, millions of California steelhead were stocked into Lake Michigan. It is these fish that are believed to have naturalized producing what is known as the Michigan or winter-run strain of steelhead in the Little Manistee River, Michigan. For over 40 years, the Michigan strain has been the primary and most successful strain of steelhead reared in hatcheries by the state of Michigan (Keller et al. 1990).

Yearling Atlantic salmon (*Salmo salar*) were stocked in the Little Manistee River for a short period between 1977 and 1982 (Table 1). Because Atlantic salmon returned poorly in Great Lakes fisheries, were also prone to disease and difficult to rear in the hatchery, stocking was discontinued (Keller et al. 1990).

Weir Operation

Since its construction in 1967, the Little Manistee River weir operates in the fall as the primary source for Chinook salmon eggs and occasionally, as a back up source to the Platte River Upper Weir for coho salmon eggs. Additionally, steelhead, brown trout (*Salmo trutta*) and Atlantic salmon runs are monitored. The Little Manistee River Weir also operates in the spring as an egg-take facility for steelhead. Details regarding spring operations will be provided in a separate summary report. During the fall, Chinook and coho salmon are typically harvested and sold to a commercial contractor while other salmonines are passed upstream. Some level of biological data has been collected on all trout and salmon since operations began in 1967. Summary results of fall operations from 1983 through 1990 have been previously compiled and are available in a published MDNR Fisheries Division Technical Report (Hay 1992). The current report provides summarized results from fall weir operations from 1991 through 2007.

From 1991 to 2007, weir blocking grates were typically installed around August 15 and were removed on or around November 8. Harvest operations, on average, have lasted for 86 days (range 81 to 92 days; Table 2). The earliest harvest operations were initiated in 1993 when grates were first installed on August 13 and the latest occurred in 1999 on August 18. The earliest ending date occurred in 2002 on November 4 and the latest in 1995 on November 14. Because of strong annual variations in run size, there were no obvious correlations between the number of fish harvested and the number of days in which the weir was operational.

All salmon harvested annually at the weir have been sold through a competitive bid process to various contractors. These contractors provided laborers at the weir for security and to assist with the harvest activities. Fisheries Division personnel were on-site to collect eggs and monitor harvest operations. Specific contractors have changed through time. Tempotech Industries, Inc., Hart, Michigan, held the contract for 10 years from 1986 to August 1996. In 1995, the owner of Tempotech Industries was convicted in federal court for selling contaminated salmon eggs (from Lake Ontario fish) in the state of New York. In response, MDNR cancelled their contract with Tempotech Industries and in the fall of 1995, fish were donated to the “Sportsmen against Hunger” program operated by the Michigan United Conservation Clubs (MUCC). MUCC solicited bids and granted a contract to Tempotech Industries, Inc., under new leadership, to transport and process the fish for distribution to the Michigan Food Council and the Michigan Department of Corrections. At the weir, security was provided by seasonal Michigan Civilian Conservation Corps (MCCC) employees and harvest assistance was provided by inmates under the direction of the Michigan Department of Corrections. From 1996 until 1998 the Sault Ste. Marie Tribe of Chippewa Indians, Sault Ste. Marie, Michigan, held the contract. The Clearwater Fisherman’s Cooperative, Moran, Michigan was the contractor from 1999 until 2001. Since 2002, the contract has been held by American Canadian Fisheries, Inc., Bear Lake, Michigan.

Egg-take Operations

Chinook Salmon

Since the inception of the salmon program in Michigan, the Little Manistee River Weir has been the primary source to provide Chinook salmon gametes for hatchery rearing programs. The spawning process from 1991 to 1996 involved the collection of sperm from individual males which was then held in a designated paper cup until an internal examination was completed. If the male was clinically negative for disease, the sperm was pooled with that from a number of other males in a bottle and used to fertilize eggs. With increasing knowledge and review of genetic stock practices in 1998, gametes from males were no longer pooled, and instead individual males were used to fertilize females to achieve a 1:1 spawning ratio (Table 3).

Gametes were collected from ripe females using compressed air which was blown into the upper body cavity creating pressure to expel the eggs. From 1988 to 1990, the egg fertilization technique was referred to as the "dry" method whereby eggs from several females were mixed with a pooled sample of sperm in a 5 gallon plastic pail without water. The mixture set for 30 minutes before it was water-hardened for 1 hour in flowing river water, and transported to a hatchery. In 1991, the "wet" egg fertilization method was adopted. In this process, the eggs from one female were mixed with sperm from a group of pooled males and water was added. The eggs were allowed to stand for one minute to enable fertilization. Eggs were then rinsed and water-hardened in flowing river water for at least one hour prior to being transported to the hatchery. In 2005 evaluations were conducted to determine if fertilization in a 0.75% saline solution improved gamete survival to eye-up. Eye-up rates increased by 8.3 percentage points (nonsaline, 59.5% and saline, 67.8%; Sapak, unpublished data). Since 2006, all salmon eggs have been fertilized in saline solution to improve survival.

During the mid to late 1980s, Lake Michigan experienced significant die-offs of Chinook salmon due to BKD (Holey et al. 1998). From 1991 through 2007, in efforts to reduce the incidence of BKD in hatcheries, a variety of culling methods were employed during Little Manistee River weir egg take operations (Table 4). Initially from 1991 through 1996, all eggs and sperm from fish showing gross clinical signs (cloudy ovarian fluid; "cheesy" membranes on the spleen, liver or heart; bleeding from the vent; swollen kidneys or kidneys with pustules) were discarded. In 1993 additional culling occurred with the introduction of a Field Enzyme-Linked Immunosorbent Assay (FELISA) test which was conducted on all clinically negative females. Procedurally, eggs from individual females were kept separate in numbered pails and fertilized. FELISA tests were run using a swab from the kidney of each female. Fertilized eggs were water-hardened for 2–3 hours until test results were available. After testing was complete, all eggs from females testing positive were discarded. To further reduce exposure to the BKD bacterium from 1993 to 2007, fertilized and water-hardened eggs were rinsed with oxygenated well water instead of flowing river water. Because concerns regarding the role of males in disease transmission were less certain, emphasis was placed on removing infected females from the broodstock, and culling practices for males were ceased in 1997. After the 2004 season, because of lingering questions regarding the accuracy of FELISA testing, and to reduce costs, the test was discontinued. Alternative antibiotic and disinfection treatment procedures for BKD were adopted, whereby eggs were water hardened in 2 ppm of erythromycin for 1 hour and then disinfected in 50 ppm iodophore for 30 minutes. Additionally, all males and females are examined for gross clinical signs, and only clinically negative fish are used for egg-take and fertilization procedures.

The highest culling rates for male and female Chinook salmon exhibiting clinical signs of disease occurred from 1991 through 1998 (Table 4). Female culling rates averaged 18% and rates for males were around 5%. More recently, clinical signs of disease, and therefore the number of individuals culled in egg take operations have declined substantially. In 2006 and 2007, less than 1% of female Chinook salmon were removed from egg take operations because they exhibited clinical signs of disease and less than 3% of males were removed.

Additional emphasis has been placed on hygiene and disinfection procedures during egg take operations in recent years. Since 2003, all ripe females used for egg take were disinfected in a 100 ppm iodophore (Argentyne) solution, then rinsed and wiped clean prior to initiation of the spawning and fertilization process. Beginning in 2005, after fertilization, eggs were water-hardened in 2 ppm erythromycin phosphate for one hour. Water hardened eggs were rinsed and pooled, and then disinfected in 50 ppm iodophore for 30 minutes. The erythromycin and iodophore solutions were buffered with hydrochloric acid to a pH of 7.2–7.4.

Egg take operations at the Little Manistee River weir typically began around October 1 and lasted approximately two weeks ending around October 15. The longest egg take operation occurred in 1992 and lasted for 26 days (Table 3). The shortest occurred in 2005 lasting only 6 days. Egg size, recorded as number of eggs per quart (Von Beyer method) has averaged 2,722, and the largest average size occurred in 1994 at 2,468 per quart (Table 3). The average egg size has been trending downward and the smallest occurred in 2007 at 3,413 eggs per quart (Table 3). The number of eggs per female is determined in this report, from the number of eggs extracted from the female during egg-take. On average there were 4,499 eggs per female from 1991 through 2007. The highest numbers were observed in 1993 at 4,932 and the lowest in 2005 at 3,741. This represented a 24% change in egg production per female among high and low years. The percentage of eggs surviving through eye-up provides an indication of survival in the hatchery system. Between 1993 and 2007, eye-up rates have ranged from 56 to 87 percent, and have averaged 73% (Table 3).

The number of Chinook salmon eggs collected for rearing in MDNR hatchery facilities has averaged 6.1 million, ranging from 3.1 million in 2005 to 9.6 million in 1997 (Table 3). Chinook salmon eggs collected for at the MDNR Little Manistee River Weir are incubated at either the Platte River State Fish Hatchery in Beulah, Michigan or Wolf Lake State Fish Hatchery in Mattawan, Michigan. In many years additional Chinook salmon eggs were collected and sent to hatcheries in Indiana and Illinois (Table 3). The number of eggs transferred to other states has averaged 1.9 million from 1991 through 2007, and has ranged from 0.8 million in 2007 to 3.1 million in 1991 (Table 3). Due to low run sizes in 1998 and 2005, eggs provided to other states were collected at the Swan River weir in Rogers City, Michigan.

Coho Salmon

The Little Manistee River weir has served as a backup source for coho eggs when insufficient egg numbers were recovered from the Platte River Upper Weir (Table 5). In 1988, approximately 885,000 green eggs were taken from 308 females over a three day period. Eggs were fertilized using both the “wet” and “dry” methods. Eye-up rates ranged from 65 to 80% using the “wet” method and from 76 to 81% percent using the “dry” method. At this time, fish were not examined for clinical signs of disease. In 1992, a total of 3.74 million coho salmon eggs were taken from 1,394 females over four days of egg take and the total number of males used for fertilization was not recorded. Females were culled from egg-take if clinical signs of disease were present. At this time, males were not culled, and milt from several individuals was pooled before fertilization. In 2006 due to lower than normal returns to the Platte River Upper Weir, approximately 85,000 eggs were collected from 41 females and both the females and males were checked for clinical signs of disease and culled if positive. The eggs from one female were fertilized with the milt from one male.

Harvest

Chinook salmon comprised 89% of the fall harvest at the Little Manistee River weir over the last ten years (1997–2007). As of 2006, all coho salmon are passed upstream and not harvested. In earlier years (1967–93), greater numbers of coho salmon were stocked and harvests of coho and Chinook

salmon were nearly equal (Table 2). Coho salmon stocking in the Little Manistee River was terminated in 1992. By 1994, the contribution of coho salmon to the weir harvest had declined from near 50% to <4%. Brown trout and steelhead are present but less abundant during fall operations and are not harvested at the weir. From 1967 through 2007, brown trout comprised <1% of the fish processed, and steelhead <15%. Fisheries Division personnel conducted all biological sampling of coho and Chinook salmon at the contractors' fish processing facility. A sampling protocol was established and sex, length, weight, fin clips, coded wire tags, lamprey scars and clinical signs of BKD were recorded for 15% of the Chinook salmon and 7.5% of the coho salmon harvested. Biological sampling of steelhead and brown trout was conducted at the weir facility, all brown trout and up to 50 steelhead per week were sampled to determine length, weight, sex, maturity, fin clips, tags, and lamprey scars. Scale samples were collected to determine fish ages.

Chinook Salmon

During most of the last 17 years, Chinook salmon have been the most abundant fish handled during fall harvest weir operations. Between 1991 and 2007, the average number (mean ± SD) of Chinook salmon harvested at the Little Manistee River weir was 14,614 ± 3,562 fish (Table 2). The highest harvest of 21,062 Chinook salmon occurred in 1991. The lowest harvest on record occurred in 1998 when 7,170 fish were harvested. The age of Chinook salmon at the Little Manistee River weir has ranged from 0.0 to 0.5 years (stream years (pre-smolt).lake years (post-smolt)). For Chinook salmon, the age of fish was estimated by evaluating the length of known-age fish which had been implanted with coded-wire tags and collected through time from multiple Lake Michigan harvest weir operations. An age-generating model based on length was applied to assign age proportionally to harvested individuals whose age was not known (Randall Claramunt, MDNR, personal communication; Clevenger 2007). Age 0.0 and 0.5 fish rarely occurred, and were therefore not included in most summary tables (Table 6).

The gender ratio of Chinook salmon was often skewed in favor of males. On average, males comprised 65% of the harvest. The highest percentage of males (90%) was observed in 1996 and the lowest (50%) in 2007 (Table 6). Age 0.1 males (jacks) comprised 18% of the harvest from 1991 through 2007 (range 7 to 33%). The majority of the males returning to the weir were age 0.2, these accounted for 36% of all returns. The proportion of age 0.2 males relative to females has ranged annually from a high of 66% in 1996 to a low of 20% in 2007. Age 0.3 males comprised 10% of the harvest (range 4% to 22%), and age 0.4 males were rare (<2%) occurring in only 9 of the most recent 16 years (1991 through 2007). Nearly all female Chinook salmon returned to the weir from 1991 through 2007 were age 0.2 or 0.3 (97%). Age 0.3 female Chinook salmon represented 70% of all females returned while age 0.2 were 27%. It was relatively rare to observe age 0.1 or 0.4 females and these age groups combined represented less than 4% of the returning females (Table 6).

In previous summaries of Chinook salmon returning to the Little Manistee River weir in the fall, the relative returns of stocked year-classes have been used to benchmark post-stocking survival (Table 7). These data show returns to the weir that were higher in the early 1980's averaging 7% and declined to 2.4% from 1984 through 1993 (Hay 1992). More recently, returns from 1999 through 2001 increased averaging 3.6%. As of 2007, the 2002 and 2003 year-classes of stocked fish were the last fully recruited to the weir. Returns of these most recent year-classes appear to be lower, averaging 2% of the fish stocked (Table 7). Reductions in stocking and increases in recruitment of naturalized Chinook salmon may be confounding more recent comparisons.

It is important to note that the return rate, as a percent of the fish stocked, may be somewhat misleading. Substantial numbers of naturally produced Chinook salmon return to the Little Manistee River weir (Seelbach 1985; Woldt and Rutherford, unpublished data). Additionally, there does not appear to be a strong correlation between the number of fish stocked and the numbers of fish

associated with a given year-class returning to the weir (df=1,26, P>0.83, R^2=0.002). The numbers of Chinook salmon returning to the weir should provide a realistic approximation of year-class strength for both stocked and naturalized fish. Prior to 1984, year-class strength was relatively high with 39,900 fish returning from each year-class on average. Between 1984 and 2004, returns of Chinook salmon were lower and relatively consistent averaging 15,000 fish (range 8,900 to 21,900).

From 1991 through 2007, the average length of Chinook salmon at age 0.1 was 23.3 inches and ranged from 21.7 to 24.4 inches (Table 8). Age 0.2 fish were 31.6 inches (range 30.0 to 32.6 inches); age 0.3 fish were 35.4 inches (range 33.0 to 36.8 inches) and age 0.4 were 37.4 inches (range 33.8 to 40.0 inches). Both of the most abundant ages of females (0.2 and 0.3 years) returning to the weir experienced declines in length at age in recent years. From 1991 through 2001 the size-at-age of 0.3 year old females had been relatively consistent averaging 35.3 ± 2.0 inches (mean ± SD). After 2001 the length of three-year-old female Chinook salmon trended downward and reached 32.5 ± 1.5 inches in 2007. Similarly, the length-at-age of 0.2 year old females had averaged 32.0 ± 2.0 inches from 1991 through 2002, but declined to 29.8 ± 1.3 inches by 2007. The length of age 0.1 males has been relatively consistent throughout the 1991 to 2007 time period, averaging 22.7 ± 2.5 inches. As with females, age 0.2 and 0.3 males experienced less extreme but measurable declines in length-at-age in recent years. The average length of age 0.2 males declined from 32.9 ± 2.1 inches in 2000 to 30.6 ± 2.3 inches in 2007 and length of 0.3 year olds declined more sharply from 37.9 ± 1.9 inches in 2001 to 33.6 ± 1.8 inches in 2007 (Table 8).

The Fulton type condition factor (K_{TL}=Weight/Length^3*10,000), while somewhat controversial, can be used as a surrogate for relative condition or plumpness of fish (Cone 1989). At the Little Manistee River weir, Chinook salmon showed declines in condition in recent years with males experiencing a sharper drop than females. Age-specific estimates of condition factor (K_{TL}) for females showed little trending through time and averaged 3.4 ± 0.2 (mean ± SD) for 0.2-year-olds and 3.3 ± 0.2 for 0.3-year-olds. Average K_{TL} values for age 0.2 female Chinook were 13% lower and for age 0.3 were 12% lower in 2007 compared to values in 1995. For males, the average K_{TL} for age 0.2 fish was 3.8 in 1995 and in 2007 had dropped to 3.0, a 20% decline. Similarly, K_{TL} values for age 0.3 males had declined from 3.8 in 1995 to 2.8 in 2007, a 26% decline.

Reported numbers of sea lamprey (*Petromyzon marinus*) marks on Chinook salmon were standardized to represent the average number of fresh wounds per 1,000 fish. From 1991 through 2007 wounding rates had averaged 7.4 wounds per 1,000 fish (range 2.9 to a high of 15.7). Increases in wounding rates were evident in recent years (2003 through 2007) and the average wounds per 1,000 fish had risen to 11.3 in 2007 (Table 9). The high wounding rates observed at the Little Manistee River weir agreed with increases in adult sea lamprey populations reported by the modelling subcommittee of the Technical Fisheries Committee (2009).

Coho Salmon

During the last 17 years, coho salmon have comprised 17% of the fish handled during fall weir harvest operations. From 1991 to 1993, the annual harvest of coho salmon was 14,599 ± 3,078 (mean ± SD) fish (Table 2). Coho salmon stocking in the Little Manistee River was terminated in 1994. As a result, the number of coho salmon returning had declined substantially by 1996. Since 1996, the harvest of coho salmon at the weir has averaged 979 ± 727 fish. Continued coho salmon returns to the weir, even after all stocking had been discontinued provided evidence that self-sustaining naturalized populations were present in the river. Additionally, researchers documented wild coho salmon smolts in the river throughout the 1980s and 1990s (Seelbach 1985; Tonello 2005; Woldt 1998).

Increased interest in conserving naturalized runs of coho salmon in the Little Manistee River resulted in a decision to pass all coho salmon upstream beginning in 2006. During a cold and wet fall in 2005, a significant run of coho salmon returned to the weir and were harvested on the last day of

operation for the season. Managers were concerned that harvest of these fish might reduce the reproductive potential of naturalized coho salmon populations. In 2007, all coho salmon were passed upstream during weir operations without collection of biological data.

There are only two age groups of coho salmon which are assigned based on a length-at-age key (Clevenger 2007). Generally, fish <18 inches total length are assigned as age 1.0 and >18 inches are assigned as age 1.1 (stream years (pre-smolt).lake years (post-smolt)). In 1999, coho salmon were much larger than usual and fish with total lengths <21 inches were assigned to the 1.0 age group. Coho salmon assigned as age 1.0 are typically precocious males called "jacks". These younger male coho salmon represent a reproductive strategy whereby they spawn a year earlier than is typical.

The gender ratio of coho salmon returning to the Little Manistee River weir was skewed slightly in favor of males which on average comprised 56% of the returns (Table 10). The lowest proportion of males was observed in 1996 (41.0%) and the highest in 1997 (68.6%). Age 1.0 males represented 19% of all males returned annually. The majority of the males (81%) and females (99.6%) returning to the weir were age 1.1. From 1991 through 2007 age 1.1 males comprised 45.4% of the fall harvest of coho. During the same time period, age 1.1 female coho salmon comprised 43.9% of the annual harvest. Age 1.0 females were very rare and comprised less than 1.6% of the fish handled in any year (Table 10).

The returns of stocked year-classes of coho salmon to the weir were higher in the early 1980's, averaging 11%, compared to 4.1% from 1985 through 1991 (Table 11; Hay 1992). After 1991, returns were primarily indicative of year-class strength for naturalized fish. The highest returns of nonstocked coho were associated with the 1994, 1996 and 2003 year-classes (Table 11).

Since 1991, male and female coho were similar in size. The average total length of age 1.0 coho salmon was 15.83 ± 1.11 (mean ± SD) inches and ranged from values of 14.9 to 16.4 inches. Age 1.1 coho averaged 25.38 ± 2.13 inches over the time series and ranged from 22.1 to 30.2 inches (Table 12). The more abundant age 1.1 males and females were largest in 1999 (average 30.24 ± 2.29 inches) and were smallest in 1997 (average 22.09 ± 1.83 inches).

