Little Manistee River

Lake County, T20N, R14W, Sec. 24, 25 and T19N, R13W, Sec. 5 and T20N, R14W, Sec.
Surveyed August, 2002; August, 2003; and August, 2004

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Environment

The Little Manistee River watershed drains 145,280 acres in Lake, Mason, and Manistee counties (Wicklund and Dean 1957; Figure 1). The Little Manistee River originates from several swamps in eastern Lake County about eight miles east of the Village of Luther. Below Luther Dam it flows northwest through most of Lake County, the very northeast tip of Mason County, and then southwestern Manistee County (Figure 2). Below the Luther Dam, the Little Manistee River is free-flowing for 55 miles before entering Manistee Lake in the Village of Stronach. Manistee Lake empties into Lake Michigan through a channel in the town of Manistee.

The majority of the Little Manistee River watershed is forested with northern hardwoods and conifers. Soils consist mostly of deep, permeable sand, although there are a few areas with loamy soils and some with wet soils. Several large wetland complexes exist in the watershed; one of note is the Baylor Swamp from which both branches of Twin Creek flow. Much of the river between Luther and M-37 flows through lowland conifer and tag-alder swamp.

Land use in the watershed is primarily forest and rural residential. Upstream of M-37, about half of the land through which the river flows is public, owned by the state of Michigan as part of the Pere Marquette State Forest. There is more public land below M-37. Overall, 53.2% of the land in the Little Manistee River watershed is owned by either the State of Michigan as part of the Pere Marquette State Forest or by the United States Forest Service (USFS) as part of the Manistee National Forest (USDA Forest Service 2001). The USFS maintains three rustic campgrounds within the watershed (Old Grade, Driftwood Valley, and Bear Track) and the Michigan Department of Natural Resources (MDNR) maintains one rustic campground at Carrieville. The only two municipalities that the Little Manistee River flows through are the villages of Luther and Stronach (Figure 1), and the only significant agricultural land in the watershed is in the Cool Creek subwatershed and the headwaters area upstream from Luther. The USFS lists the Little Manistee River as a candidate river for national wild and scenic designation (USDA Forest Service 2001). Therefore, Manistee National Forest lands within 1/4 mile of the river are currently managed in accordance with national wild and scenic designation.

Due to the sandy geology of the watershed, the Little Manistee River is primarily a groundwater-fed system. Groundwater-fed streams with forested, relatively undeveloped watersheds are cooler and have much more stable flow regimes than those in agricultural or urban areas. This is why the Little Manistee River is among the coldest, most stable streams in Michigan. Two areas of the Little Manistee River in particular receive large amounts of groundwater. The first is the area between Spencer's Bridge and DeWitt's Bridge where the river passes through a large moraine (an accumulation of earth and stones carried and deposited by a glacier), which adds significant groundwater flow. The second area of the Little Manistee River that receives large amounts of groundwater is in the 6-Mile to

9-Mile reach. Here the river flows at the base of another large moraine locally known as the Udell Hills. These high hills act as "water towers", forcing groundwater into the Little Manistee River.

There are relatively few tributaries to the Little Manistee River, particularly in the lower two-thirds of the watershed. The Little Manistee River is fed by several small unnamed tributaries and Manistee Creek before reaching Luther. Between Luther and M-37, the Little Manistee River is fed by tributaries including Lincoln Creek, Fairbanks Creek, Little Widewaters Creek, Twin Creek, and Syers Creek (which actually joins the Little Manistee River just below M-37). Between M-37 and Manistee Lake, only a few tributaries flow into the Little Manistee. Butterfly Creek enters several miles below M-37, and Cool Creek comes in about midway between M-37 and Manistee Lake. The two largest tributaries to the Little Manistee River are Twin Creek and Cool Creek (Figure 2). Twin Creek is significant in that it hosts substantial natural reproduction of steelhead and brown trout (Tonello, 2003). Cool Creek does hold some trout, but is warmer than Twin Creek and has smaller trout populations (Tonello, 2003). All named Little Manistee tributaries are Designated Trout Streams. Designated Trout Streams are those that have (or had at one time) a documented trout population.