Condition factor (K_{TL}) of coho salmon declined in recent years similar to observations for Chinook salmon. The condition values for age 1.1 coho salmon males decreased from 3.68 in 2001 to 3.24 in 2007 (11% decline). Age 1.1 females dropped from 3.78 in 2001 to 2.89 in 2007 (23% decline).

Sea lamprey marks on coho salmon from 1991 to 2007 were variable averaging 2.5 ± 3.6 (mean ± SD) wounds per 1,000 fish (Table 9). Wounding rates were relatively high during the period from 1991 through 1993 (average 4.1 ± 2.4 wounds per 1,000 fish) and were near zero for most of the time period between 1994 and 2001 (average 0.5 ± 1.3 wounds per 1,000 fish). Wounding rates increased in 2002 and reached an all time high of 13.1 wounds per 1,000 fish in 2005 (Table 9).

Steelhead

Steelhead were the third most abundant fish handled during fall harvest weir operations averaging 1,551 ± 1,419 (mean ± SD) fish from 1991 through 2007 (Table 2). This is somewhat below the long-term (41-year) average of 2,162 ± 2,009 fish (1967–2007). During the most recent 10 years (1997–2007), 863 ± 586 steelhead were passed each year. The greatest numbers of fall steelhead returned in 1985 (6,356 fish), 1991 (3,666), 1992 (3,054), and 1996 (5,249). The lowest numbers returned in 1995 (351 fish), 2000 (319), and 2002 (120). With the exception of a small number of mortalities, all steelhead were passed upstream. Ages of steelhead were determined by evaluating annuli on scales. The age in years for stream residence and lake residence were recorded separately and differentiated based on identification of the smolt check.

The gender ratio of steelhead in the fall run was 52.2% male and 47.8% female from 1991 to 2007. Lake age-.0 steelhead (skippers) were mostly males (>95%) and made up 5.9% of the fall run. Approximately 56% of the fish returning to the weir had smolted after two years in the stream, and 44% had smolted after only one year in the stream (Table 13). The most abundant age groups were comprised of lake age-.2 (36.6%) and age-.3 (36.7%) fish. Fish of lake age-.1 were 10.4% and lake age-.4 were 9.7% of the return. Lake age-.5 fish represented only 0.4% of recovered steelhead.

Steelhead generally have not been stocked in the Little Manistee River, and the majority of the run has been wild fish. Hatchery or wild origin was determined by estimating the ratio of the distance between annuli around the smolt check (Ratio 2:3; Seelbach and Whelan 1988). Steelhead returning to the weir in the fall from 1991 through 2007 averaged 82.9% wild and 17.1% hatchery origin(Table 14). The highest percentages of wild fish were returned in 1998 (91.0%), 1994 (90.5%) and 2003 (90.4%). The lowest percentages of wild fish returned occurred in the most recent two years 2006 (56.3%) and 2007 (48.1%). Returns were similar for both males and females.

Investigators researching the stock composition of Lake Michigan steelhead observed an increased contribution of hatchery reared fish in the lakewide population (Bartron and Scribner 2004). They hypothesized that this was because of the improved survival of stocked fish after the timing and size-at-stocking were increased in 1983 (fall fingerlings to spring yearlings). The wild run of steelhead as measured by fall returns to the Little Manistee River weir is down in recent years. Proportionally, there have been substantially higher numbers of stocked fish in the run as well. The majority of stocked fish had spent one year in the stream whereas naturalized fish spent two years in the stream prior to smolting. Substantially higher numbers of stream age-1 fish have resulted from the 2000 to 2004 year-classes as measured in Little Manistee River returns (Table 15). Most of the stream age-2 fish (96.2%) were of wild origin. Three of the year-classes (1984, 2002, and 2005) were entirely wild fish. Age-1 stream fish were composed of 67.6% wild and 32.4% hatchery origin. Hatchery contribution was relatively high considering that steelhead have not been stocked in the Little Manistee River. Since 2001, declining numbers of stream age-2 fish have been observed in fall weir returns (Table 15).

The size of returning adults is more dependent upon the years spent in the lake than on the age at smolting or the overall age (Rand et al. 1993). From 1999 through 2001, the average length, weight, and condition (K_{TL}) were substantially above the 1991 to 2007 average (Table 16). In the most recent three years (2005 to 2007), length, weight, and condition were generally near or below average for fish spending two or three years in the lake. By 2007, these parameters declined to some of the lowest levels on record. From 1999 to 2001, the average K_{TL} for fish spending two years in the lake was 3.9 and for those spending three years in the lake 3.8. In 2007, condition factors were 11% lower (K_{TL}=3.4) for fish with two lake years and 16% lower (K_{TL}=3.2) for those with three lake years.

The spawning history of steelhead can be interpreted from compressed areas on scales which result from reduced growth during the spawning season. These “spawning checks” can be used to establish the number, age and timing of spawning events. At lake age-1, an average of 23.5% percent of males are returning to spawn for a second time, and only 5.2% of females are returning. By lake age-3 just over 50% of males and 63% of females have spawned in previous years. Approximately 90% of lake age 4 fish have spawned before, and on average they have spawned two times (Table 17). In general, males tended to spawn for the first time at an earlier age than females. The number of repeat spawns for females was higher than that of males at lake age 3 and older.

Lamprey wounds on steelhead averaged 1.7 ± 2.6 (mean ± SD) per 1,000 fish, with a maximum rate of 9.4 in 2002 (Table 9). Because the number of wounds observed on steelhead was low and highly variable from 1991 to 2007, it was difficult to discern if there were temporal trends.

Brown Trout

Brown trout represented only a small number of the fish harvested at the Little Manistee River weir. From 1991 to 2007, an average of 77 ± 42 (mean ± SD) brown trout were passed (Table 2). This is very close to the long term (40 year) average of 79 ± 51 fish per year. The highest return of 238 fish occurred in 1975. During the period from 1991 to 2007, the highest number of brown trout returned was 176 fish in 1996, and the lowest was 28 fish in 1998. With the exception of handling mortalities, all brown trout were sampled for biological data and similar to practices for steelhead, were released upstream. Ages of brown trout were determined by evaluating annuli on scales.

Gender ratios for brown trout were skewed in favor of females. Male brown trout comprised 39.4% and females 60.6% of weir returns from 1991 to 2007. Most brown trout returned after only one year in the stream and one or two years in the lake (Table 18). Less than 10% of brown trout had spent two years in the stream prior to smolting.

Brown trout showed above average growth from 1998 through 2002 (Table 19). Similar to observations for other salmon and trout at the weir, since 2003 average length, weight and K_{TL} values have generally been below the long-term average for the time period between 1991 and 2007.

Special Studies and Finclips

A special study of female Chinook and coho salmon was conducted during the fall of 1991 and 1992 to determine the percent contribution of ripe eggs to total body weight (Table 20). During weir operations, a sample of 25 females per week were measured and weighed before and after eggs were removed. The weight of a stripped female was compared to the original round weight. Eggs comprised 21.86 ± 1.79 (mean ± SD) percent of the body mass for Chinook and 19.36 ± 3.07 for coho salmon (Table 20).

In another study, oxytetracycline marked fish were used to determine the contribution of naturalized fish to Chinook salmon populations in Lake Michigan. All Chinook stocked since 2000, except those stocked in 2005, were marked with oxytetracycline. Indications from estimates of smolt production in the river hint that a substantial portion of returning adult Chinook salmon may be naturalized and not of hatchery origin (Tonello 2005).

Fin clip records provide information regarding the history of stocked Chinook salmon and steelhead returning to the Little Manistee River weir. From 1991 to 1995 a substantial number of right ventral (RV) clipped Chinook salmon were observed. These represented a strain of Chinook salmon from New York which had been stocked in 1990 and 1991 (Table 21). Fish with an adipose clip likely had been implanted with a coded-wire tag and were recovered in all years except for 1999 and 2000. Coded-wire tags were placed in fish to differentiate the Michigan, New York and triploid strains of Chinook salmon. Triploid Chinook salmon were stocked in the Little Manistee River from 1986 to 1990 and were represented in the 1991–94 returns to the weir at similar levels to sexually mature fish (Clevenger, personal communication). Triploid Chinook salmon that had been stocked in the Muskegon River in 1991 returned to the Little Manistee River weir in 1993–94.

From 1990 through 1994, high levels of Bacterial Kidney Disease (BKD) were found in Lake Michigan salmon. In response Chinook salmon eggs were instead obtained from fish in the Salmon River, New York. Eggs were transferred to MDNR hatcheries and stocked as spring fingerlings in Michigan waters, including the Little Manistee River (Table 1). Returns of these fish were not as successful as anticipated, and Field Enzyme-Linked Immuno Assay (FELISA) testing indicated that the returning New York strain of Chinook salmon were heavily infected with BKD (Table 22). The State of Michigan returned to stocking only Michigan strain of Chinook salmon in 1995.

Fin clipped steelhead have not been stocked in the Little Manistee River since 1984. However, a small number of steelhead returning to the weir from 1991 to 2007 had clearly identifiable fin clips. These were likely fish that had strayed from their original stocking locations. Only 3% of the steelhead returning to the weir in the fall from 1991 to 2007 had finclips (Table 23). The most commonly occurring clips were left maxillary (LM) and right maxillary (RM), which were stocked by Wisconsin Department of Natural Resources (Wisconsin DNR, 2006), and right pectoral (RP) and adipose (AD) which were stocked by MDNR.

Discussion

Chinook salmon harvest and egg take operations at the Little Manistee River weir occurred annually from 1991 to 2007, and are expected to continue in the future. Chinook salmon stocking was decreased in the Little Manistee River from 878,000 fish in 1992 to 377,000 in 2007. The number returning to the weir ranged between 7,071 and 21, and has been generally lower in recent years. The average length, weight, and condition of Chinook have also declined substantially in recent years. Numbers of eggs requested have been reduced due to lower stocking requests. Despite this, in some years egg take targets were not reached because too few adults were available. Egg size declined in 2007 to 3,400 eggs per quart compared to the long term average of 2,700 eggs per quart. The number of eggs per female has also trended downward. Lamprey scarring rates on Chinook salmon for the years 1991–2007 varied from 1.96 to 15.68 wounds per 1,000 fish, and have averaged 7.41. In recent years (2003–07), the average wounds per 1,000 fish had increased to 10.27. The incidence of clinical signs of BKD in Chinook salmon females has decreased substantially, from a high of 20.5% in 1992 to 1.2% in 2007.

Coho salmon were last stocked in the Little Manistee River in 1992 and adult returns dropped from a high in 1993 of 18,096 to a low of 238 in 2006. In two different years, 1992 and 2006, coho salmon eggs were taken at the Little Manistee River weir to supplement the egg take at the Upper Platte River Weir. Coho salmon were harvested from 1991 to 2006 and were passed upstream of the weir in 2006–07 to facilitate naturalized runs. The average length, weight and condition of coho salmon also declined in recent years.

The numbers of fall run steelhead returning to the Little Manistee River declined from a long term average of 2,171 fish during 1967–2007 to 1,551 fish from 1991 to 2007. Declines in steelhead runs have continued and in recent years (2002–07) returns averaged 740 fish. From 1991 to 2005, 86.2% of the returning steelhead were of wild origin. In 2006 and 2007, the wild component of the run was reduced to 52.6%, largely due to the lower return of stream age-2 fish, which are generally of wild origin. The length, weight, and condition of steelhead were lower in recent years as was observed for Chinook and coho salmon.

Brown trout continue to return to the Little Manistee River weir in low numbers each fall. The long-term (1968–2007) average return was 79 ± 51 (mean ± SD) fish. From 1991 to 2007 the return averaged 77 ± 42 fish, but in the most recent 10 years (1998–2007) the return has dropped to an average of 51 ± 14 fish. Most brown trout return after one year in the stream and one or two years in the lake. The average length, weight, and condition of brown trout had declined below the long term average in recent years.

Acknowledgments

Assistance with data collection and tabulation was provided by Scott Heintzelman, Eric Askam, Bob Kerry and the numerous other MDNR fisheries biologists and technicians who have worked at the Little Manistee River weir over the past 40 years. Scale reading and aging was performed by Jan

Sapak, Eric Askam, Bob Kerry and Dennis Tar. Data entry was done by Nikki Sherretz. Salmon biological sampling was conducted by Bill Rupright, Chuck Jeffery, Don Barnard and Ed Melling. Salmon biodata was tabulated and summarized by John Clevenger. Mark Tonello and Bob Haas reviewed this report. This work was funded in part by Federal Aid in Sport Fish Restoration, Project F-81-R, Study 513.

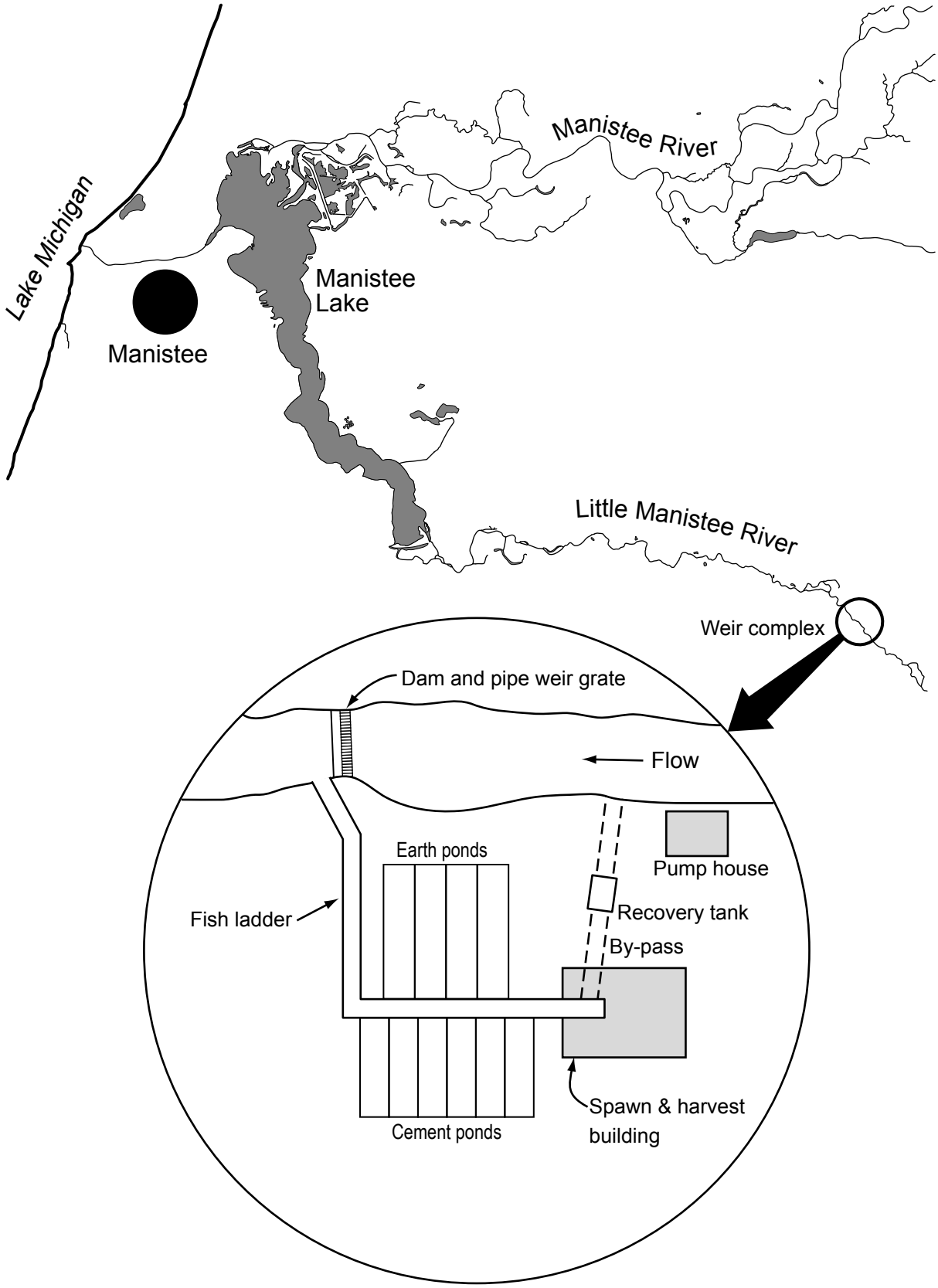


Figure 1.–Location and schematic diagram of the Little Manistee weir facility.

Table 1.–Number, life-stage and species of anadromous salmonines stocked in the Little Manistee River each year from 1967 to 2007. Ages of fish at planted are spring fingerlings, fall fingerlings, and yearlings. Occasionally stocked fish were fin clipped and these are indicated as Ad (adipose) or RV (right ventral), unclipped fish are represented by NC (not clipped). All fish given the Ad fin clip were also marked with a coded wire in the snout. All are Michigan strains unless otherwise indicated in footnotes.

	Species, life stage, and finclip					
	Chinook		Coho	Atlantic	Steelhead	
Year	(spring fingerlings)		(yearlings)	(yearlings)	(yearlings)	(fall fingerlings)
stocked	NC	Ad	NC	NC	NC	NC
1967	590,830	0	433,215	0	0	0
1968	321,912	0	148,365	0	0	0
1969	300,000	0	700,002	0	500	0
1970	308,900	0	550,012	0	0	0
1971	301,868	0	91,674	0	0	0
1972	300,908	0	150,067	0	0	0
1973	356,140	0	165,714	0	0	0
1974	402,330	0	150,067	0	0	0
1975	300,144	0	200,601	0	0	0
1976	301,300	0	400,282	0	0	0
1977	250,200	0	358,832	7,497	0	0
1978	400,028	0	302,980	15,000	0	0
1979	603,098	0	675,000	0	0	0
1980	550,272	0	400,158	0	0	0
1981	500,204	0	202,815	0	35,200	102,236
1982	600,294	0	200,000	25,030	30,000	100,000
1983	677,250	0	429,612	0	16,428	0
1984	805,773	0	500,066	0	14,896 [a]	0
1985	500,012	0	375,283	0	0	0
1986	450,273	19,721 [b]	343,121	0	0	0
1987	372,325	63,321 [b]	266,914	0	0	0
1988	523,400	78,143 [b]	358,250	0	0	0
1989	659,858	60,494 [b]	400,883	0	0	0
1990 [c]	100,000	77,444 [b]	225,007	0	0	0
	297,845 [d] (RV)	107,031 [d]	–	–	–	–
	–	205,109	–	–	–	–
1991 [c]	65,000	211,979	355,403	0	0	0
	296,394 [d] (RV)	106,958 [d]	–	–	–	–
1992 [c]	576,050 [d]	302,298 [d]	300,440	0	0	0
1993 [c]	300,182 [d]	101,428 [d]	0	0	0	0
	100,000 [e]	200,000 [e]	–	–	–	–
1994 [c]	441,585	101,240 [d]	0	0	0	0
	–	200,136 [e]	–	–	–	–
1995 [c]	758,903	0	0	0	0	0
1996	750,653	0	0	0	0	0
1997	722,159	0	0	0	500	0
1998	701,945	0	0	0	0	0
1999	491,393	0	0	0	0	0
2000 [c]	396,584	100,541	0	0	0	0
2001 [c]	290,304	203,380	0	0	0	0

Table 1.–Continued.

Year stocked	Species, life stage, and finclip					
	Chinook (spring fingerlings)		Coho (yearlings)	Atlantic (yearlings)	Steelhead (yearlings)	Steelhead (fall fingerlings)
	NC	Ad	NC	NC	NC	NC
2002 [c]	287,617	203,908	0	0	0	0
2003 [c]	390,223	201,090	0	0	0	0
2004 [c]	293,063	202,436	0	0	0	0
2005	293,056	202,366	0	0	0	0
2006 [c]	176,567	200,869 [f]	0	0	0	0
2007 [c]	276,130	101,234	0	0	0	0
Total	18,081,672	3,251,126	8,684,763	47,527	97,524	202,236
10-yr avg	392,640	128,711	0	0	0	0

[a] Stocked multiple strains of summer run steelhead including 5,079 of Siletz River, 5,000 of Rogue River, and 4,817 of Umpqua River strain.
[b] Triploid Chinook salmon (Michigan strain)
[c] Chinook salmon marked with oxytetracycline
[d] New York strain of Chinook salmon
[e] Mixed plant of New York and Michigan strain Chinook salmon
[f] 100,290 of Ad marked fish did not receive the OTC mark.