There are two permanent dams on the mainstem of the Little Manistee River, both of which are quite far upstream. The first creates a small, private, in-line pond located about four miles upstream of Luther at the westernmost One Road crossing. The other is a larger dam located in the Village of Luther (Figure 2). The Luther Dam was originally constructed in 1880 to establish a sawmill pond (Bullen 1974) and now creates a small impoundment (8 acres or so). It was later remodeled and operated as a gristmill facility, and then again as a power-generating facility (apparently, it was even operated as a peaking facility back in the 1930's). Although hydropower operations ended some time ago, the Village of Luther continued to maintain the dam. In September of 1986, the dam failed, releasing a torrent of sediment downstream. Although the MDNR opposed reconstruction of the dam due to water quality issues, the Michigan legislature passed legislation allowing it to be rebuilt. Unfortunately, the dam failed again as the impoundment was being refilled in May of 1993, and another huge slug of sediment was released downstream. The MDNR again opposed reconstruction of the dam, but it was again allowed to be rebuilt due to the previous legislation. The dam was reconstructed with a bottom draw in an attempt to keep downstream temperatures cool, but it does not provide fish passage. The legislation that allowed the dam to be rebuilt was later found to be unconstitutional, but by that time the dam had been rebuilt for the second time. The only other dam on the mainstem of the Little Manistee River is at the Little Manistee weir, which is operated seasonally by the MDNR Fisheries Division (Figure 2).

History

Native fish community and stocking

Although there are few records of the original fish community of the Little Manistee River, the Arctic grayling was likely the only native salmonid inhabitant of the river. It was sometime in the late 1880's or early 1890's that the Arctic grayling disappeared from the Little Manistee River. No one knows exactly when or why they disappeared, but it was likely from competition with introduced brook, brown, and rainbow trout (steelhead), although overharvest and habitat damage from log drives may have also played a part. Mershon (1923) recollects that in the mid-1880s (exact dates are not clear) that there were no trout in the river, just Arctic grayling. He reports that he and his friends had

phenomenal fishing for the Arctic grayling "in quantity that now would be shocking". However, he also recollects that within a few years, the Arctic grayling were all gone, having been replaced by brook trout. Although brook trout are native to other parts of Michigan, they were not native to the Little Manistee River. While the first known stocking of brook trout in the Little Manistee River occurred in 1897, it is possible that some had been privately stocked earlier by the first white settlers in the area.

The first recorded fish stocking in the Little Manistee River was in 1873 when 3,000 Atlantic salmon fry were stocked (Table 1). The plant was not successful, as there are no known records of any returning adult Atlantic salmon. Steelhead were first stocked in the watershed in 1895 (Table 1), when 5,000 fry were planted in at least one tributary to the Little Manistee River (exactly which tributary or tributaries is unknown). Steelhead had been stocked in other Lake Michigan tributaries starting in 1880, and adults were already returning to rivers like the Muskegon and Pere Marquette by 1886 (MacCrimmon and Gots 1972). Therefore, it is possible that steelhead had already established themselves in the Little Manistee River through straying and subsequent natural reproduction. Similarly, no early stocking records for brown trout in the Little Manistee River could be found, although they were surely stocked sometime before the turn of the century. Although records are not entirely clear, cutthroat trout may have also been stocked into the Little Manistee River in 1895. If they were stocked, they did not survive. Certainly, by the turn of the century brook trout, steelhead, and brown trout had all become naturalized residents of the Little Manistee River, and the Arctic grayling were gone.