Table 2.–Dates of operation, and the number, and species of anadromous salmonines returned to the Little Manistee River weir during fall egg take operations annually from 1967 to 2007. The ? represents missing information.

Year	Weir grates in	Weir grates out	Number of days	Number returning Chinook	Coho	Steelhead	Brown trout
1967	08/29	02/08	164	0	0	1,048	0
1968	08/30	01/02	126	11,230	60,248	1,322	28
1969	08/15	11/23	101	26,288	25,186	3,043	36
1970	08/??	12/15	?	34,190	108,400	7,411	123
1971	08/04	01/11	161	21,213	59,123	7,622	69
1972	09/01	12/18	140	24,994	2,314	3,561	5
1973	09/04	12/10	129	16,476	11,872	1,926	48
1974	09/06	12/09	95	24,156	6,129	3,488	161
1975	09/09	12/08	91	29,228	15,863	6,121	238
1976	09/09	12/06	89	16,159	24,505	578	106
1977	09/02	12/09	99	11,136	25,255	2,031	98
1978	08/31	12/01	93	20,230	23,696	320	51
1979	09/06	11/14	70	22,925	27,925	640	100
1980	09/02	11/13	73	15,761	50,004	1,111	28
1981	08/28	11/12	76	11,811	14,656	849	101
1982	08/25	11/10	77	14,358	18,458	347	62
1983	09/06	11/07	63	39,359	26,968	3,100	43
1984	09/04	11/05	63	32,632	33,982	1,909	141
1985	08/19	11/08	82	33,174	15,286	6,356	177
1986	08/22	11/12	83	22,294	16,082	4,659	99
1987	09/01	11/12	73	31,840	15,100	1,446	49
1988	08/16	11/09	86	12,236	4,466	1,050	20
1989	08/14	10/31	79	18,339	14,022	1,125	30
1990	08/15	10/29	76	19,497	10,030	1,505	51
1991	08/15	11/07	85	21,062	12,300	3,666	113
1992	08/14	11/06	85	15,669	13,400	3,054	104
1993	08/13	11/10	90	12,911	18,096	1,702	118
1994	08/15	11/10	88	11,886	562	2,849	126
1995	08/15	11/14	92	13,104	394	351	31
1996	08/15	11/06	84	17,120	2,584	5,249	176
1997	08/15	11/07	85	15,433	781	915	123
1998	08/17	11/06	82	7,170	1,463	888	28
1999	08/18	11/09	84	18,621	519	662	39
2000	08/17	11/09	87	13,029	600	319	74
2001	08/16	11/08	85	18,279	911	2,262	59
2002	08/16	11/04	81	19,392	528	120	38
2003	08/15	11/10	88	14,357	616	1,404	42
2004	08/16	11/08	85	15,618	1,102	1,082	69
2005	08/15	11/09	87	11,075	2,100	678	54
2006	08/15	11/08	86	12,772	238	417	56
2007	08/15	11/08	86	10,946	306	741	55
Total				757,970	666,070	88,927	3,169
Average (1997–2007)			86	14,245	833	863	58

Table 3.–Number, sex, and fecundity of adult fish used in the egg take, as well as the destination and viability of the Chinook salmon eggs collected at the Little Manistee River weir, annually in the fall from 1991 to 2007. Eggs per quart are based on eggs measured by the Von Beyer method by Platte River, Wolf Lake and Indiana hatchery personnel. Percent eye-up represents an average across all raceways and facilities, missing data is represented by "–".

	Spawning dates		Used for egg take					Michigan use	Out-of-state		Total	
Year	Begin	End	Male	Female	M:F	Eggs/female	Eggs/quart	(Millions)	(Millions)		eggs taken	% eye-up
1991	9/30	10/15	541	2,442	1:4.5	4,611	2,670	8.2	3.1	IL, IN	11.2	–
1992	10/1	10/27	233	2,162	1:9.3	4,840	2,597	8.1	2.4	IL, IN	10.5	–
1993	9/27	10/13	207	1,473	1:7.1	4,932	2,744	5.6	0.9	IL	6.4	56.4
1994	9/29	10/19	302	1,813	1:6.0	4,515	2,468	5.2	1.8	IL, IN	7.0	63.5
1995	10/3	10/18	407	1,705	1:4.2	4,408	2,505	5.5	1.6	IL, IN	7.2	72.0
1996	10/1	10/23	479	2,057	1:4.3	4,846	2,713	6.2	2.4	IL, IN	8.6	73.6
1997	9/25	10/14	923	3,342	1:3.6	4,410	2,503	9.6	2.2	IL, IN	11.8	73.5
1998	9/29	10/22	1,798	1,804	1:1.0	4,552	2,611	6.2	0	–	6.2	85.8
1999	10/4	10/14	2,255	2,279	1:1.0	4,265	2,516	5.5	2.3	IL, IN	7.8	–
2000	10/4	10/12	1,751	1,752	1:1.0	4,840	2,677	4.6	2.3	IL, IN	6.9	–
2001	10/1	10/11	2,352	2,367	1:1.0	4,397	2,597	6.0	2.0	IL, IN	8.0	87.0
2002	10/2	10/10	2,331	2,367	1:1.0	4,427	2,676	6.5	1.9	IL, IN	8.5	79.5
2003	10/6	10/14	2,618	2,618	1:1.0	4,892	2,659	5.1	1.7	IL, IN	6.8	74.8
2004	9/30	10/12	1,934	1,948	1:1.0	4,442	2,830	5.9	1.8	IL, IN	7.7	74.9
2005	10/4	10/10	801	801	1:1.0	3,741	3,158	3.1	0	–	3.1	61.9
2006	10/3	10/18	1,668	1,668	1:1.0	4,229	2,934	4.6	1.5	IL, IN	6.1	75.2
2007	10/2	10/11	2,104	2,135	1:1.0	4,128	3,413	7.0	0.8	IL	7.8	71.3
Average	10/1	10/15	1,336	2,043	1:1.5	4,499	2,722	6.1	1.9		7.7	73.0

Table 4.–Number of Chinook salmon evaluated for visual signs of disease and the percentage culled from egg collections. Number of fish tested for bacterial kidney disease (BKD) using Field Enzyme Linked Immuno Assay (FELISA) techniques and the percentage culled from egg collections. Annual percentages of females culled from egg take operations at the Little Manistee River weir from 1991 to 2007. The very low FELISA designation was not used until 1997.

		Visual culling				FELISA						
		Males		Females			Very			Very		Overall %
Year	Sampling dates	Total	% culled	Total	% culled	Negative	low	Low	High	high	% positive	females culled
1991	9/30–10/4, 10/7–11, 10/14–15	526	6.7	2,787	18.9	–	–	–	–	–	–	18.9
1992	10/1, 10/6–9, 10/12	258	9.7	2,720	20.5	–	–	–	–	–	–	20.5
1993	9/27–30, 10/4–6, 10/11–13	228	9.2	1,815	18.8	1,314	–	129	30	0	10.8	27.6
1994	9/29, 10/3–5, 10/10–14, 10/18–19	315	4.1	1,814	0.0	1,545	–	196	73	0	14.8	14.8
1995	10/3–6, 10/9–11, 10/16–18	441	7.3	1,636	0.0	1,553	–	38	45	0	5.1	5.1
1996	10/1–23	498	3.8	2,306	10.8	1,761	–	216	56	24	14.4	23.6
1997[a]	9/25–10/3, 10/7–10	–	–	3,059	2.6	2,381	242	189	101	66	20.1	22.2
1998	9/29–10/1, 10/8–9, 10/12, 10/22	–	–	1,628	3.0	1,245	159	114	44	17	21.2	13.8
1999	10/4–5, 10/7–8, 10/11–14	–	–	1,995	0.8	1,520	265	95	64	35	23.2	10.5
2000	10/4–6, 10/9–12	–	–	1,643	1.9	1,423	0	112	45	31	11.7	13.4
2001	10/1–5, 10/8–11	–	–	2,128	0.7	1,921	0	124	50	17	9.0	9.7
2002	10/2–4, 10/7–11	–	–	2,087	0.0	1,720	197	123	28	19	17.6	8.2
2003	10/6–10, 10/13–15	–	–	2,120	3.2	1,157	314	332	165	84	43.6	30.6
2004	9/30–10/1, 10/4–8, 10/11–12	–	–	2,120	0.0	1,488	431	142	46	13	29.8	9.5
2005[b]	10/4–7, 10/10	862	7.1	1,968	1.0	–	–	–	–	–	–	1.0
2006	10/3, 10/5–6, 10/9–11, 10/18	1,708	2.3	1,668	0.0	–	–	–	–	–	–	0.0
2007	10/2–5, 10/8–11	2,164	2.8	2,161	1.2	–	–	–	–	–	–	1.2

[a] Males were not checked for clinical signs of BKD from 1997 to 2004.

[b] FELISA testing was not conducted during 1991, 1992, or from 2005 to 2007.

Table 5.–Number, sex, and fecundity of adult fish used in the egg take, as well as the destination and viability of the coho salmon eggs collected at the Little Manistee River weir, annually in the fall from 1988 to 2007. Eggs per quart are based on eggs measured by the Von Beyer method by Platte River hatchery personnel. Percent eye-up represents an average across all raceways and facilities, missing data is represented by "–".

	Spawning dates		Used for egg take			Eggs/	Eggs/	Total	%
Year	Begin	End	Male	Female	M:F	female	quart	eggs taken	eye-up
1988	9/30	10/15	–	308	Unknown	2,937	3,326	0.9	70.7
1992	10/15	10/26	–	1,394	Unknown	2,673	3,555	3.7	–
2006	10/18	10/18	41	41	1:1	2,120	3,326	0.1	–
Average	10/11	10/19				2,577	3,402	1.6	

Table 6.–Number and percent (%) of Chinook salmon by age and sex, harvested at the Little Manistee River weir, 1991–2007. This table is based on the biosample and includes known-sex fish only. Unsexed biosampled fish were left out of the total. Also, harvest numbers of age 0.0 and 0.5 fish were not included since these age categories were represented by fewer than 10 fish. The grand total, sexes combined may be less than the actual number of fish harvested each year because of this. Years with * are slightly less than the actual harvest. In 1991–93 there were some fish of known sex, but unknown age.

	Age (years in stream . years in lake)											
	UNK		0.1		0.2		0.3		0.4		Total	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1991*	1,694	209	7,015	71	6,395	2,132	849	2,843	170	128	16,123	5,383
	(7.9)	(1.0)	(32.6)	(0.3)	(29.7)	(9.9)	(3.9)	(13.2)	(0.8)	(0.6)	(75.0)	(25.0)
1992*	745	497	3,564	73	4,456	2,400	905	3,209	169	127	9,840	6,305
	(4.6)	(3.1)	(22.1)	(0.5)	(27.6)	(14.9)	(5.6)	(19.9)	(1.0)	(0.8)	(60.9)	(39.1)
1993	–	476	2,411	127	3,812	1,794	662	3,474	85	70	6,970	5,941
	–	(3.7)	(18.7)	(1.0)	(29.5)	(13.9)	(5.1)	(26.9)	(0.7)	(0.5)	(54.0)	(46.0)
1994*	–	–	2,227	22	5,934	809	1,830	4,269	0	0	9,990	5,101
	–	–	(14.8)	(0.1)	(39.3)	(5.4)	(12.1)	(28.3)	(0.0)	(0.0)	(66.2)	(33.8)
1995	–	–	2,891	29	4,299	944	1,859	4,779	178	200	9,227	5,953
	–	–	(19.0)	(0.2)	(28.3)	(6.2)	(12.2)	(31.5)	(1.2)	(1.3)	(60.8)	(39.2)
1996*	–	–	2,948	30	11,285	470	1,129	1,176	0	0	15,362	1,676
	–	–	(17.3)	(0.2)	(66.2)	(2.8)	(6.6)	(6.9)	(0.0)	(0.0)	(90.2)	(9.8)
1997*	–	–	1,175	36	5,596	1,313	2,017	5,188	20	81	8,809	6,618
	–	–	(7.6)	(0.2)	(36.3)	(8.5)	(13.1)	(33.6)	(0.1)	(0.5)	(57.1)	(42.9)
1998*	–	–	2,143	44	2,305	650	537	1,453	0	0	4,985	2,147
	–	–	(30.0)	(0.6)	(32.3)	(9.1)	(7.5)	(20.4)	(0.0)	(0.0)	(69.9)	(30.1)
1999*	–	–	4,308	0	7,700	1,925	1,440	3,204	0	0	13,447	5,129
	–	–	(23.2)	(0.0)	(41.4)	(10.4)	(7.8)	(17.3)	(0.0)	(0.0)	(72.4)	(27.6)
2000*	–	–	2,134	66	4,656	1,391	1,179	3,536	0	0	7,968	4,992
	–	–	(16.5)	(0.5)	(35.9)	(10.7)	(9.1)	(27.3)	(0.0)	(0.0)	(61.5)	(38.5)
2001*	–	–	3,208	65	6,986	1,639	1,644	4,678	0	0	11,837	6,382
	–	–	(17.6)	(0.4)	(38.3)	(9.0)	(9.0)	(25.7)	(0.0)	(0.0)	(65.0)	(35.0)

Table 6.–Continued.

	Age (years in stream . years in lake)											
	UNK		0.1		0.2		0.3		0.4		Total	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2002*	–	–	3,197	65	5,982	1,889	2,607	5,292	78	275	11,863	7,522
	–	–	(16.5)	(0.3)	(30.9)	(9.7)	(13.4)	(27.3)	(0.4)	(1.4)	(61.2)	(38.8)
2003*	–	–	2,300	23	6,182	2,172	658	2,996	0	0	9,139	5,191
	–	–	(16.1)	(0.2)	(43.1)	(15.2)	(4.6)	(20.9)	(0.0)	(0.0)	(63.8)	(36.2)
2004*	–	–	1,429	14	4,655	1,390	2,674	5,429	0	0	8,758	6,833
	–	–	(9.2)	(0.1)	(29.9)	(8.9)	(17.1)	(34.8)	(0.0)	(0.0)	(56.2)	(43.8)
2005	–	–	3,495	35	2,696	674	1,380	2,453	188	154	7,759	3,316
	–	–	(31.6)	(0.3)	(24.3)	(6.1)	(12.5)	(22.1)	(1.7)	(1.4)	(70.1)	(29.9)
2006	–	–	859	9	5,895	1,474	1,662	2,712	61	100	8,478	4,294
	–	–	(6.7)	(0.1)	(46.2)	(11.5)	(13.0)	(21.2)	(0.5)	(0.8)	(66.4)	(33.6)
2007	–	–	711	7	2,213	738	2,440	4,531	132	175	5,495	5,451
	–	–	(6.5)	(0.1)	(20.2)	(6.7)	(22.3)	(41.4)	(1.2)	(1.6)	(50.2)	(49.8)
Total	2,439	1,182	46,016	718	91,046	23,802	25,470	61,222	1,081	1,310	166,053	88,234
	(1.0)	(0.5)	(18.1)	(0.3)	(35.8)	(9.4)	(10.0)	(24.1)	(0.4)	(0.5)	(65.3)	(34.7)

Table 7.–Number returned and percent (%) of stocked year-classes of Chinook salmon returned to the Little Manistee River weir by age 1 to 5 years after stocking, (fish were stocked as spring fingerlings). An "–" indicates blank spaces for data which are not available for older fish in more recent year-classes.

Year-class	Number stocked	Age (years in stream . years in lake) 0.0		0.1		0.2		0.3		0.4		0.5		Total	
1967	590,830	0	(0.0)	11,230	(1.9)	20,588	(3.5)	18,420	(3.1)	0	(0.0)	0	(0.0)	50,238	(8.5)
1968	321,912	0	(0.0)	5,700	(1.8)	11,100	(3.4)	6,415	(2.0)	0	(0.0)	0	(0.0)	23,215	(7.2)
1981	500,204	0	(0.0)	2,077	(0.4)	17,637	(3.5)	8,376	(1.7)	5,990	(1.2)	10	(<0.1)	34,090	(6.8)
1982	600,294	0	(0.0)	8,865	(1.5)	18,342	(3.1)	19,437	(3.2)	6,849	(1.1)	977	(0.2)	54,470	(9.1)
1983	677,250	0	(0.0)	5,914	(0.9)	6,326	(0.9)	13,850	(2.0)	11,482	(1.7)	27	(<0.1)	37,599	(5.5)
1984	805,773	0	(0.0)	2,005	(0.2)	1,025	(0.1)	12,191	(1.5)	1,556	(0.2)	91	(<0.1)	16,868	(2.1)
1985	500,012	0	(0.0)	397	(0.1)	3,962	(0.8)	6,849	(1.4)	5,076	(1.0)	32	(<0.1)	16,316	(3.3)
1986	469,994	0	(0.0)	3,229	(0.7)	1,973	(0.4)	7,720	(1.6)	3,121	(0.7)	6	(<0.1)	16,049	(3.4)
1987	435,646	0	(0.0)	2,114	(0.5)	2,309	(0.5)	6,891	(1.6)	292	(0.1)	6	(<0.1)	11,612	(2.7)
1988	601,543	0	(0.0)	3,142	(0.5)	3,428	(0.6)	3,611	(0.6)	287	(<0.1)	0	(0.0)	10,468	(1.7)
1989	720,352	0	(0.0)	6,027	(0.8)	8,338	(1.2)	3,991	(0.6)	155	(<0.1)	0	(0.0)	18,511	(2.6)
1990	787,429	0	(0.0)	6,930	(0.9)	6,651	(0.8)	4,136	(0.5)	47	(<0.1)	0	(0.0)	17,764	(2.3)
1991	680,331	25	(<0.1)	3,637	(0.5)	5,606	(0.8)	6,099	(0.9)	378	(0.1)	0	(0.0)	12,420	(1.8)
1992	878,348	0	(0.0)	2,538	(0.3)	6,743	(0.8)	6,638	(0.8)	82	(<0.1)	0	(0.0)	13,978	(1.6)
1993	701,610	0	(0.0)	2,250	(0.3)	5,243	(0.8)	2,305	(0.3)	101	(<0.1)	0	(0.0)	9,803	(1.4)
1994	742,961	7	(<0.1)	2,920	(0.4)	11,755	(1.6)	7,205	(1.0)	38	(<0.1)	0	(0.0)	21,918	(2.9)
1995	758,903	0	(0.0)	2,978	(0.4)	6,909	(0.9)	1,990	(0.3)	44	(<0.1)	0	(0.0)	11,922	(1.6)
1996	750,653	0	(0.0)	1,211	(0.2)	2,955	(0.4)	4,644	(0.6)	68	(<0.1)	0	(0.0)	8,879	(1.2)
1997	722,159	7	(<0.1)	2,186	(0.3)	9,625	(1.3)	4,714	(0.7)	53	(<0.1)	7	(<0.1)	16,592	(2.3)
1998	701,945	0	(0.0)	4,308	(0.6)	6,046	(0.9)	6,322	(0.9)	352	(0.1)	0	(0.0)	17,029	(2.4)
1999	491,393	0	(0.0)	2,200	(0.4)	8,625	(1.8)	7,899	(1.6)	26	(<0.1)	0	(0.0)	18,750	(3.8)
2000	497,125	0	(0.0)	3,273	(0.7)	7,872	(1.6)	3,654	(0.7)	26	(<0.1)	0	(0.0)	14,825	(3.0)
2001	493,684	7	(<0.1)	3,262	(0.7)	8,353	(1.7)	8,102	(1.6)	342	(0.1)	0	(0.0)	20,067	(4.1)
2002	491,525	0	(0.0)	2,323	(0.5)	6,045	(1.2)	3,833	(0.8)	162	(<0.1)	0	(0.0)	12,363	(2.5)
2003	591,313	0	(0.0)	1,444	(0.2)	3,369	(0.6)	4,374	(0.7)	307	(0.1)	–		9,494	(1.6)
2004	495,499	0	(0.0)	3,531	(0.7)	7,368	(1.5)	6,971	(1.4)	–		–		17,870	(3.6)
2005	495,422	0	(0.0)	868	(0.2)	2,950	(0.6)	–		–		–		3,818	(0.8)
2006	377,436	0	(0.0)	718	(0.2)	–		–		–		–		718	(0.2)
2007	377,364	0	(0.0)	–		–		–		–		–		0	(0.0)

Table 8.–Mean total length (inches) and weight (pounds), by age and sex of Chinook salmon harvested at the Little Manistee River weir, fall 1991–2007. Data is from known-age, coded wire tagged, fish collected at the weir (N equals sample size).

	Age 0.0								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	4	11.88 ± 1.72	0.78 ± 0.33	0	–	–	4	11.88 ± 1.72	0.78 ± 0.33
1992	0	–	–	0	–	–	0	–	–
1993	0	–	–	0	–	–	0	–	–
1994	1	14.20 ± NA	1.00 ± NA	0	–	–	1	14.20 ± NA	1.00 ± NA
1995	0	–	–	0	–	–	0	–	–
1996	0	–	–	0	–	–	0	–	–
1997	1	9.30 ± NA	0.30 ± NA	0	–	–	1	9.30 ± NA	0.30 ± NA
1998	0	–	–	0	–	–	0	–	–
1999	0	–	–	0	–	–	0	–	–
2000	0	–	–	0	–	–	0	–	–
2001	1	11.80 ± NA	0.50 ± NA	0	–	–	1	11.80 ± NA	0.50 ± NA
2002	0	–	–	0	–	–	0	–	–
2003	0	–	–	0	–	–	0	–	–
2004	0	–	–	0	–	–	0	–	–
2005	0	–	–	0	–	–	0	–	–
2006	0	–	–	0	–	–	0	–	–
2007	0	–	–	0	–	–	0	–	–
Avg.	7	11.79 ± 1.72	0.64 ± 0.33	0	–	–	7	11.79 ± 1.72	0.64 ± 0.33

Table 8.–Extended.

	Age 0.1								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	1,109	23.36 ± 1.85	4.97 ± 1.18	8	23.96 ± 2.17	5.30 ± 1.60	1,117	23.66 ± 2.01	5.14 ± 1.39
1992	556	22.36 ± 2.15	4.44 ± 1.24	9	23.08 ± 2.52	4.81 ± 1.15	565	22.72 ± 2.33	4.62 ± 1.20
1993	451	22.58 ± 2.34	4.53 ± 1.40	24	23.59 ± 3.95	5.35 ± 2.65	475	23.09 ± 3.14	4.94 ± 2.03
1994	330	23.55 ± 3.33	4.99 ± 1.99	2	24.80 ± 4.53	6.40 ± 3.96	332	24.17 ± 3.93	5.70 ± 2.98
1995	421	21.99 ± 2.78	4.11 ± 1.64	4	22.95 ± 2.03	4.05 ± 1.20	425	22.47 ± 2.40	4.08 ± 1.42
1996	360	22.82 ± 2.94	4.55 ± 1.76	3	20.63 ± 2.32	3.07 ± 0.84	363	21.73 ± 2.63	3.81 ± 1.30
1997	175	24.78 ± 2.61	5.48 ± 1.50	5	23.40 ± 2.35	4.34 ± 1.17	180	24.09 ± 2.48	4.91 ± 1.33
1998	284	23.64 ± 2.75	4.97 ± 1.59	6	24.68 ± 1.69	4.82 ± 0.69	290	24.16 ± 2.22	4.90 ± 1.14
1999	487	23.69 ± 1.53	4.77 ± 1.02	0	–	–	487	23.69 ± 1.53	4.77 ± 1.02
2000	311	21.92 ± 2.43	4.17 ± 1.39	11	23.30 ± 2.43	4.67 ± 1.10	322	22.61 ± 2.43	4.42 ± 1.25
2001	484	23.46 ± 2.86	4.96 ± 1.76	12	25.27 ± 4.12	6.00 ± 3.57	496	24.36 ± 3.49	5.48 ± 2.67
2002	463	21.89 ± 3.48	4.09 ± 2.07	9	26.51 ± 6.76	8.76 ± 5.41	472	24.20 ± 5.12	6.43 ± 3.74
2003	349	24.32 ± 2.91	5.14 ± 1.69	2	24.40 ± 0.99	4.55 ± 0.49	351	24.36 ± 1.95	4.85 ± 1.09
2004	217	21.96 ± 2.57	3.77 ± 1.25	2	24.50 ± 1.41	5.00 ± 0.71	219	23.23 ± 1.99	4.39 ± 0.98
2005	519	20.97 ± 2.08	3.31 ± 0.93	7	24.29 ± 2.43	4.20 ± 0.97	526	22.63 ± 2.25	3.75 ± 0.95
2006	128	22.33 ± 2.41	3.87 ± 1.26	1	21.60 ± NA	3.30 ± NA	129	21.97 ± 2.41	3.58 ± 1.26
2007	109	20.90 ± 2.26	3.10 ± 1.03	1	25.10 ± NA	5.60 ± NA	110	23.00 ± 2.26	4.35 ± 1.03
Avg.	6,753	22.74 ± 2.54	4.42 ± 1.45	106	23.89 ± 2.84	5.01 ± 1.82	6,859	23.29 ± 2.68	4.71 ± 1.62

Table 8.–Extended.

	Age 0.2								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	1,007	32.18 ± 2.25	12.22 ± 2.67	337	32.14 ± 1.97	11.09 ± 2.44	1,344	32.16 ± 2.11	11.66 ± 2.55
1992	695	32.81 ± 2.86	12.74 ± 3.09	370	32.33 ± 1.89	11.53 ± 2.63	1,065	32.57 ± 2.37	12.13 ± 2.86
1993	714	31.56 ± 3.05	11.86 ± 3.27	335	32.27 ± 1.95	11.42 ± 2.24	1,049	31.92 ± 2.50	11.64 ± 2.76
1994	835	31.29 ± 2.72	11.49 ± 3.10	160	31.54 ± 2.15	10.52 ± 2.51	995	31.42 ± 2.43	11.01 ± 2.81
1995	616	31.61 ± 2.87	11.94 ± 3.37	147	31.86 ± 2.08	11.58 ± 2.94	763	31.74 ± 2.48	11.76 ± 3.15
1996	1,369	31.27 ± 2.36	11.40 ± 2.80	64	31.66 ± 2.29	12.40 ± 3.19	1,433	31.47 ± 2.32	11.90 ± 2.99
1997	830	32.21 ± 2.88	11.84 ± 3.21	197	32.29 ± 1.73	11.39 ± 2.74	1,027	32.25 ± 2.31	11.61 ± 2.98
1998	306	31.42 ± 3.02	11.08 ± 3.23	86	32.09 ± 1.84	10.28 ± 2.04	392	31.76 ± 2.43	10.68 ± 2.64
1999	872	32.73 ± 2.18	12.40 ± 2.64	216	32.15 ± 1.46	11.79 ± 2.34	1,088	32.44 ± 1.82	12.09 ± 2.49
2000	684	32.88 ± 2.11	12.73 ± 2.62	201	31.80 ± 1.76	11.58 ± 2.59	885	32.34 ± 1.93	12.16 ± 2.61
2001	1,057	31.65 ± 2.52	11.54 ± 2.84	250	31.78 ± 1.96	11.75 ± 2.63	1,307	31.71 ± 2.24	11.65 ± 2.74
2002	870	32.10 ± 3.03	11.84 ± 3.32	269	32.13 ± 1.93	12.26 ± 3.00	1,139	32.11 ± 2.48	12.05 ± 3.16
2003	933	30.92 ± 2.90	10.30 ± 3.04	329	31.55 ± 1.92	11.29 ± 2.68	1,262	31.24 ± 2.41	10.79 ± 2.86
2004	706	31.69 ± 2.73	10.42 ± 2.78	211	31.00 ± 1.60	9.72 ± 2.35	917	31.35 ± 2.17	10.07 ± 2.56
2005	404	30.14 ± 2.48	8.48 ± 2.20	98	30.04 ± 1.93	8.23 ± 2.05	502	30.09 ± 2.21	8.35 ± 2.13
2006	871	30.18 ± 1.97	8.81 ± 2.00	224	29.73 ± 1.45	8.22 ± 1.83	1,095	29.96 ± 1.71	8.51 ± 1.92
2007	338	30.59 ± 2.31	8.67 ± 2.23	114	29.81 ± 1.30	8.29 ± 1.57	452	30.20 ± 1.80	8.48 ± 1.90
Avg.	13,107	31.60 ± 2.60	11.16 ± 2.85	3,608	31.54 ± 1.83	10.78 ± 2.48	16,715	31.57 ± 2.22	10.97 ± 2.65

Table 8.–Extended.

	Age 0.3								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	135	37.08 ± 3.03	18.02 ± 3.82	447	35.92 ± 1.78	15.10 ± 3.11	582	36.50 ± 2.40	16.56 ± 3.46
1992	138	37.79 ± 2.17	19.12 ± 3.27	501	35.85 ± 1.56	15.63 ± 3.16	639	36.82 ± 1.86	17.38 ± 3.21
1993	122	37.37 ± 3.11	19.04 ± 4.34	652	35.43 ± 2.11	14.19 ± 3.21	774	36.40 ± 2.61	16.62 ± 3.77
1994	140	36.07 ± 4.18	17.34 ± 5.11	760	34.77 ± 2.53	13.46 ± 3.38	900	35.42 ± 3.36	15.40 ± 4.24
1995	198	36.62 ± 4.41	18.52 ± 5.31	767	35.36 ± 2.28	15.27 ± 3.94	966	35.99 ± 3.35	16.90 ± 4.63
1996	137	37.60 ± 2.88	19.80 ± 4.57	144	36.08 ± 1.79	17.58 ± 3.67	281	36.84 ± 2.33	18.69 ± 4.12
1997	296	37.03 ± 1.80	17.49 ± 3.14	775	34.86 ± 1.92	13.21 ± 3.11	1071	35.94 ± 1.86	15.35 ± 3.13
1998	70	37.03 ± 2.95	17.33 ± 3.83	194	34.99 ± 1.77	12.70 ± 2.61	264	36.01 ± 2.36	15.02 ± 3.22
1999	161	37.22 ± 1.78	17.57 ± 3.02	364	34.57 ± 1.90	13.86 ± 3.35	525	35.89 ± 1.84	15.71 ± 3.19
2000	170	37.14 ± 2.11	17.61 ± 3.11	520	34.83 ± 1.94	14.94 ± 3.17	690	35.99 ± 2.02	16.27 ± 3.14
2001	251	37.95 ± 1.93	18.52 ± 3.49	707	35.33 ± 2.04	14.83 ± 3.40	958	36.64 ± 1.99	16.68 ± 3.45
2002	375	35.69 ± 2.68	15.63 ± 3.49	768	34.01 ± 1.87	13.67 ± 3.11	1,143	34.85 ± 2.28	14.65 ± 3.30
2003	99	35.88 ± 2.90	15.26 ± 4.26	453	34.15 ± 1.73	12.98 ± 3.09	552	35.01 ± 2.32	14.12 ± 3.67
2004	406	34.31 ± 2.30	12.48 ± 2.89	823	33.01 ± 1.62	11.04 ± 2.54	1,229	33.66 ± 1.96	11.76 ± 2.72
2005	203	33.89 ± 2.52	11.57 ± 2.70	368	32.68 ± 2.05	10.72 ± 2.66	571	33.28 ± 2.28	11.15 ± 2.68
2006	246	33.53 ± 1.92	11.28 ± 2.20	404	32.62 ± 1.76	10.37 ± 2.33	650	33.07 ± 1.84	10.83 ± 2.27
2007	370	33.60 ± 1.80	10.64 ± 1.91	698	32.47 ± 1.47	10.37 ± 1.96	1,068	33.04 ± 1.63	10.50 ± 1.93
Avg.	3,517	36.22 ± 2.61	16.31 ± 3.56	9,345	34.52 ± 1.89	13.52 ± 3.05	12,862	35.37 ± 2.25	14.92 ± 3.30

Table 8.–Extended.

	Age 0.4								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	27	39.75 ± 1.99	22.29 ± 3.00	20	39.19 ± 1.36	20.09 ± 3.59	47	39.47 ± 1.67	21.19 ± 3.30
1992	26	38.71 ± 1.71	21.81 ± 2.57	20	38.85 ± 1.26	20.76 ± 2.42	46	38.78 ± 1.48	21.28 ± 2.50
1993	16	39.13 ± 1.28	20.43 ± 3.17	13	39.08 ± 1.20	19.02 ± 2.73	29	39.10 ± 1.24	19.73 ± 2.95
1994	4	39.30 ± 2.01	21.85 ± 6.04	26	35.61 ± 2.33	13.20 ± 2.82	30	37.45 ± 2.17	17.53 ± 4.43
1995	9	40.87 ± 1.33	26.09 ± 4.40	46	35.69 ± 3.09	14.80 ± 4.15	54	38.28 ± 2.21	20.45 ± 4.27
1996	5	38.62 ± 0.41	22.76 ± 2.21	5	35.90 ± 4.16	16.80 ± 5.58	10	37.26 ± 2.28	19.78 ± 3.89
1997	3	37.93 ± 2.04	18.00 ± 2.77	12	34.81 ± 4.97	12.92 ± 4.16	15	36.37 ± 3.51	15.46 ± 3.47
1998	1	44.20 ± NA	29.00 ± NA	4	34.15 ± 6.78	13.75 ± 6.85	5	39.18 ± 6.78	21.38 ± 6.85
1999	1	40.80 ± NA	27.00 ± NA	4	39.12 ± 1.58	20.25 ± 5.98	5	39.96 ± 1.58	23.63 ± 5.98
2000	6	40.17 ± 0.89	20.08 ± 2.03	4	34.75 ± 5.76	13.45 ± 6.34	10	37.46 ± 3.32	16.77 ± 4.18
2001	3	38.93 ± 0.64	23.53 ± 7.72	5	39.22 ± 0.78	17.82 ± 1.79	8	39.08 ± 0.71	20.68 ± 4.76
2002	11	36.08 ± 2.64	15.41 ± 3.22	40	33.28 ± 2.82	13.36 ± 3.25	51	34.68 ± 2.73	14.38 ± 3.24
2003	1	39.60 ± NA	18.00 ± NA	3	38.07 ± 2.66	16.90 ± 4.61	4	38.83 ± 2.66	17.45 ± 4.61
2004	0	–	–	4	34.18 ± 2.12	12.67 ± 2.34	4	34.18 ± 2.12	12.67 ± 2.34
2005	28	33.45 ± 3.40	10.90 ± 2.76	23	34.23 ± 1.91	11.54 ± 2.45	51	33.84 ± 2.65	11.22 ± 2.60
2006	9	36.73 ± 3.18	13.67 ± 3.35	15	34.31 ± 2.82	11.33 ± 2.90	24	35.52 ± 3.00	12.50 ± 3.12
2007	20	34.73 ± 2.13	11.06 ± 2.32	27	33.56 ± 1.73	10.43 ± 2.21	47	34.15 ± 1.93	10.75 ± 2.26
Avg.	170	38.69 ± 1.82	20.12 ± 3.50	271	36.12 ± 2.78	15.24 ± 3.77	441	37.36 ± 2.37	17.60 ± 3.66

Table 8.–Extended.

	Age 0.5								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	1	40.90 ± NA	24.60 ± NA	0	–	–	1	40.90 ± NA	24.60 ± NA
1992	1	41.90 ± NA	25.20 ± NA	0	–	–	1	41.90 ± NA	25.20 ± NA
1993	0	–	–	0	–	–	0	–	–
1994	0	–	–	0	–	–	0	–	–
1995	0	–	–	1	34.00 ± NA	10.60 ± NA	1	34.00 ± NA	10.60 ± NA
1996	0	–	–	0	–	–	0	–	–
1997	0	–	–	0	–	–	0	–	–
1998	0	–	–	0	–	–	0	–	–
1999	0	–	–	0		–	0	–	–
2000	0	–	–	0	–	–	0	–	–
2001	0	–	–	0	–	–	0	–	–
2002	1	29.60 ± NA	8.30 ± NA	0	–	–	1	29.60 ± NA	8.30 ± NA
2003	0	–	–	0	–	–	0	–	–
2004	0	–	–	0	–	–	0	–	–
2005	0	–	–	0	–	–	0	–	–
2006	0	–	–	0	–	–	0	–	–
2007	0	–	–	0	–	–	0	–	–
Avg.	3	37.47 ± 6.83	19.37 ± 9.59	1	34.00 ± NA	10.60 ± NA	4	36.60 ± 5.84	17.18 ± 8.97

Table 9.–Number of fresh lamprey wounds per 1,000 fish recorded annually for species harvested at the Little Manistee River weir, 1991–2007.

Year	Species				
	Brook trout	Brown trout	Chinook salmon	Coho salmon	Steelhead
1991	0.0	0.0	5.0	3.5	0.0
1992	0.0	0.0	13.2	2.1	0.0
1993	0.0	0.0	10.3	6.7	4.6
1994	0.0	0.0	2.0	0.0	0.0
1995	0.0	0.0	2.7	0.0	0.0
1996	0.0	0.0	6.2	0.0	2.4
1997	0.0	0.0	3.9	0.0	0.0
1998	0.0	0.0	3.2	0.0	0.0
1999	0.0	0.0	9.0	3.8	0.0
2000	0.0	0.0	6.3	0.0	0.0
2001	0.0	0.0	9.0	0.0	2.2
2002	0.0	0.0	4.6	2.9	9.4
2003	0.0	0.0	15.7	5.2	3.7
2004	0.0	0.0	7.2	4.7	0.0
2005	0.0	0.0	10.3	13.1	3.3
2006	0.0	25.6	6.8	0.0	3.1
2007	0.0	0.0	11.3	0.0	0.0
Average	0.0	1.5	7.5	2.5	1.7

Table 10.–Number and percent (%) of coho salmon by age and sex, harvested at the Little Manistee River weir, 1991–2007. This table is based on the biosample and includes known-sex fish only. Unsexed biosampled fish were left out of the total. The grand total, sexes combined may be less than the actual number of fish harvested each year because of this. Years with * are slightly less than the actual harvest. In 1991–93 there were some fish of known sex, but unknown age.

	Age (years in stream . years in lake)					
	1.0		1.1		Total	
Year	Male	Female	Male	Female	Male	Female
1991	2,438	0	4,832	5,029	7,271	5,029
	(19.8)	(0.0)	(39.3)	(40.9)	(59.1)	(40.9)
1992	2,002	62	6,235	5,101	8,237	5,163
	(14.9)	(0.5)	(46.5)	(38.1)	(61.5)	(38.5)
1993*	0	0	9,194	8,834	9,194	8,834
	(0.0)	(0.0)	(51.0)	(49.0)	(51.0)	(49.0)
1994	136	0	170	256	306	256
	(24.2)	(0.0)	(30.3)	(45.5)	(54.5)	(45.5)
1995	117	0	136	141	253	141
	(29.6)	(0.0)	(34.5)	(35.9)	(64.1)	(35.9)
1996*	0	0	1,036	1,490	1,036	1,490
	(0.0)	(0.0)	(41.0)	(59.0)	(41.0)	(59.0)
1997	240	13	296	232	536	245
	(30.7)	(1.6)	(37.9)	(29.8)	(68.6)	(31.4)
1998	304	13	607	539	912	551
	(20.8)	(0.9)	(41.5)	(36.8)	(62.3)	(37.7)
1999	32	0	224	263	256	263
	(6.1)	(0.0)	(43.2)	(50.7)	(49.3)	(50.7)
2000	48	3	236	313	284	316
	(8.0)	(0.0)	(39.3)	(52.1)	(47.4)	(52.6)
2001	91	0	402	418	493	418
	(9.9)	(0.0)	(44.1)	(45.9)	(54.1)	(45.9)
2002	32	3	271	222	303	225
	(6.0)	(0.6)	(51.4)	(42.0)	(57.4)	(42.6)
2003	123	0	212	281	335	281
	(19.9)	(0.0)	(34.4)	(45.7)	(54.3)	(45.7)
2004	247	5	450	399	698	404
	(22.4)	(0.5)	(40.9)	(36.2)	(63.3)	(36.7)
2005	220	7	1,030	843	1,250	850
	(10.5)	(0.3)	(49.0)	(40.1)	(59.5)	(40.5)
2006	0	0	112	126	112	126
	(0.0)	(0.0)	(47.0)	(53.0)	(47.0)	(53.0)
2007	0	0	0	0	0	0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Total	6,029	105	25,445	24,489	31,474	24,594
	(10.8)	(0.2)	(45.4)	(43.7)	(56.1)	(43.9)

Table 11.–Annual numbers returned and percentage (%) of stocked year-classes for age 1 and 2 coho salmon during the fall at the Little Manistee River, (fish were stocked as yearlings). An "–" indicates blank spaces for data which are not available for older fish in more recent year-classes.