Unfortunately, fish stocking records for the first part of the 20th century were destroyed in a fire. The remaining records start in the mid-1930's. From the mid-1930's through the mid-1960's, the Michigan Department of Conservation (MDOC, the precursor to today's MDNR) stocking program for the Little Manistee River consisted of brown, brook, and rainbow trout plants aimed at creating or enhancing fishing for resident trout (Table 1). That strategy changed dramatically in 1967, when the first coho and Chinook salmon were stocked into the Little Manistee River. Since that time, very few "resident" trout have been stocked. Hatchery-raised steelhead were stocked in the early 1980's as part of a research study (Seelbach, 1985a), and most came from eggs taken at the Little Manistee weir. The only occasion where steelhead other than Little Manistee strain were stocked was in 1984, when three different summer run strains were planted (Table 1). The majority of the stocking effort for the Little Manistee River since 1967 has focused on Pacific salmon. Coho and Chinook salmon were stocked in most years from 1967 through 1992. Coho salmon have not been stocked since 1992, but large numbers of Chinook salmon continue to be stocked annually. Through the 1990's, Chinook salmon stocking numbers ranged from 681,000 to 878,000. However, in 1999, stocking numbers were reduced because of concerns regarding the forage base in Lake Michigan. Since then, nearly 500,000 have been stocked annually, except for 2003, when close to 600,000 were stocked. Sebago-strain Atlantic salmon were stocked into the Little Manistee River in 1982, but as with the 1873 plant, no returning adults were ever noted.

Little Manistee weir operation

The Little Manistee weir has been seasonally operated each year since 1968. The dam boards and weir grates are installed in the early spring (usually early to mid-March) for two purposes. The first is to

direct migrating steelhead into the facility for egg-take purposes (since 1968, adult Little Manistee River steelhead have been the primary broodstock for most steelhead stocked in Michigan). The second reason for spring installation of the dam boards is to block migrations of spawning sea lamprey, an exotic parasite that preys on large fish in the Great Lakes. In the mid-1900's, sea lampreys were responsible for decimating lake trout, whitefish, and steelhead populations in Lake Michigan. Aggressive chemical control, along with blocking access to spawning grounds, has reduced sea lamprey populations to lower, more manageable levels. The dam boards at the weir are typically left in place until mid-July, although the weir grates are removed as soon as the quota of steelhead eggs has been reached. This allows jumping fish like salmon and steelhead to proceed upstream after they navigate the dam boards. Both the dam boards and the weir grates are then re-installed in mid-August, this time to steer fall migrations of Chinook salmon into the facility for egg-take and harvest purposes. The dam boards and weir grates are then removed in mid-November.

The Little Manistee weir is open to the public during Chinook salmon and steelhead egg takes, and is heavily visited by anglers and other interested persons. During Chinook salmon egg take, many school groups are given tours of the facility by MDNR personnel. The children get a close up view of weir personnel taking and fertilizing the eggs and performing autopsies on Chinook salmon. Weir personnel also answer questions about the operation and discuss natural resources career options with older students. All Chinook salmon entering the weir are harvested by a private company under contract with the state of Michigan. Chinook salmon numbers harvested at the Little Manistee weir since 1968 have ranged from 7,170 in 1998 to 39,359 in 1983 (Table 5). In most years since the late 1980's, the harvest has been between 10,000 and 20,000 fish. The Little Manistee weir is one of only two Chinook egg-take stations in Michigan; the other is at the Swan River near Rogers City, on Lake Huron. Chinook salmon eggs from the Little Manistee weir are also raised and stocked into Lake Michigan by Indiana and Illinois.

The Little Manistee River also hosts natural reproduction of Chinook salmon. Seelbach (1985b) estimated the number of wild Chinook salmon smolts leaving the river for three years from 1982-1984. His estimates ranged from 25,980 to 120,331 individuals (Table 13). Woldt and Rutherford (University of Michigan, unpublished data) estimated the number of wild Chinook salmon smolts outmigrating from 1996-1998. Their estimates ranged from 59,876 to 128,774 individuals per year (Table 6).