Year-class	Number stocked	Age (years in stream . years in lake) 1.0		1.1		Total	
1967	148,365	501	(0.3)	22,306	(15.0)	22,807	(15.4)
1968	700,002	2,880	(0.4)	105,006	(15.0)	107,886	(15.4)
1981	200,000	979	(0.7)	15,334	(10.2)	16,313	(10.9)
1982	429,612	492	(0.2)	23,525	(11.7)	24,017	(12.0)
1983	500,066	873	(0.4)	24,264	(12.1)	25,137	(12.6)
1984	375,283	2,704	(0.6)	33,764	(7.9)	36,468	(8.5)
1985	343,121	218	(<0.1)	15,177	(3.0)	15,395	(3.1)
1986	266,914	79	(<0.1)	16,599	(4.4)	16,678	(4.4)
1987	358,250	0	(0.0)	12,236	(3.4)	12,236	(3.4)
1988	400,883	1,803	(0.4)	9,873	(2.5)	11,676	(2.9)
1989	225,007	253	(0.1)	9,862	(4.4)	10,115	(4.5)
1990	355,403	2,438	(0.7)	11,336	(3.2)	13,775	(3.9)
1991	300,440	2,064	(0.7)	18,028	(6.0)	20,092	(6.7)
1992	0	68	(0.0)	426	(0.0)	494	(0.0)
1993	0	136	(0.0)	277	(0.0)	413	(0.0)
1994	0	117	(0.0)	2,526	(0.0)	2,643	(0.0)
1995	0	58	(0.0)	528	(0.0)	587	(0.0)
1996	0	253	(0.0)	1,146	(0.0)	1,399	(0.0)
1997	0	317	(0.0)	487	(0.0)	804	(0.0)
1998	0	32	(0.0)	549	(0.0)	580	(0.0)
1999	0	51	(0.0)	820	(0.0)	872	(0.0)
2000	0	91	(0.0)	493	(0.0)	584	(0.0)
2001	0	35	(0.0)	493	(0.0)	528	(0.0)
2002	0	123	(0.0)	850	(0.0)	972	(0.0)
2003	0	252	(0.0)	1,873	(0.0)	2,125	(0.0)
2004	0	227	(0.0)	238	(0.0)	465	(0.0)
2005	0	0	(0.0)	0	(0.0)	0	(0.0)
2006	0	0	(0.0)	–		0	(0.0)
2007	0	–		–		–	

Table 12.–Mean total length (inches) and weight (pounds), by age and sex of coho salmon harvested at the Little Manistee River weir, fall 1991–2007. N equals sample size.

	Age 1.0								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	338	15.42 ± 1.14	1.46 ± 0.35	1	17.30 ± NA	1.90 ± NA	339	16.36 ± 1.14	1.68 ± 0.36
1992	142	15.21 ± 1.04	1.45 ± 0.29	4	16.40 ± 1.30	1.92 ± 0.35	146	15.80 ± 1.17	1.69 ± 0.32
1993	3	15.70 ± 2.26	1.47 ± 0.61	2	16.70 ± 0.42	1.75 ± 0.21	5	16.20 ± 1.34	1.61 ± 0.41
1994	15	15.33 ± 1.01	1.35 ± 0.34	0	–	–	15	15.33 ± 1.01	1.35 ± 0.34
1995	32	15.13 ± 1.22	1.37 ± 0.35	0	–	–	32	15.13 ± 1.22	1.37 ± 0.35
1996	4	14.90 ± 1.72	1.23 ± 0.41	1	16.40 ± NA	1.80 ± NA	5	15.65 ± 1.72	1.51 ± 0.41
1997	105	14.54 ± 1.22	1.18 ± 0.30	5	16.80 ± 1.23	1.64 ± 0.26	110	15.67 ± 1.22	1.41 ± 0.28
1998	50	15.59 ± 1.11	1.63 ± 0.33	2	16.35 ± 0.35	1.90 ± 0.14	52	15.97 ± 0.73	1.77 ± 0.24
1999	16	15.65 ± 1.15	1.50 ± 0.32	0	–	–	16	15.65 ± 1.15	1.50 ± 0.32
2000	30	15.47 ± 1.61	1.43 ± 0.45	2	16.90 ± 0.14	1.70 ± 0.14	32	16.19 ± 0.87	1.56 ± 0.30
2001	39	14.94 ± 1.22	1.20 ± 0.32	0	–	–	39	14.94 ± 1.22	1.20 ± 0.32
2002	21	14.80 ± 1.32	1.17 ± 0.32	2	17.60 ± 0.57	1.85 ± 0.21	23	16.20 ± 0.94	1.51 ± 0.26
2003	38	15.01 ± 1.12	1.32 ± 0.30	0	–	–	38	15.01 ± 1.12	1.32 ± 0.30
2004	48	15.37 ± 1.23	1.41 ± 0.37	1	17.00 ± NA	1.80 ± NA	49	16.18 ± 1.23	1.61 ± 0.37
2005	32	15.50 ± 0.88	1.43 ± 0.27	1	15.80 ± NA	2.90 ± NA	33	15.65 ± 0.88	2.16 ± 0.27
2006	0	–	–	0	–	–	0	–	–
2007	0	–	–	0	–	–	0	–	–
Avg.	913	15.24 ± 1.28	1.37 ± 0.36	21	16.72 ± 0.67	1.92 ± 0.22	934	15.83 ± 1.11	1.59 ± 0.32

Table 12.–Extended.

	Age 1.1								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	672	27.20 ± 2.99	8.09 ± 2.45	699	26.58 ± 1.82	7.64 ± 1.61	1,371	26.89 ± 2.40	7.87 ± 2.03
1992	441	26.44 ± 2.13	6.58 ± 1.65	361	25.66 ± 1.75	5.99 ± 1.36	802	26.05 ± 1.94	6.28 ± 1.50
1993	683	26.69 ± 2.46	7.40 ± 2.12	648	25.75 ± 2.03	6.78 ± 1.78	1,331	26.22 ± 2.25	7.09 ± 1.95
1994	19	23.86 ± 2.90	5.05 ± 1.99	28	24.55 ± 2.57	5.93 ± 2.17	47	24.21 ± 2.74	5.49 ± 2.08
1995	37	26.28 ± 2.70	6.36 ± 2.19	39	25.59 ± 2.06	6.05 ± 1.64	76	25.94 ± 2.38	6.21 ± 1.92
1996	90	26.71 ± 2.72	7.08 ± 2.17	127	26.25 ± 1.67	6.93 ± 1.45	217	26.48 ± 2.19	7.00 ± 1.81
1997	128	22.17 ± 2.05	3.82 ± 1.15	102	22.01 ± 1.61	3.85 ± 0.93	230	22.09 ± 1.83	3.83 ± 1.04
1998	100	22.35 ± 2.12	4.00 ± 1.35	88	22.36 ± 1.70	4.12 ± 1.03	188	22.36 ± 1.91	4.06 ± 1.19
1999	113	30.46 ± 2.64	10.80 ± 3.24	134	30.03 ± 1.93	10.92 ± 2.33	247	30.24 ± 2.29	10.86 ± 2.78
2000	148	26.54 ± 2.26	6.73 ± 1.91	195	25.98 ± 2.02	6.74 ± 1.59	343	26.26 ± 2.14	6.73 ± 1.75
2001	174	26.93 ± 2.31	7.19 ± 2.03	179	26.29 ± 2.01	6.87 ± 1.66	353	26.61 ± 2.16	7.03 ± 1.85
2002	179	22.88 ± 2.39	4.20 ± 1.56	148	22.24 ± 1.96	4.08 ± 1.21	327	22.56 ± 2.17	4.14 ± 1.39
2003	66	26.11 ± 1.91	6.10 ± 1.58	87	25.22 ± 1.84	5.91 ± 1.44	153	25.66 ± 1.88	6.00 ± 1.51
2004	87	25.22 ± 2.42	5.30 ± 1.62	78	25.16 ± 1.52	5.58 ± 1.28	165	25.19 ± 1.97	5.44 ± 1.45
2005	149	25.16 ± 2.31	5.38 ± 1.53	123	24.73 ± 1.92	5.30 ± 1.17	272	24.94 ± 2.11	5.34 ± 1.35
2006	14	24.75 ± 1.86	4.91 ± 1.25	16	24.11 ± 1.43	4.04 ± 1.00	30	24.43 ± 1.65	4.48 ± 1.12
2007	0	–	–	0	–	–	0	–	–
Avg.	3,100	25.61 ± 2.39	6.19 ± 1.86	3,052	25.16 ± 1.86	6.05 ± 1.48	6,152	25.38 ± 2.13	6.12 ± 1.67

Table 13.–Number and percent (%) of steelhead by age and sex, harvested at the Little Manistee River weir, 1991–2007. This table is based on the biosample and includes only known-sex fish. Unsexed biosampled fish were left out of the total. The grand total, sexes combined may be less than the actual number of fish harvested each year because of this. Total harvest numbers of age 3.0, 3.1, 3.2, 3.3, 2.5, 1.6, and 2.6 fish were not included since these age categories were represented by fewer than 10 fish.

Harvest year	Age (years in stream.years in lake)											
	1.0		1.1		1.2		1.3		1.4		1.5	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1991	184 (5.2)	8 (0.2)	0 (0.0)	0 (0.0)	160 (4.5)	167 (4.7)	498 (14.1)	460 (13.0)	57 (1.6)	191 (5.4)	0 (0.0)	0 (0.0)
1992	84 (2.9)	0 (0.0)	0 (0.0)	0 (0.0)	52 (1.8)	97 (3.3)	253 (8.6)	136 (4.6)	98 (3.3)	110 (3.8)	72 (2.4)	19 (0.7)
1993*	51 (3.1)	0 (0.0)	31 (1.9)	12 (0.7)	71 (4.3)	90 (5.5)	87 (5.3)	98 (6.0)	28 (1.7)	16 (0.9)	0 (0.0)	0 (0.0)
1994	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	194 (7.1)	187 (6.8)	190 (6.9)	241 (8.8)	67 (2.4)	39 (1.4)	0 (0.0)	0 (0.0)
1995	17 (5.4)	0 (0.0)	0 (0.0)	0 (0.0)	23 (7.4)	17 (5.3)	46 (14.7)	35 (11.1)	9 (2.9)	11 (3.4)	0 (0.0)	0 (0.0)
1996*	0 (0.0)	0 (0.0)	113 (2.3)	63 (1.3)	177 (3.7)	200 (4.1)	592 (12.2)	641 (13.2)	264 (5.4)	176 (3.6)	0 (0.0)	0 (0.0)
1997	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	128 (15.6)	97 (11.7)	93 (11.3)	73 (8.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
1998	24 (2.8)	12 (1.4)	0 (0.0)	0 (0.0)	71 (8.6)	91 (10.9)	24 (2.9)	65 (7.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
1999	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	59 (9.7)	61 (10.1)	48 (7.8)	23 (3.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2000	0 (0.0)	0 (0.0)	9 (2.8)	16 (5.2)	25 (7.9)	17 (5.5)	2 (0.8)	11 (3.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2001	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	299 (14.4)	299 (14.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2002	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	21 (28.9)	12 (16.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2003	0 (0.0)	0 (0.0)	42 (3.2)	32 (2.4)	215 (16.1)	215 (16.1)	42 (3.2)	54 (4.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2004	53 (5.3)	7 (0.6)	36 (3.6)	94 (9.4)	225 (22.5)	286 (28.7)	60 (6.0)	53 (5.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2005	77 (11.5)	3 (0.5)	29 (4.3)	27 (4.0)	95 (14.2)	99 (14.8)	52 (7.8)	64 (9.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2006	19 (4.8)	2 (0.4)	14 (3.6)	14 (3.6)	31 (7.7)	50 (12.6)	35 (8.8)	37 (9.2)	16 (3.9)	20 (5.0)	0 (0.0)	0 (0.0)
2007	0 (0.0)	0 (0.0)	30 (4.3)	25 (3.5)	79 (11.3)	109 (15.5)	50 (7.2)	57 (8.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	509 (2.1)	31 (0.1)	306 (1.3)	283 (1.2)	1,928 (8.1)	2,095 (8.8)	2,072 (8.7)	2,048 (8.6)	538 (2.3)	562 (2.4)	72 (0.3)	19 (0.1)

Table 13.–Extended.

Harvest year	Age (years in stream.years in lake)											
	2.0		2.1		2.2		2.3		2.4		Total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1991	304	0	191	112	153	230	223	272	24	64	1,794	1,504
	(8.6)	(0.0)	(5.4)	(3.2)	(4.3)	(6.5)	(6.3)	(7.7)	(0.7)	(1.8)	(54.4)	(45.6)
1992	104	7	51	91	174	273	485	430	143	149	1,516	1,311
	(3.5)	(0.2)	(1.8)	(3.1)	(6.0)	(9.3)	(16.5)	(14.7)	(4.9)	(5.1)	(53.6)	(46.4)
1993*	110	0	90	102	171	217	200	157	67	39	905	730
	(6.7)	(0.0)	(5.5)	(6.2)	(10.4)	(13.3)	(12.2)	(9.6)	(4.1)	(2.4)	(55.3)	(44.7)
1994	151	0	39	56	209	256	456	344	123	101	1,429	1,224
	(5.5)	(0.0)	(1.4)	(2.1)	(7.6)	(9.3)	(16.7)	(12.6)	(4.5)	(3.7)	(53.9)	(46.1)
1995	27	0	25	11	23	26	26	18	0	0	196	117
	(8.8)	(0.0)	(7.9)	(3.4)	(7.3)	(8.3)	(8.3)	(5.8)	(0.0)	(0.0)	(62.7)	(37.3)
1996*	0	0	75	152	340	290	623	762	265	125	2,450	2,409
	(0.0)	(0.0)	(1.5)	(3.1)	(7.0)	(6.0)	(12.8)	(15.7)	(5.5)	(2.6)	(50.4)	(49.6)
1997	37	0	23	23	91	111	94	55	0	0	466	359
	(4.4)	(0.0)	(2.7)	(2.7)	(11.1)	(13.5)	(11.4)	(6.7)	(0.0)	(0.0)	(56.5)	(43.5)
1998	139	33	59	53	59	97	41	32	0	0	418	382
	(16.6)	(3.9)	(7.1)	(6.3)	(7.1)	(11.6)	(4.9)	(3.9)	(0.0)	(0.0)	(52.3)	(47.7)
1999	0	0	71	77	83	101	21	28	0	0	282	292
	(0.0)	(0.0)	(11.8)	(12.7)	(13.7)	(16.7)	(3.5)	(4.7)	(0.0)	(0.0)	(49.2)	(50.8)
2000	0	0	43	49	64	51	5	9	0	0	148	152
	(0.0)	(0.0)	(13.7)	(15.4)	(20.4)	(16.0)	(1.5)	(2.7)	(0.0)	(0.0)	(49.3)	(50.7)
2001	0	0	78	100	439	516	69	75	0	0	886	990
	(0.0)	(0.0)	(3.8)	(4.8)	(21.1)	(24.8)	(3.3)	(3.6)	(0.0)	(0.0)	(47.2)	(52.8)
2002	0	0	0	0	18	22	0	0	0	0	39	34
	(0.0)	(0.0)	(0.0)	(0.0)	(24.1)	(30.7)	(0.0)	(0.0)	(0.0)	(0.0)	(53.0)	(47.0)
2003	0	0	70	53	180	166	57	44	37	48	643	612
	(0.0)	(0.0)	(5.2)	(3.9)	(13.5)	(12.4)	(4.2)	(3.3)	(2.8)	(3.6)	(51.3)	(48.7)
2004	0	0	30	30	28	37	0	0	0	0	431	506
	(0.0)	(0.0)	(3.0)	(3.0)	(2.8)	(3.7)	(0.0)	(0.0)	(0.0)	(0.0)	(46.0)	(54.0)
2005	0	0	15	22	47	47	23	13	0	0	339	276
	(0.0)	(0.0)	(2.2)	(3.3)	(7.1)	(7.1)	(3.5)	(2.0)	(0.0)	(0.0)	(55.2)	(44.8)
2006	20	0	14	9	25	24	18	6	0	0	193	163
	(4.9)	(0.0)	(3.6)	(2.3)	(6.4)	(6.1)	(4.6)	(1.6)	(0.0)	(0.0)	(54.2)	(45.8)
2007	25	2	35	38	56	69	17	17	0	0	293	316
	(3.6)	(0.4)	(5.0)	(5.4)	(8.0)	(9.8)	(2.5)	(2.5)	(0.0)	(0.0)	(48.0)	(52.0)
Total	915	42	909	976	2,162	2,533	2,359	2,264	659	525	12,429	11,378
	(3.8)	(0.2)	(3.8)	(4.1)	(9.1)	(10.6)	(9.9)	(9.5)	(2.8)	(2.2)	(52.2)	(47.8)

Table 14.–Percent (%) of hatchery and wild origin steelhead, by harvest year and sex, returning to the Little Manistee River weir, fall 1991–2007.

Harvest year	Male		Female		Sexes combined	
	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild
1991	20.3	79.7	19.5	80.5	19.9	80.1
1992	15.5	84.5	15.4	84.6	15.5	84.5
1993	10.3	89.7	10.5	89.5	10.4	89.6
1994	10.4	89.6	8.5	91.5	9.5	90.5
1995	12.4	87.6	17.2	82.8	14.3	85.7
1996	12.1	87.9	16.6	83.4	14.3	85.7
1997	15.9	84.1	24.6	75.4	19.7	80.3
1998	6.7	93.3	11.5	88.5	9.0	91.0
1999	9.0	91.0	12.1	87.9	10.5	89.5
2000	12.0	88.0	14.2	85.8	13.1	86.9
2001	13.8	86.2	11.1	88.9	12.3	87.7
2002	16.3	83.7	17.4	82.6	16.8	83.2
2003	10.0	90.0	9.2	90.8	9.6	90.4
2004	18.6	81.4	16.9	83.1	17.7	82.3
2005	15.1	84.9	13.3	86.7	14.3	85.7
2006	39.0	61.0	49.2	50.8	43.7	56.3
2007	50.8	49.2	53.1	46.9	51.9	48.1
Average	16.3	83.7	18.0	82.0	17.1	82.9

Table 15.–Number and percent of hatchery and wild origin steelhead, by year-class and stream age, returning to the Little Manistee River weir, 1991–2007.

	Stream age								
	1			2			Combined		
Year-class	Number	Hatchery (%)	Wild (%)	Number	Hatchery (%)	Wild (%)	Number	Hatchery (%)	Wild (%)
1984	1	0.0	100.0	2	0.0	100.0	3	0.0	100.0
1985	6	33.3	66.7	16	6.3	93.8	22	13.6	86.4
1986	43	53.5	46.5	107	8.4	91.6	150	21.3	78.7
1987	157	21.7	78.3	215	6.0	94.0	372	12.6	87.4
1988	113	32.7	67.3	240	3.3	96.7	353	12.7	87.3
1989	98	36.7	63.3	311	3.9	96.1	409	11.7	88.3
1990	173	23.7	76.3	212	0.9	99.1	385	11.2	88.8
1991	180	26.1	73.9	197	3.6	96.4	377	14.3	85.7
1992	154	25.3	74.7	155	6.5	93.5	309	15.9	84.1
1993	110	31.8	68.2	138	5.8	94.2	248	17.3	82.7
1994	138	26.8	73.2	96	3.1	96.9	234	17.1	82.9
1995	96	12.5	87.5	142	2.8	97.2	238	6.7	93.3
1996	87	26.4	73.6	246	5.3	94.7	333	10.8	89.2
1997	67	40.3	59.7	301	3.3	96.7	368	10.1	89.9
1998	160	27.5	72.5	102	2.9	97.1	262	17.9	82.1
1999	66	34.8	65.2	92	4.3	95.7	158	17.1	82.9
2000	141	25.5	74.5	72	2.8	97.2	213	17.8	82.2
2001	265	21.9	78.1	92	2.2	97.8	357	16.8	83.2
2002	188	41.0	59.0	77	0.0	100.0	265	29.1	70.9
2003	144	59.0	41.0	78	1.3	98.7	222	38.7	61.3
2004	131	61.8	38.2	44	2.3	97.7	175	46.9	53.1
2005	39	71.8	28.2	11	0.0	100.0	50	56.0	44.0
2006	7	85.7	14.3	0	0.0	0.0	7	85.7	14.3
Average	2,564	32.4	67.6	2,946	3.8	96.2	5,510	17.1	82.9

Table 16.–Mean total length (inches) and weight (pounds), by age and sex of steelhead harvested at the Little Manistee River weir, fall 1991–2007. Lengths and weights presented as mean ± SD. Data is from fish collected at the weir and scale ages (N equals sample size) and missing data are represented by "–".

	Age 1.0								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	23	15.80 ± 1.44	1.57 ± 0.49	1	18.20 ± NA	2.60 ± NA	24	17.00 ± 1.44	2.08 ± 0.49
1992	13	15.08 ± 1.27	1.60 ± 0.79	0	–	–	13	15.08 ± 1.27	1.60 ± 0.79
1993	13	14.37 ± 1.10	1.17 ± 0.34	0	–	–	13	14.37 ± 1.10	1.17 ± 0.34
1994	9	14.36 ± 1.33	0.98 ± 0.26	0	–	–	9	14.36 ± 1.33	0.98 ± 0.26
1995	11	14.82 ± 1.51	1.19 ± 0.49	0	–	–	11	14.82 ± 1.51	1.19 ± 0.49
1996	2	14.80 ± 0.14	1.15 ± 0.07	0	–	–	2	14.80 ± 0.14	1.15 ± 0.07
1997	10	14.59 ± 1.11	1.10 ± 0.38	0	–	–	10	14.59 ± 1.11	1.10 ± 0.38
1998	8	15.75 ± 1.39	1.56 ± 0.53	4	14.48 ± 1.10	1.07 ± 0.40	12	15.11 ± 1.24	1.32 ± 0.47
1999	4	17.42 ± 1.55	2.30 ± 0.70	0	–	–	4	17.42 ± 1.55	2.30 ± 0.70
2000	0	–	–	0	–	–	0	–	–
2001	1	14.90 ± NA	1.30 ± NA	0	–	–	1	14.90 ± NA	1.30 ± NA
2002	2	14.95 ± 3.32	1.30 ± 0.85	1	15.20 ± NA	1.50 ± NA	3	15.07 ± 3.32	1.40 ± 0.85
2003	1	15.60 ± NA	1.30 ± NA	0	–	–	1	15.60 ± NA	1.30 ± NA
2004	17	16.33 ± 1.69	1.72 ± 0.69	2	19.65 ± 3.89	3.80 ± 2.12	19	17.99 ± 2.79	2.76 ± 1.40
2005	27	16.91 ± 1.29	2.12 ± 0.53	1	15.90 ± NA	1.60 ± NA	28	16.41 ± 1.29	1.86 ± 0.53
2006	12	15.12 ± 0.99	1.37 ± 0.34	1	18.20 ± NA	2.40 ± NA	13	16.66 ± 0.99	1.88 ± 0.34
2007	7	16.86 ± 1.49	1.91 ± 0.49	0	–	–	7	16.88 ± 1.49	1.91 ± 0.49
Avg.	160	15.48 ± 1.40	1.48 ± 0.50	10	16.94 ± 2.49	2.16 ± 1.26	170	15.63 ± 1.35	1.66 ± 0.59

Table 16.–Extended.

	Age 1.1								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	7	21.21 ± 3.48	4.21 ± 1.90	2	23.90 ± 1.27	6.25 ± 2.90	9	22.56 ± 2.38	5.23 ± 2.40
1992	6	23.20 ± 2.53	5.22 ± 1.69	3	22.93 ± 1.22	4.27 ± 0.80	9	23.07 ± 1.87	4.74 ± 1.25
1993	8	21.16 ± 1.66	3.66 ± 0.87	3	24.90 ± 2.94	6.33 ± 2.75	11	23.03 ± 2.30	5.00 ± 1.81
1994	5	20.26 ± 1.57	2.72 ± 0.70	3	22.80 ± 2.62	4.10 ± 1.06	8	21.53 ± 2.10	3.41 ± 0.88
1995	6	18.05 ± 3.61	2.48 ± 1.32	3	23.50 ± 1.77	5.03 ± 1.46	9	20.78 ± 2.69	3.76 ± 1.39
1996	9	23.29 ± 1.72	4.74 ± 0.92	5	24.64 ± 1.78	6.08 ± 1.49	14	23.96 ± 1.75	5.41 ± 1.21
1997	4	22.23 ± 1.38	4.18 ± 0.86	3	25.80 ± 0.70	5.87 ± 0.32	7	24.01 ± 1.04	5.02 ± 0.59
1998	2	23.55 ± 1.20	4.45 ± 0.49	6	23.83 ± 1.35	5.07 ± 0.62	8	23.69 ± 1.28	4.76 ± 0.56
1999	4	25.82 ± 2.81	7.35 ± 2.42	4	26.65 ± 0.66	8.05 ± 1.55	8	26.24 ± 1.73	7.70 ± 1.98
2000	7	25.03 ± 3.53	6.41 ± 2.37	13	24.50 ± 1.97	6.11 ± 1.65	20	24.76 ± 2.75	6.26 ± 2.01
2001	4	26.13 ± 2.18	6.75 ± 1.68	4	23.90 ± 2.08	5.95 ± 2.63	8	25.01 ± 2.13	6.35 ± 2.16
2002	1	23.20 ± NA	6.00 ± NA	3	22.17 ± 4.06	4.43 ± 1.93	4	22.68 ± 4.06	5.22 ± 1.93
2003	8	23.11 ± 2.38	4.67 ± 1.27	6	24.37 ± 2.24	5.37 ± 1.52	14	23.74 ± 2.31	5.02 ± 1.39
2004	12	23.74 ± 2.34	5.12 ± 1.55	31	25.22 ± 2.21	6.09 ± 1.34	43	24.48 ± 2.28	5.61 ± 1.44
2005	12	23.52 ± 3.19	5.29 ± 2.17	11	23.00 ± 1.43	4.65 ± 0.81	23	23.26 ± 2.31	4.97 ± 1.49
2006	11	23.40 ± 2.42	5.04 ± 1.41	11	23.82 ± 1.01	4.85 ± 0.59	22	23.61 ± 1.71	4.94 ± 1.00
2007	12	21.42 ± 2.46	3.76 ± 1.21	10	24.14 ± 2.72	5.21 ± 1.73	22	22.78 ± 2.59	4.48 ± 1.47
Avg.	118	22.84 ± 2.40	4.83 ± 1.43	121	24.12 ± 1.89	5.51 ± 1.48	239	23.48 ± 2.14	5.17 ± 1.45

Table 16.–Extended.

	Age 1.2								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	20	27.62 ± 1.78	7.91 ± 1.29	21	26.96 ± 1.55	7.35 ± 1.16	41	27.29 ± 1.66	7.63 ± 1.23
1992	8	28.14 ± 1.63	7.86 ± 1.27	15	27.60 ± 0.92	7.81 ± 0.85	23	27.87 ± 1.28	7.84 ± 1.06
1993	18	27.84 ± 1.46	7.89 ± 1.46	23	27.28 ± 1.52	7.26 ± 1.34	41	27.56 ± 1.49	7.58 ± 1.40
1994	35	27.62 ± 1.84	7.63 ± 1.73	33	26.28 ± 2.00	6.54 ± 1.57	68	26.95 ± 1.92	7.08 ± 1.65
1995	15	26.19 ± 2.46	6.66 ± 2.03	11	26.40 ± 1.42	6.59 ± 1.25	26	26.29 ± 1.94	6.63 ± 1.64
1996	14	28.19 ± 3.48	8.08 ± 2.84	16	27.12 ± 1.74	7.86 ± 1.64	30	27.65 ± 2.61	7.97 ± 2.24
1997	44	28.43 ± 1.81	7.54 ± 1.61	33	26.91 ± 1.44	6.59 ± 0.99	77	27.67 ± 1.62	7.07 ± 1.30
1998	24	26.79 ± 1.16	6.86 ± 1.15	31	25.85 ± 1.28	6.09 ± 0.87	55	26.32 ± 1.22	6.48 ± 1.01
1999	25	30.78 ± 1.87	11.34 ± 2.11	26	29.06 ± 1.69	9.85 ± 1.80	51	29.92 ± 1.78	10.59 ± 1.95
2000	20	30.51 ± 2.01	11.30 ± 2.73	14	28.71 ± 1.75	9.34 ± 1.50	34	29.61 ± 1.88	10.32 ± 2.12
2001	60	30.30 ± 1.67	10.50 ± 1.96	61	27.95 ± 2.36	8.46 ± 1.72	121	29.13 ± 2.01	9.48 ± 1.84
2002	18	29.04 ± 1.27	8.62 ± 1.10	10	28.22 ± 1.50	7.80 ± 1.40	28	28.63 ± 1.38	8.21 ± 1.25
2003	40	28.55 ± 1.85	8.22 ± 1.56	40	27.13 ± 1.20	7.08 ± 1.02	80	27.84 ± 1.52	7.65 ± 1.29
2004	76	28.48 ± 1.82	8.01 ± 1.51	95	27.40 ± 1.31	7.40 ± 1.08	171	27.94 ± 1.56	7.70 ± 1.30
2005	38	26.98 ± 2.30	7.08 ± 1.44	39	26.51 ± 1.83	6.73 ± 1.33	77	26.75 ± 2.07	6.90 ± 1.39
2006	23	26.75 ± 2.26	6.86 ± 1.52	37	26.29 ± 1.75	6.69 ± 1.40	60	26.52 ± 2.01	6.78 ± 1.46
2007	31	27.70 ± 2.66	7.26 ± 2.07	42	26.93 ± 1.75	6.98 ± 1.36	73	27.32 ± 2.20	7.12 ± 1.71
Avg.	509	28.23 ± 1.96	8.21 ± 1.73	547	27.21 ± 1.59	7.44 ± 1.31	1,055	27.72 ± 1.77	7.82 ± 1.52

Table 16.–Extended.

	Age 1.3								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	62	29.16 ± 1.21	9.33 ± 1.19	58	28.10 ± 1.17	8.50 ± 1.27	120	28.63 ± 1.19	8.91 ± 1.23
1992	39	30.18 ± 2.00	10.03 ± 1.98	21	29.00 ± 2.27	9.26 ± 2.39	60	29.59 ± 2.13	9.65 ± 2.18
1993	22	29.95 ± 2.26	9.62 ± 1.79	25	29.45 ± 2.11	8.90 ± 1.73	47	29.70 ± 2.18	9.26 ± 1.76
1994	34	28.05 ± 1.91	7.91 ± 1.93	43	27.42 ± 2.32	7.52 ± 2.11	77	27.74 ± 2.11	7.72 ± 2.02
1995	30	29.45 ± 2.53	9.10 ± 2.52	23	28.59 ± 2.12	8.39 ± 1.54	53	29.02 ± 2.32	8.75 ± 2.03
1996	47	29.60 ± 1.85	9.87 ± 2.12	51	28.00 ± 1.65	8.40 ± 1.52	98	28.80 ± 1.75	9.13 ± 1.82
1997	32	30.37 ± 2.63	9.82 ± 2.54	25	29.33 ± 1.79	8.77 ± 1.41	57	29.85 ± 2.21	9.29 ± 1.97
1998	8	29.05 ± 1.85	8.78 ± 1.83	22	28.47 ± 1.83	7.83 ± 1.38	30	28.76 ± 1.84	8.30 ± 1.60
1999	20	31.02 ± 2.00	11.77 ± 2.47	10	29.15 ± 1.29	9.54 ± 0.98	30	30.09 ± 1.64	10.65 ± 1.72
2000	2	33.95 ± 1.77	16.25 ± 3.04	9	30.17 ± 1.42	9.88 ± 1.21	11	32.06 ± 1.59	13.06 ± 2.13
2001	7	31.86 ± 0.83	12.14 ± 1.58	3	29.63 ± 0.50	10.00 ± 1.51	10	30.75 ± 0.67	11.07 ± 1.54
2002	4	31.90 ± 1.61	11.20 ± 1.43	1	30.00 ± NA	9.60 ± NA	5	30.95 ± 1.61	10.40 ± 1.43
2003	8	31.63 ± 2.06	10.17 ± 1.84	10	30.09 ± 1.59	9.48 ± 1.00	18	30.86 ± 1.83	9.83 ± 1.42
2004	20	29.90 ± 2.27	8.92 ± 1.58	18	28.46 ± 1.41	8.01 ± 1.61	38	29.18 ± 1.84	8.47 ± 1.59
2005	20	29.03 ± 1.71	8.34 ± 1.26	24	28.65 ± 1.26	8.57 ± 1.49	44	28.84 ± 1.49	8.45 ± 1.37
2006	27	29.53 ± 1.89	9.11 ± 1.92	28	28.18 ± 0.83	7.87 ± 0.71	54	28.85 ± 1.36	8.49 ± 1.31
2007	20	29.08 ± 2.01	7.93 ± 1.49	23	27.80 ± 1.67	7.35 ± 1.24	42	28.44 ± 1.84	7.64 ± 1.36
Avg.	402	30.22 ± 1.91	10.02 ± 1.91	394	28.85 ± 1.58	8.70 ± 1.44	794	29.53 ± 1.75	9.36 ± 1.68

Table 16.–Extended.

	Age 1.4								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	7	31.63 ± 2.11	11.36 ± 2.60	24	31.04 ± 1.17	10.95 ± 1.43	31	31.34 ± 1.64	11.16 ± 2.01
1992	15	31.65 ± 1.47	11.14 ± 1.92	17	29.72 ± 1.83	9.68 ± 1.78	32	30.69 ± 1.65	10.41 ± 1.85
1993	7	31.76 ± 3.08	11.63 ± 2.31	4	31.63 ± 1.47	9.73 ± 1.72	11	31.69 ± 2.27	10.68 ± 2.02
1994	12	30.86 ± 1.97	10.43 ± 3.26	7	29.20 ± 1.28	9.10 ± 1.85	19	30.03 ± 1.63	9.76 ± 2.55
1995	6	30.72 ± 1.67	10.03 ± 2.61	7	31.09 ± 2.39	10.31 ± 1.71	13	30.90 ± 2.03	10.17 ± 2.16
1996	21	32.22 ± 2.30	11.77 ± 2.29	14	28.54 ± 2.60	9.21 ± 1.60	35	30.38 ± 2.45	10.49 ± 1.94
1997	2	33.25 ± 0.07	11.75 ± 2.76	5	29.74 ± 2.06	8.86 ± 1.51	7	31.49 ± 1.07	10.31 ± 2.14
1998	1	31.10 ± NA	9.90 ± NA	2	28.80 ± 3.39	9.15 ± 3.75	3	29.95 ± 3.39	9.52 ± 3.75
1999	0	–	–	3	29.53 ± 1.87	9.97 ± 2.48	3	29.53 ± 1.87	9.97 ± 2.48
2000	2	29.65 ± 0.35	9.65 ± 0.35	1	28.50 ± NA	8.90 ± NA	3	29.07 ± 0.35	9.27 ± 0.35
2001	1	34.40 ± NA	14.20 ± NA	4	31.83 ± 0.77	11.90 ± 0.95	5	33.11 ± 0.77	13.05 ± 0.95
2002	0	–	–	1	31.70 ± NA	11.30 ± NA	1	31.70 ± NA	11.30 ± NA
2003	1	31.70 ± NA	11.80 ± NA	4	30.18 ± 1.21	10.02 ± 1.37	5	30.94 ± 1.21	10.91 ± 1.37
2004	2	32.05 ± 4.88	9.65 ± 2.90	7	30.16 ± 2.64	9.74 ± 2.37	9	31.10 ± 3.76	9.70 ± 2.64
2005	6	30.33 ± 0.89	9.20 ± 0.95	4	28.80 ± 0.28	8.68 ± 0.56	10	29.57 ± 0.58	8.94 ± 0.75
2006	12	29.93 ± 0.81	8.94 ± 0.82	15	29.40 ± 1.33	8.65 ± 1.34	27	29.66 ± 1.07	8.80 ± 1.08
2007	5	28.70 ± 1.01	7.32 ± 0.66	3	29.17 ± 1.81	7.87 ± 1.46	8	28.93 ± 1.41	7.59 ± 1.06
Avg.	100	31.33 ± 1.72	10.58 ± 1.95	122	29.94 ± 1.74	9.65 ± 1.73	222	30.59 ± 1.73	10.09 ± 1.83

Table 16.–Extended.

	Age 1.5								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	0	–	–	4	31.15 ± 1.31	11.22 ± 1.05	4	31.15 ± 1.31	11.22 ± 1.05
1992	11	32.35 ± 1.71	11.33 ± 2.25	3	31.27 ± 0.45	10.83 ± 0.32	14	31.81 ± 1.08	11.08 ± 1.29
1993	2	33.75 ± 0.49	10.60 ± 1.41	3	30.87 ± 0.81	9.53 ± 2.19	5	32.31 ± 0.65	10.07 ± 1.80
1994	0	–	–	1	32.20 ± NA	13.20 ± NA	1	32.20 ± NA	13.20 ± NA
1995	0	–	–	1	31.40 ± NA	10.30 ± NA	1	31.40 ± NA	10.30 ± NA
1996	4	31.15 ± 2.23	11.80 ± 2.65	5	29.34 ± 1.30	9.48 ± 1.43	9	30.24 ± 1.77	10.64 ± 2.04
1997	0	–	–	0	–	–	0	–	–
1998	1	30.10 ± NA	9.40 ± NA	0	–	–	1	30.10 ± NA	9.40 ± NA
1999	0	–	–	0	–	–	0	–	–
2000	0	–	–	0	–	–	0	–	–
2001	0	–	–	0	–	–	0	–	–
2002	0	–	–	0	–	–	0	–	–
2003	0	–	–	0	–	–	0	–	–
2004	0	–	–	1	30.00 ± NA	8.90 ± NA	1	30.00 ± NA	8.90 ± NA
2005	0	–	–	0	–	–	0	–	–
2006	4	30.47 ± 2.02	9.13 ± 1.70	4	28.45 ± 1.96	8.18 ± 1.23	8	29.46 ± 1.99	8.65 ± 1.46
2007	0	–	–	1	29.30 ± NA	8.00 ± NA	1	29.30 ± NA	8.00 ± NA
Avg.	22	31.57 ± 1.61	10.45 ± 2.00	23	30.44 ± 1.17	9.96 ± 1.24	45	30.84 ± 1.37	10.14 ± 1.58

Table 16.–Extended.

	Age 2.0								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	38	16.21 ± 1.70	1.79 ± 0.67	0	–	–	38	16.21 ± 1.70	1.79 ± 0.67
1992	16	16.16 ± 1.49	1.61 ± 0.46	1	15.70 ± NA	0.80 ± NA	17	15.93 ± 1.49	1.21 ± 0.46
1993	28	16.13 ± 1.86	1.64 ± 0.58	0	–	–	28	16.13 ± 1.86	1.64 ± 0.58
1994	27	15.29 ± 1.55	1.29 ± 0.47	0	–	–	27	15.29 ± 1.55	1.29 ± 0.47
1995	18	16.48 ± 1.97	1.82 ± 0.56	0	–	–	18	16.48 ± 1.97	1.82 ± 0.56
1996	3	17.43 ± 2.18	2.50 ± 1.28	0	–	–	3	17.43 ± 2.18	2.50 ± 1.28
1997	12	17.66 ± 1.26	2.06 ± 0.51	0	–	–	12	17.66 ± 1.26	2.06 ± 0.51
1998	47	17.24 ± 1.31	2.10 ± 0.51	11	16.27 ± 1.76	1.75 ± 0.78	58	16.75 ± 1.54	1.93 ± 0.64
1999	7	18.24 ± 1.78	2.69 ± 0.71	0	–	–	7	18.24 ± 1.78	2.69 ± 0.71
2000	2	17.35 ± 1.06	2.25 ± 0.35	1	17.20 ± NA	2.40 ± NA	3	17.28 ± 1.06	2.33 ± 0.35
2001	6	16.05 ± 1.41	1.65 ± 0.50	1	29.20 ± NA	9.50 ± NA	7	22.63 ± 1.41	5.57 ± 0.50
2002	0	–	–	1	16.60 ± NA	2.20 ± NA	1	16.60 ± NA	2.20 ± NA
2003	8	17.45 ± 1.35	1.95 ± 0.53	1	17.50 ± NA	2.50 ± NA	9	17.47 ± 1.35	2.22 ± 0.53
2004	9	17.56 ± 1.06	2.36 ± 0.42	1	23.60 ± NA	4.70 ± NA	10	20.58 ± 1.06	3.53 ± 0.42
2005	9	17.43 ± 0.55	2.24 ± 0.28	0	–	–	9	17.43 ± 0.55	2.24 ± 0.28
2006	14	17.51 ± 0.89	2.08 ± 0.50	0	–	–	14	17.51 ± 0.89	2.08 ± 0.50
2007	10	17.24 ± 1.28	2.14 ± 0.24	1	17.70 ± NA	1.80 ± NA	11	17.47 ± 1.28	1.97 ± 0.24
Avg.	254	16.96 ± 1.42	2.01 ± 0.53	18	19.22 ± 1.76	3.21 ± 0.78	272	17.72 ± 1.44	2.41 ± 0.55

Table 16.–Extended.

	Age 2.1								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	24	22.38 ± 2.23	4.38 ± 1.31	14	23.91 ± 1.07	5.53 ± 0.95	38	23.14 ± 1.65	4.95 ± 1.13
1992	8	23.08 ± 2.00	4.79 ± 1.22	14	23.89 ± 0.66	5.34 ± 0.67	22	23.48 ± 1.33	5.07 ± 0.94
1993	23	23.97 ± 1.70	5.25 ± 1.19	26	24.14 ± 1.70	5.72 ± 1.64	49	24.05 ± 1.70	5.49 ± 1.41
1994	7	19.17 ± 2.53	2.56 ± 0.74	10	22.85 ± 1.36	4.24 ± 0.63	17	21.01 ± 1.94	3.40 ± 0.68
1995	16	22.48 ± 1.48	4.14 ± 0.83	7	22.79 ± 1.12	4.34 ± 0.73	23	22.63 ± 1.30	4.24 ± 0.78
1996	6	25.70 ± 0.77	6.80 ± 1.15	12	24.74 ± 0.88	6.18 ± 0.81	18	25.22 ± 0.82	6.49 ± 0.98
1997	8	24.16 ± 1.48	4.90 ± 0.71	8	23.76 ± 1.18	4.87 ± 0.96	16	23.96 ± 1.33	4.89 ± 0.83
1998	20	22.86 ± 2.56	4.43 ± 1.19	18	23.43 ± 1.79	4.99 ± 1.09	38	23.14 ± 2.18	4.71 ± 1.14
1999	30	27.32 ± 2.10	8.21 ± 1.82	33	26.46 ± 1.59	7.54 ± 1.47	63	26.89 ± 1.85	7.87 ± 1.65
2000	36	25.91 ± 1.59	7.03 ± 1.30	40	25.37 ± 1.23	6.70 ± 1.04	76	25.64 ± 1.41	6.86 ± 1.17
2001	16	25.88 ± 1.90	6.66 ± 1.25	20	25.98 ± 1.35	6.77 ± 1.06	36	25.93 ± 1.62	6.72 ± 1.15
2002	5	22.48 ± 1.74	4.42 ± 1.06	4	23.15 ± 0.82	5.02 ± 0.55	9	22.82 ± 1.28	4.72 ± 0.81
2003	13	24.59 ± 2.29	5.21 ± 1.40	10	24.99 ± 1.02	5.79 ± 0.73	23	24.79 ± 1.66	5.50 ± 1.07
2004	10	25.44 ± 2.44	6.26 ± 1.77	10	24.38 ± 1.46	5.56 ± 1.37	20	24.91 ± 1.95	5.91 ± 1.57
2005	6	24.22 ± 5.41	5.66 ± 2.97	9	24.17 ± 2.98	5.57 ± 1.47	15	24.19 ± 4.20	5.61 ± 2.22
2006	11	22.17 ± 2.89	4.35 ± 1.66	7	24.50 ± 1.61	5.54 ± 0.98	18	23.34 ± 2.25	4.95 ± 1.32
2007	14	23.60 ± 2.70	4.79 ± 1.43	15	24.39 ± 1.00	5.22 ± 0.71	29	24.00 ± 1.85	5.01 ± 1.07
Avg.	253	23.85 ± 2.22	5.28 ± 1.35	257	24.29 ± 1.34	5.58 ± 0.99	510	24.07 ± 1.78	5.43 ± 1.17

Table 16.–Extended.

	Age 2.2								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	19	26.01 ± 1.68	7.27 ± 1.34	29	26.42 ± 1.57	7.14 ± 1.31	48	26.21 ± 1.63	7.21 ± 1.32
1992	27	26.84 ± 2.29	7.44 ± 1.92	42	27.47 ± 1.36	7.90 ± 1.17	69	27.16 ± 1.83	7.67 ± 1.55
1993	44	28.02 ± 1.85	8.22 ± 1.57	55	27.43 ± 1.44	7.91 ± 1.25	99	27.72 ± 1.65	8.06 ± 1.41
1994	37	27.73 ± 1.91	8.26 ± 1.90	46	26.49 ± 2.03	6.94 ± 1.90	83	27.11 ± 1.97	7.60 ± 1.90
1995	15	26.42 ± 3.03	7.05 ± 2.86	17	25.88 ± 1.67	6.31 ± 1.17	32	26.15 ± 2.35	6.68 ± 2.02
1996	27	27.93 ± 2.28	8.46 ± 2.00	23	26.81 ± 1.91	7.60 ± 1.66	50	27.37 ± 2.09	8.03 ± 1.83
1997	32	28.77 ± 1.34	8.09 ± 1.30	39	27.53 ± 1.56	7.35 ± 1.18	71	28.15 ± 1.45	7.72 ± 1.24
1998	20	27.31 ± 1.35	7.32 ± 1.35	33	25.88 ± 1.24	6.11 ± 0.92	53	26.59 ± 1.29	6.71 ± 1.13
1999	34	31.12 ± 2.00	11.94 ± 2.85	42	29.44 ± 1.10	10.31 ± 1.48	76	30.28 ± 1.55	11.13 ± 2.17
2000	51	30.58 ± 2.84	11.34 ± 3.09	40	29.64 ± 1.76	10.03 ± 1.61	91	30.11 ± 2.30	10.68 ± 2.35
2001	88	30.67 ± 1.88	10.73 ± 1.99	104	29.08 ± 1.59	9.54 ± 1.86	192	29.88 ± 1.73	10.14 ± 1.92
2002	15	30.07 ± 1.64	9.28 ± 1.47	19	27.88 ± 2.52	7.94 ± 2.17	34	28.98 ± 2.08	8.61 ± 1.82
2003	34	29.20 ± 2.26	8.85 ± 1.90	31	27.86 ± 1.46	7.79 ± 1.30	65	28.53 ± 1.86	8.32 ± 1.60
2004	9	29.84 ± 1.88	9.26 ± 2.17	12	28.28 ± 1.42	7.78 ± 1.20	21	29.06 ± 1.65	8.52 ± 1.68
2005	18	29.03 ± 2.48	8.26 ± 1.31	18	26.93 ± 1.52	6.92 ± 1.11	36	27.98 ± 2.00	7.59 ± 1.21
2006	19	27.99 ± 2.60	7.91 ± 1.69	18	26.32 ± 1.20	6.64 ± 0.78	37	27.16 ± 1.90	7.28 ± 1.23
2007	22	27.09 ± 3.03	6.90 ± 2.18	27	26.93 ± 2.01	7.00 ± 1.49	49	27.01 ± 2.52	6.95 ± 1.84
Avg.	511	28.51 ± 2.14	8.62 ± 1.93	595	27.43 ± 1.61	7.72 ± 1.39	1,106	27.97 ± 1.87	8.17 ± 1.66

Table 16.–Extended.

	Age 2.3								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	28	29.97 ± 1.58	10.19 ± 1.67	34	28.79 ± 1.21	9.00 ± 1.38	62	29.38 ± 1.40	9.60 ± 1.52
1992	75	29.59 ± 1.81	9.60 ± 1.89	66	28.28 ± 1.22	8.60 ± 1.18	141	28.94 ± 1.51	9.10 ± 1.53
1993	51	29.39 ± 2.27	9.64 ± 2.63	40	29.07 ± 1.58	9.36 ± 1.50	91	29.23 ± 1.93	9.50 ± 2.06
1994	81	29.40 ± 1.86	9.42 ± 2.34	62	27.33 ± 1.55	7.55 ± 1.63	143	28.36 ± 1.71	8.48 ± 1.99
1995	17	28.42 ± 2.42	8.55 ± 2.65	12	27.45 ± 1.48	7.46 ± 1.62	29	27.93 ± 1.95	8.01 ± 2.13
1996	49	29.73 ± 1.60	10.03 ± 2.02	61	28.29 ± 1.48	8.46 ± 1.48	110	29.01 ± 1.54	9.24 ± 1.75
1997	33	30.45 ± 1.96	9.91 ± 2.17	19	28.98 ± 1.28	8.09 ± 0.98	51	29.72 ± 1.62	9.00 ± 1.57
1998	14	27.76 ± 1.57	7.55 ± 1.64	11	27.84 ± 1.69	7.57 ± 1.48	25	27.80 ± 1.63	7.56 ± 1.56
1999	9	31.12 ± 1.57	11.01 ± 1.53	12	30.45 ± 1.30	11.18 ± 1.68	21	30.79 ± 1.43	11.10 ± 1.61
2000	4	32.20 ± 1.77	12.53 ± 2.13	7	31.27 ± 1.12	11.41 ± 1.25	11	31.74 ± 1.44	11.97 ± 1.69
2001	14	30.79 ± 2.19	10.99 ± 2.09	15	30.49 ± 1.88	10.90 ± 2.02	29	30.64 ± 2.04	10.95 ± 2.05
2002	4	33.05 ± 1.93	12.80 ± 2.42	6	30.92 ± 2.39	10.17 ± 2.18	10	31.98 ± 2.16	11.48 ± 2.30
2003	10	32.24 ± 1.84	11.30 ± 1.80	8	31.10 ± 1.36	10.66 ± 1.61	18	31.67 ± 1.60	10.98 ± 1.70
2004	4	29.56 ± 4.68	9.20 ± 3.34	4	30.70 ± 1.38	10.18 ± 2.11	9	30.13 ± 3.03	9.69 ± 2.73
2005	9	28.18 ± 1.18	7.92 ± 1.30	5	28.64 ± 1.21	8.70 ± 0.81	14	28.41 ± 1.19	8.31 ± 1.05
2006	14	30.28 ± 1.82	9.56 ± 1.75	5	28.14 ± 1.71	7.72 ± 1.73	19	29.21 ± 1.77	8.64 ± 1.74
2007	7	29.53 ± 1.66	8.23 ± 2.42	7	28.09 ± 1.58	7.57 ± 1.28	14	28.81 ± 1.62	7.90 ± 1.85
Avg.	423	30.10 ± 1.98	9.91 ± 2.11	374	29.17 ± 1.50	9.09 ± 1.52	797	29.63 ± 1.74	9.50 ± 1.81

Table 16.–Extended.

	Age 2.4								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	3	31.10 ± 3.50	10.50 ± 3.38	8	30.77 ± 1.52	11.13 ± 1.74	11	30.94 ± 2.51	10.81 ± 2.56
1992	22	30.32 ± 1.60	10.35 ± 1.75	23	28.94 ± 1.79	9.17 ± 1.66	45	29.63 ± 1.69	9.76 ± 1.70
1993	17	31.92 ± 1.87	11.86 ± 2.20	10	29.56 ± 1.57	9.10 ± 2.25	27	30.74 ± 1.72	10.48 ± 2.23
1994	22	30.28 ± 1.96	10.17 ± 1.76	18	28.83 ± 1.20	8.68 ± 1.21	40	29.56 ± 1.58	9.43 ± 1.49
1995	3	29.53 ± 1.50	9.10 ± 1.23	3	30.23 ± 1.36	10.07 ± 1.19	6	29.88 ± 1.43	9.58 ± 1.21
1996	21	31.72 ± 1.60	11.94 ± 2.30	10	29.04 ± 1.79	9.49 ± 2.21	31	30.38 ± 1.70	10.72 ± 2.25
1997	5	29.30 ± 2.48	9.00 ± 0.79	4	28.50 ± 1.53	7.75 ± 1.85	9	28.90 ± 2.00	8.38 ± 1.32
1998	1	31.90 ± NA	11.70 ± NA	2	29.05 ± 2.19	9.25 ± 3.18	3	30.47 ± 2.19	10.47 ± 3.18
1999	1	29.80 ± NA	11.80 ± NA	1	29.70 ± NA	11.00 ± NA	2	29.75 ± NA	11.40 ± NA
2000	0	–	–	1	31.30 ± NA	13.00 ± NA	1	31.30 ± NA	13.00 ± NA
2001	1	31.80 ± NA	10.60 ± NA	3	32.03 ± 0.55	11.93 ± 1.20	4	31.92 ± 0.55	11.27 ± 1.20
2002	0	–	–	0	–	–	0	–	–
2003	7	30.93 ± 2.38	10.17 ± 3.23	9	30.22 ± 1.59	9.37 ± 1.36	16	30.58 ± 1.98	9.77 ± 2.30
2004	1	30.60 ± NA	9.70 ± NA	3	30.03 ± 1.32	9.43 ± 0.90	4	30.32 ± 1.32	9.57 ± 0.90
2005	0	–	–	0	–	–	0	–	–
2006	4	30.05 ± 1.86	9.68 ± 1.97	4	28.38 ± 0.63	7.85 ± 0.51	8	29.21 ± 1.25	8.76 ± 1.24
2007	2	29.65 ± 0.78	8.10 ± 0.57	1	29.00 ± NA	7.80 ± NA	3	29.33 ± 0.78	7.95 ± 0.57
Avg.	110	30.64 ± 1.95	10.33 ± 1.92	100	29.71 ± 1.42	9.67 ± 1.60	210	30.16 ± 1.66	9.99 ± 1.75

Table 17.–Percent of repeat spawners, and average number ( ) of previous spawns per repeat spawner, by lake age, and sex, of steelhead returning to the Little Manistee River weir annually in the fall from 1991 to 2007. When no fish were collected data are represented by "–".

	Lake age											
	1		2		3		4		5		6	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1991	41.9	–	21.7	10.9	42.6	50.0	100.0	93.9	100.0	100.0	–	100.0
	(1.0)	–	(1.4)	(1.0)	(1.2)	(1.2)	(2.0)	(1.8)	(4.0)	(2.8)	–	(4.0)
1992	40.0	–	28.2	6.8	30.8	45.5	84.2	93.0	100.0	100.0	100.0	100.0
	(1.0)	–	(1.2)	(1.0)	(1.4)	(1.3)	(2.1)	(2.2)	(3.6)	(3.2)	(4.5)	(4.5)
1993	3.2	3.3	18.8	11.3	61.3	65.2	95.8	93.3	100.0	100.0	–	–
	(1.0)	(1.0)	(1.1)	(1.0)	(1.4)	(1.2)	(1.9)	(2.3)	(3.3)	(3.0)	–	–
1994	50.0	–	14.9	28.9	62.2	80.2	91.9	96.0	–	100.0	–	–
	(1.0)	–	(1.2)	(1.0)	(1.6)	(1.6)	(2.1)	(2.3)	–	(3.5)	–	–
1995	21.7	–	41.9	17.9	70.8	83.8	100.0	100.0	–	100.0	–	–
	(1.0)	–	(1.2)	(1.0)	(1.7)	(1.7)	(2.8)	(2.2)	–	(3.8)	–	–
1996	26.7	–	24.4	20.0	63.3	76.5	86.4	100.0	100.0	100.0	100.0	–
	(1.0)	–	(1.1)	(1.0)	(1.1)	(1.4)	(2.1)	(2.2)	(3.0)	(3.9)	(5.0)	–
1997	8.3	–	7.7	9.7	59.1	71.1	100.0	90.0	–	100.0	–	–
	(1.0)	–	(1.2)	(1.1)	(1.5)	(1.5	(2.3)	(2.2)	–	(3.5)	–	–
1998	17.4	–	11.1	7.5	63.6	60.0	100.0	100.0	100.0	–	–	–
	(1.0)	–	(1.0)	(1.0)	(1.0)	(1.4)	(1.0)	(2.6)	(3.3)	–	–	–
1999	11.1	2.6	18.8	15.3	77.4	86.4	100.0	100.0	–	–	–	100.0
	(1.0)	(1.0)	(1.2)	(1.0)	(1.3)	(1.2)	(2.0)	(2.5)	–	–	–	(5.0)
2000	6.7	0.0	15.1	3.6	28.6	75.0	100.0	100.0	–	100.0	–	–
	(1.0)	(0.0)	(1.5)	(1.0)	(1.0)	(1.1)	(1.7)	(2.0)	–	(3.0)	–	–
2001	4.8	3.8	5.3	11.6	62.5	78.9	100.0	100.0	–	100.0	–	–
	(1.0)	(1.0)	(1.0)	(1.0)	(1.1)	(1.3)	(2.0)	(2.0)	–	(2.5)	–	–
2002	33.3	12.5	–	15.2	50.0	71.4	–	100.0	–	–	–	–
	(1.0)	(1.0)	–	(1.0)	(1.3)	(1.0)	–	(2.0)	–	–	–	–
2003	19.0	–	5.2	9.2	33.3	57.9	100.0	100.0	–	–	–	–
	(1.0)	–	(1.5)	(1.0)	(1.3)	(1.1)	(2.2)	(2.0)	–	–	–	–
2004	16.0	–	23.0	12.5	65.5	75.0	100.0	90.0	–	100.0	–	–
	(1.0)	–	(1.1)	(1.0)	(1.4)	(1.6)	(2.0)	(2.6)	–	(4.0)	–	–
2005	25.0	–	11.5	27.6	27.3	36.7	50.0	40.0	–	100.0	–	100.0
	(1.0)	–	(1.1)	(1.1)	(1.2)	(1.3)	(1.3)	(1.5)	–	(2.0)	–	(2.0)
2006	52.0	–	4.4	6.7	18.2	22.9	37.5	71.4	25.0	66.7	100.0	–
	(1.0)	–	(1.5)	(1.3)	(1.0)	(1.0)	(1.7)	(1.6)	(1.0)	(2.0)	(2.7)	–
2007	22.2	3.4	15.5	23.4	36.7	48.7	77.8	100.0	–	–	–	–
	(1.0)	(1.0)	(1.2)	(1.1)	(1.4)	(1.4)	(1.7)	(1.3)	–	–	–	–
Average	23.5	5.2	16.7	14.0	50.3	63.8	89.0	92.2	87.5	97.2	100.0	100.0
	(1.0)	(1.0)	(1.2)	(1.0)	(1.3)	(1.3)	(1.9)	(2.1)	(3.0)	(3.1)	(4.1)	(3.9)

Table 18.–Number and percent (%) of brown trout by age and sex, harvested at the Little Manistee River weir, 1991–2007. This table is based on the biosample and includes known-sex fish only. Unsexed biosampled fish were left out of the total. The total, sexes combined may be less than the actual number of fish harvested each year because of this. Total harvest numbers of age 1.0, 2.0, 3.0, 4.0, 2.2, 1.3, 2.3, and 1.4 fish were not included since these age categories were represented by fewer than 10 fish. Fish of known sex, but unknown age are generally fish where the stream age was unreadable.

Harvest year	Age (years in stream.years in lake)							
	1.1		1.2		2.1		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
1991	12 (12.3)	39 (38.8)	10 (10.0)	13 (13.3)	7 (6.6)	19 (18.9)	29 (28.9)	72 (71.1)
1992	16 (24.6)	10 (15.1)	7 (11.3)	7 (11.3)	8 (12.1)	16 (25.7)	30 (48.0)	33 (52.0)
1993*	29 (29.7)	38 (39.4)	9 (9.5)	7 (7.5)	7 (7.5)	6 (6.4)	45 (46.7)	52 (53.3)
1994	35 (32.2)	44 (40.9)	16 (15.1)	13 (11.8)	0 (0.0)	0 (0.0)	51 (47.2)	57 (52.8)
1995	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
1996*	0 (0.0)	0 (0.0)	27 (67.0)	13 (33.0)	0 (0.0)	0 (0.0)	27 (67.0)	13 (33.0)
1997	9 (10.5)	43 (51.1)	12 (14.6)	20 (23.8)	0 (0.0)	0 (0.0)	21 (25.1)	63 (74.9)
1998	0 (0.0)	0 (0.0)	3 (27.0)	9 (73.0)	0 (0.0)	0 (0.0)	3 (27.0)	9 (73.0)
1999	6 (18.6)	12 (34.5)	5 (15.5)	11 (31.4)	0 (0.0)	0 (0.0)	12 (34.1)	23 (65.9)
2000	21 (34.0)	42 (66.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	21 (34.0)	42 (66.0)
2001	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (42.0)	10 (58.0)	7 (42.0)	10 (58.0)
2002	10 (40.0)	15 (60.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	10 (40.0)	15 (60.0)
2003	8 (23.3)	7 (19.0)	9 (26.0)	12 (31.7)	0 (0.0)	0 (0.0)	18 (49.2)	18 (50.8)
2004	9 (14.5)	29 (45.9)	11 (17.4)	14 (22.2)	0 (0.0)	0 (0.0)	20 (31.9)	43 (68.1)
2005	12 (50.0)	12 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	12 (50.0)	12 (50.0)
2006	9 (36.0)	15 (64.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	9 (36.0)	15 (64.0)
2007	9 (28.0)	24 (72.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	9 (28.0)	24 (72.0)
Total	187 (22.5)	331 (39.9)	111 (13.4)	120 (14.5)	29 (3.5)	51 (6.2)	326 (39.4)	502 (60.6)

Table 19.–Mean total length (inches) and weight (pounds), by age and sex of brown trout harvested at the Little Manistee River weir, fall 1991–2007. Data is from fish collected at the weir and scale ages (N equals sample size) and missing data are represented by "–".

	Age 1.1								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	11	22.63 ± 2.15	5.19 ± 1.57	35	21.55 ± 2.32	4.60 ± 1.46	46	22.09 ± 2.24	4.89 ± 1.51
1992	13	23.07 ± 2.42	5.57 ± 1.61	8	20.89 ± 2.01	4.25 ± 1.60	21	21.98 ± 2.21	4.91 ± 1.61
1993	28	21.99 ± 2.13	4.88 ± 1.52	37	20.56 ± 2.03	3.91 ± 1.14	65	21.27 ± 2.08	4.40 ± 1.33
1994	30	22.85 ± 1.35	5.14 ± 1.07	38	21.25 ± 1.67	4.25 ± 1.03	68	22.05 ± 1.51	4.69 ± 1.05
1995	6	22.33 ± 1.25	4.77 ± 0.95	1	21.40 ± NA	4.10 ± NA	7	21.87 ± 1.25	4.43 ± 0.95
1996	2	21.45 ± 1.63	4.40 ± 0.85	8	20.86 ± 1.01	4.16 ± 1.09	10	21.16 ± 1.32	4.28 ± 0.97
1997	8	17.78 ± 3.54	2.53 ± 1.60	40	20.67 ± 1.37	3.87 ± 0.86	48	19.22 ± 2.45	3.20 ± 1.23
1998	1	17.90 ± NA	2.00 ± NA	4	22.18 ± 4.67	5.35 ± 3.50	5	20.04 ± 4.67	3.67 ± 3.50
1999	6	23.17 ± 3.11	4.75 ± 1.85	11	24.22 ± 1.93	5.16 ± 1.31	17	23.69 ± 2.52	4.96 ± 1.58
2000	10	22.47 ± 1.86	5.29 ± 1.67	19	22.48 ± 1.07	4.89 ± 1.18	29	22.47 ± 1.46	5.09 ± 1.42
2001	4	21.07 ± 2.63	4.15 ± 1.69	5	24.52 ± 1.74	7.20 ± 2.06	9	22.80 ± 2.19	5.67 ± 1.87
2002	8	21.47 ± 2.10	4.42 ± 1.47	12	22.48 ± 1.45	4.90 ± 0.86	20	21.98 ± 1.77	4.66 ± 1.16
2003	6	20.97 ± 5.29	4.50 ± 3.15	5	18.38 ± 3.94	2.82 ± 1.98	11	19.67 ± 4.62	3.66 ± 2.56
2004	6	21.20 ± 3.19	3.78 ± 1.73	19	20.64 ± 3.52	4.27 ± 1.80	25	20.92 ± 3.36	4.03 ± 1.76
2005	8	21.53 ± 3.74	4.45 ± 2.71	8	21.22 ± 1.43	4.33 ± 1.14	16	21.38 ± 2.59	4.39 ± 1.93
2006	4	17.13 ± 4.27	2.28 ± 1.79	7	18.89 ± 3.12	3.06 ± 1.74	11	18.01 ± 3.69	2.67 ± 1.76
2007	7	19.86 ± 2.61	3.11 ± 1.49	18	20.82 ± 3.77	3.65 ± 1.96	25	20.34 ± 3.19	3.38 ± 1.73
Avg.	158	21.11 ± 2.70	4.19 ± 1.67	275	21.35 ± 2.31	4.40 ± 1.54	433	21.23 ± 2.51	4.29 ± 1.61

Table 19.–Extended.

	Age 1.2								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	9	25.52 ± 1.63	7.59 ± 1.99	12	25.11 ± 1.97	7.31 ± 2.30	21	25.32 ± 1.80	7.45 ± 2.14
1992	6	25.20 ± 2.52	8.32 ± 2.60	6	23.52 ± 2.05	6.48 ± 2.38	12	24.36 ± 2.28	7.40 ± 2.49
1993	9	23.86 ± 1.25	6.50 ± 1.12	7	23.57 ± 3.23	6.16 ± 2.77	16	23.71 ± 2.24	6.33 ± 1.95
1994	14	23.84 ± 1.41	6.26 ± 0.84	11	22.26 ± 2.43	5.36 ± 2.02	25	23.05 ± 1.92	5.81 ± 1.43
1995	6	24.20 ± 1.53	5.72 ± 1.03	4	23.62 ± 1.59	5.55 ± 2.02	10	23.91 ± 1.56	5.63 ± 1.52
1996	10	23.61 ± 1.88	6.26 ± 1.40	5	24.78 ± 1.48	6.38 ± 1.25	15	24.20 ± 1.68	6.32 ± 1.33
1997	11	22.06 ± 2.27	4.95 ± 1.46	18	22.08 ± 2.30	5.05 ± 1.89	29	22.07 ± 2.29	5.00 ± 1.68
1998	3	23.27 ± 3.46	4.37 ± 2.38	8	25.01 ± 1.21	6.91 ± 1.11	11	24.14 ± 2.33	5.64 ± 1.74
1999	5	24.40 ± 0.82	7.24 ± 2.01	10	24.56 ± 0.71	6.13 ± 0.84	15	24.48 ± 0.77	6.69 ± 1.42
2000	2	25.05 ± 1.20	7.05 ± 0.07	3	26.33 ± 3.88	8.20 ± 4.59	5	25.69 ± 2.54	7.62 ± 2.33
2001	2	28.45 ± 5.73	10.30 ± 4.24	1	24.50 ± NA	7.10 ± NA	3	26.47 ± 5.73	8.70 ± 4.24
2002	0	–	–	2	24.75 ± 0.92	7.20 ± 0.57	2	24.75 ± 0.92	7.20 ± 0.57
2003	5	23.50 ± 2.33	5.72 ± 1.68	6	22.90 ± 4.60	5.72 ± 2.48	11	23.20 ± 3.46	5.72 ± 2.08
2004	8	24.09 ± 2.73	6.35 ± 2.18	10	22.95 ± 5.22	6.39 ± 4.49	18	23.52 ± 3.97	6.37 ± 3.34
2005	0	–	–	2	25.80 ± 4.24	3.95 ± 1.77	2	25.80 ± 4.24	3.95 ± 1.77
2006	1	15.90 ± NA	1.50 ± NA	5	23.16 ± 2.31	5.40 ± 1.50	6	19.53 ± 2.31	3.45 ± 1.50
2007	5	22.52 ± 3.75	5.00 ± 2.59	2	20.90 ± 1.84	3.60 ± 1.27	7	21.71 ± 2.80	4.30 ± 1.93
Avg.	96	23.70 ± 2.32	6.21 ± 1.83	112	23.87 ± 2.50	6.05 ± 2.08	208	23.79 ± 2.42	6.13 ± 1.96

Table 19.–Extended.

	Age 2.1								
	Male			Female			Sexes combined		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1991	6	21.88 ± 0.95	4.50 ± 0.74	17	23.05 ± 1.48	5.40 ± 1.57	23	22.47 ± 1.21	4.95 ± 1.15
1992	6	24.33 ± 2.31	6.38 ± 2.82	13	21.92 ± 1.45	4.87 ± 1.32	19	23.12 ± 1.88	5.63 ± 2.07
1993	7	22.76 ± 1.10	4.37 ± 0.80	6	20.50 ± 1.98	3.88 ± 1.01	13	21.63 ± 1.54	4.13 ± 0.91
1994	0	–	–	5	21.40 ± 1.28	4.30 ± 0.48	5	21.40 ± 1.28	4.30 ± 0.48
1995	1	23.40 ± NA	5.20 ± NA	4	23.57 ± 1.74	4.95 ± 0.90	5	23.49 ± 1.74	5.07 ± 0.90
1996	1	22.80 ± NA	4.40 ± NA	9	22.17 ± 1.06	4.61 ± 0.83	10	22.48 ± 1.06	4.51 ± 0.83
1997	0	–	–	0	–	–	0	–	–
1998	0	–	–	0	–	–	0	–	–
1999	0	–	–	0	–	–	0	–	–
2000	0	–	–	0	–	–	0	–	–
2001	5	22.36 ± 3.62	4.60 ± 2.33	7	23.49 ± 3.32	5.99 ± 3.25	12	22.92 ± 3.47	5.29 ± 2.79
2002	0	–	–	0	–	–	0	–	–
2003	0	–	–	1	24.10 ± NA	6.90 ± NA	1	24.10 ± NA	6.90 ± NA
2004	0	–	–	1	23.20 ± NA	5.00 ± NA	1	23.20 ± NA	5.00 ± NA
2005	0	–	–	0	–	–	0	–	–
2006	0	–	–	0	–	–	0	–	–
2007	0	–	–	0	–	–	0	–	–
Avg.	26	22.92 ± 1.99	4.91 ± 1.67	63	22.60 ± 1.76	5.10 ± 1.34	89	22.73 ± 1.84	5.02 ± 1.46

Table 20–Average weight of female Chinook and coho salmon before and after eggs were removed to establish the proportion of the total mass which could be accounted for by eggs. This evaluation occurred during the fall of 1991 and 1992 and 25 females were sampled weekly.

Species and date	Length (in.)	Total weight (lbs.)	Fish without eggs (lbs.)	Eggs only (lbs.)	Percent (%) egg mass
Chinook salmon					
1991					
10/01	34.95	16.48	13.14	3.34	20.22
10/08	35.38	18.03	13.44	4.59	24.94
10/14	33.22	14.05	11.20	2.85	20.12
1992					
10/01	34.29	16.26	12.78	3.48	21.38
10/08	34.85	17.40	13.46	3.94	22.64
10/12	34.26	16.19	12.70	3.49	21.84
Average	34.49	16.40	12.79	3.62	21.86
Coho salmon					
1992					
10/09	26.80	6.68	5.24	1.44	21.54
10/20	26.32	6.47	5.34	1.13	17.19
Average	26.56	6.57	5.29	1.28	19.36

Table 21.–Number and percent (%) of fin clipped Chinook salmon returning to the Little Manistee River weir annually in the fall from 1991 to 2007. Table results are from biological samples, and do not include information collected during 1993 and 1994 for FELISA sampling. AD=adipose fin, RP=right pectoral fin, LP=left pectoral fin, RV=right ventral fin, LV=left ventral fin, BV=both ventral fins, D=dorsal fin, and NC=no clip.

	Fin clip									
Year	AD	ADRP	ADRV	BV	D	LP	LV	RP	RV	NC
1991	539	1	0	1	1	1	2	4	288	2,558
	(15.9)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.1)	(8.5)	(75.3)
1992	476	0	2	0	0	1	0	0	289	1,741
	(19.0)	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(11.5)	(69.4)
1993	896	0	0	0	0	0	0	0	257	1,263
	(37.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(10.6)	(52.3)
1994	968	0	3	0	0	0	2	0	167	1,416
	(37.9)	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)	(0.1)	(0.0)	(6.6)	(55.4)
1995	588	0	0	0	0	0	0	0	7	1,650
	(26.2)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.3)	(73.5)
1996	240	0	0	0	0	0	0	0	0	1,847
	(11.5)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(88.5)
1997	162	0	0	0	0	0	0	0	0	2,132
	(7.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(92.9)
1998	2	0	0	0	0	0	0	0	0	949
	(0.2)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(99.8)
1999	0	0	0	0	0	0	0	0	0	2,105
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)
2000	0	0	0	0	0	0	0	0	0	1,907
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)
2001	39	0	0	0	0	0	0	0	0	2,731
	(1.4)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(98.6)
2002	165	0	0	0	0	0	0	0	0	2,641
	(5.9)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(94.1)
2003	385	0	0	0	0	0	0	1	0	1,783
	(17.8)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.0)	(82.2)
2004	541	0	0	0	0	0	0	0	0	1,828
	(22.8)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(77.2)
2005	372	0	0	0	0	0	0	0	0	1,278
	(22.5)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(77.5)
2006	515	0	0	0	0	0	0	0	0	1,383
	(27.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(72.9)
2007	309	0	0	0	0	0	0	0	0	1368
	(18.4)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(81.6)
10 yr avg	226	0	0	0	0	0	0	0	0	1,828
	(11.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(89.0)

Table 22.–Results from FELISA testing of coded-wire tagged New York verses Michigan strain Chinook salmon. The number tested and percentages (%) in parentheses of fish testing positive or negative for bacterial kidney disease (BKD).

	New York strain		Michigan strain	
Year-class	Positive	Negative	Positive	Negative
1990	6 (11)	51 (89)	26 (12)	189 (88)
1991	8 (24)	26 (76)	10 (15)	55 (85)

Table 23.–Number and percent (%) of fin-clipped steelhead returning to the Little Manistee River weir in the fall annually from 1991 to 2006. Table results are from biological samples. AD=adipose fin, RP=right pectoral fin, LP=left pectoral fin, RV=right ventral fin, LV=left ventral fin, BV=both ventral fins, RM=right maxillary clip, LM=left maxillary clip, BM=both maxillaries clipped, D=dorsal fin, NC=no clip, and OTHER=combination of clips representing <0.05%.

	Fin clip																	
Year	AD	ADD	ADRM	ADRP	BM	D	DLP	DLV	DRP	LM	LP	LV	RM	RP	RV	RVLP	OTHER	NC
1991	8 (0.4)	15 (0.7)	0 (0.0)	1 (0.0)	0 (0.0)	1 (0.0)	1 (0.0)	0 (0.0)	0 (0.0)	15 (0.7)	4 (0.2)	0 (0.0)	8 (0.4)	1 (0.0)	1 (0.0)	0 (0.0)	2 (0.1)	2118 (97.4)
1992	1 (0.2)	3 (0.6)	1 (0.2)	0 (0.0)	0 (0.0)	3 (0.6)	0 (0.0)	0 (0.0)	1 (0.2)	8 (1.7)	1 (0.2)	0 (0.0)	8 (1.7)	1 (0.2)	0 (0.0)	0 (0.0)	1 (0.2)	443 (94.1)
1993	3 (0.7)	1 (0.2)	0 (0.0)	2 (0.5)	1 (0.2)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	5 (1.2)	1 (0.2)	0 (0.0)	3 (0.7)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	416 (95.9)
1994	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	11 (2.2)	0 (0.0)	0 (0.0)	7 (1.4)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	490 (96.3)
1995	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.3)	0 (0.0)	0 (0.0)	1 (0.4)	2 (0.9)	1 (0.4)	0 (0.0)	3 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	220 (95.7)
1996	0 (0.0)	0 (0.0)	1 (0.2)	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.5)	0 (0.0)	0 (0.0)	5 (1.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	408 (97.8)
1997	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.6)	0 (0.0)	0 (0.0)	4 (1.2)	5 (1.5)	1 (0.3)	0 (0.0)	0 (0.0)	323 (96.1)
1998	4 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	18 (2.3)	1 (0.1)	0 (0.0)	13 (1.7)	2 (0.3)	1 (0.1)	0 (0.0)	0 (0.0)	745 (95.0)
1999	2 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	5 (0.8)	0 (0.0)	0 (0.0)	5 (0.8)	4 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	578 (97.3)
2000	1 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)	0 (0.0)	0 (0.0)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	271 (98.2)
2001	6 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	54 (2.4)	1 (0.0)	0 (0.0)	43 (1.9)	7 (0.3)	0 (0.0)	0 (0.0)	1 (0.0)	2113 (95.0)
2002	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	1 (0.9)	2 (1.9)	0 (0.0)	101 (95.3)

Table 23.–Continued.

Year	Fin clip																	
	AD	ADD	ADRM	ADRP	BM	D	DLP	DLV	DRP	LM	LP	LV	RM	RP	RV	RVLP	OTHER	NC
2003	1 (0.4)	0 (0.0)	1 (0.4)	0 (0.0)	0 (0.0)	1 (0.4)	0 (0.0)	2 (0.7)	0 (0.0)	1 (0.4)	0 (0.0)	1 (0.4)	0 (0.0)	1 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	261 (97.0)
2004	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	4 (1.1)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	3 (0.8)	360 (97.0)
2005	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	292 (97.3)
2006	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	2 (0.6)	0 (0.0)	0 (0.0)	1 (0.3)	321 (98.5)
2007	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	300 (99.7)
Total	29 (0.3)	19 (0.2)	3 (0.0)	5 (0.0)	2 (0.0)	10 (0.1)	2 (0.0)	6 (0.1)	3 (0.0)	126 (1.2)	11 (0.1)	2 (0.0)	102 (1.0)	30 (0.3)	4 (0.0)	2 (0.0)	8 (0.1)	9,760 (96.4)

References

Bartron, M. L., and Scribner, K. T. 2004. Temporal comparisons of genetic diversity in Lake Michigan steelhead, *Oncorhynchus mykiss*, populations: effects of hatchery supplementation. Environmental Biology of Fishes 69:395-407.

Clevenger, J. A., Jr. 2007. Summary of the Chinook and coho salmon harvest from Michigan weirs on tributaries of lakes Michigan and Huron, 2007. Michigan Department of Natural Resources, Fisheries Division unpublished report, 2007.

Cone, R. S. 1989. The need to reconsider the use of condition indices in fishery science. Transactions of the American Fisheries Society 118:510-514.

Fielder, D. G. 1987. An assessment of the introduction of summer steelhead into Michigan. Michigan Department of Natural Resources, Fisheries Research Report 1948, Ann Arbor.

Hay, R. L. 1992. Little Manistee River harvest weir and chinook salmon egg-take report, 1990. Michigan Department of Natural Resources, Fisheries Technical Report 92-5, Ann Arbor.

Holey, M. E., R. F. Elliot, S. V. Marquenski, J. G. Hnath, and K. D. Smith. 1998. Chinook salmon epizootics in Lake Michigan: Possible contributing factors and management implications. Journal of Aquatic Animal Health 10(2):202-210.

Keller, M., K. D. Smith, and R. W. Rybicki. 1989. Summary of salmon and trout management in Lake Michigan 89-1, Michigan Department of Natural Resources, Fisheries Technical Report 89-1, Ann Arbor.

Keller, M., K. D. Smith, and R. W. Rybicki. 1990. Review of salmon and trout management in Lake Michigan. Michigan Department of Natural Resources, Fisheries Special Report 14, Ann Arbor.

Modeling Subcommittee, Technical Fisheries Committee. 2009. Technical Fisheries Committee Administrative Report 2008: Status of Lake Trout and Lake Whitefish Populations in the 1836 Treaty-Ceded Waters of Lakes Superior, Huron and Michigan in 2007, with recommended yield and effort levels for 2008. http://www.michigan.gov/documents/dnr/2008-status-report_288026_7.pdf.

Rand, P. S., D. J. Stewart, P. W. Seelbach, M. L. Jones, and L. R. Wedge. 1993. Modeling steelhead population energetics in Lakes Michigan and Ontario. Transactions of the American Fisheries Society 122:977-1001.

Seelbach, P. W. 1985. Smolt migration of wild and hatchery-raised coho and Chinook salmon in a tributary of northern Lake Michigan. Michigan Department of Natural Resources, Fisheries Research Report 1935, Ann Arbor.

Seelbach, P. W., and G. E. Whelan. 1988. Identification and contribution of wild and hatchery steelhead stocks in Lake Michigan tributaries. Michigan Department of Natural Resources Fisheries Research Report 1950, Ann Arbor.

Tonello, M. A. 2005. Little Manistee River, Michigan Department of Natural Resources, Status of the Fishery Resource Report 2005-08, Ann Arbor.

Wisconsin Department of Natural Resources. 2006. Wisconsin Lake Michigan fin clip summary 1995-2005 marked fish only. Wisconsin Department of Natural Resources, PUB-FH-831, Milwaukee.

Withler, R. E., and T. P. T. Evelyn. 1990. Genetic variation in resistance to bacterial kidney disease within and between two strains of coho salmon from British Columbia. Transactions of the American Fisheries Society 119:1003-1009.

Woldt, A. P. 1998. Production of juvenile steelhead in two northern Lake Michigan tributaries. Master's thesis. University of Michigan, Ann Arbor.

Mark A.Tonello, Reviewer
Robert C. Haas, Editor
Alan D. Sutton, Graphics
Ellen S. Grove, Desktop Publisher

Approved by Gary E. Whelan