The Little Manistee River summer Chinook salmon run seems to be a relatively new phenomenon. In recent years, large numbers of Chinook salmon have ascended the Little Manistee River all summer long, starting in early June. The size of the run hasn't been estimated because the weir is not in operation during the summer, but it likely numbers in the thousands. Angler reports from those fishing during the summer run have been extremely positive (J. Thomas and M. Galus, MDNR Fisheries Division, personal communication), and the consensus among anglers and biologists is that the run continues to build each year. Although it has not been extensively studied, biologists hypothesize that the summer Chinook salmon run is likely a response to the weir operation and that adult wild Chinook salmon are now entering the river earlier than their hatchery counterparts in an attempt to access the river (before the weir is put into operation on August 15th) to reproduce. This phenomenon is possible because of the water temperatures found in the Little Manistee River, which are cold enough to sustain the adult Chinook salmon until they spawn in the fall.

As with Chinook salmon, all coho salmon captured at the Little Manistee weir are harvested and marketed by a private company under contract with the state of Michigan. Coho salmon returns to the Little Manistee weir have greatly decreased over the last ten years or so (Table 5), as coho salmon stocking was ceased in the Little Manistee River in 1992. However, the Little Manistee River does host some natural reproduction of coho salmon. Seelbach (1985b) estimated the number of coho smolts leaving the river for three years, from 1982-1984. His estimates ranged from 9,272 to 37,192 individuals (Table 6). Woldt and Rutherford (University of Michigan, unpublished data) estimated the number of wild coho salmon smolts outmigrating from 1996-1998, and their estimates ranged from 2,350 to 111,494 individuals per year (Table 6).

The late fall/winter coho salmon run that occurs in the Little Manistee River is also an interesting phenomenon, and again, the weir operation may play a part. Since the weir is removed in mid-November, the size of the run has not been estimated (as with Chinook salmon, the run likely numbers in the thousands, at least in some years). The hypothesis for the late fall/winter coho salmon run is similar to that of the summer Chinook salmon run: because the weir is in place until early to mid-November, any coho salmon that return prior to removal of the weir do not get to reproduce. Therefore, the late-run coho salmon may be entering the river after the weir is removed in an attempt to gain access to habitat suitable for reproduction. As with Chinook salmon, one reason that this phenomenon is possible is the groundwater-fed flow regime of the Little Manistee River: the same groundwater which helps keep the river cool in the summer also keeps the river a few degrees warmer in the winter, thereby allowing coho salmon to spawn throughout the winter.

Steelhead numbers passed at the Little Manistee weir have averaged 7,610 fish annually since 1968 (Table 5). Of those, an average of 2,294 were passed each fall, and 5,283 passed each spring. The majority of the steelhead that run the Little Manistee River are wild, naturally reproduced fish. Although no steelhead are stocked in the Little Manistee River, some hatchery-bred steelhead stray into the river each year. From the spring of 1991 through the fall of 2004, 18% of the fish in the fall run were hatchery-produced, while 24.5% of the spring run were hatchery fish (Table 7). Again, the number passed over the weir is only a portion of the run each year; many fish are not counted because they run at times when the weir is not in place. It is likely that the average adult run of steelhead on the Little Manistee River exceeds 10,000 fish annually, and in exceptional years may even exceed 20,000 fish. Seelbach (1993) estimated annual smolt production for the Little Manistee from 1982-1984. He estimated that 11,803 smolts outmigrated in 1982, 56,256 in 1983, and 86,451 in 1984. Seelbach (1993) also estimated that the adult run averaged between 5,800 and 13,600 for the period between 1979 and 1987.

The Little Manistee weir is the sole source of steelhead eggs for the vast majority of the steelhead stocked in Michigan. Other than plants in the St. Joseph and Manistee Rivers, which each receive some Skamania-strain steelhead from Indiana, all steelhead stocked in Michigan waters are Little Manistee strain. Over the years, steelhead from the Little Manistee River have been stocked by ten states and two countries. Currently, Ohio receives steelhead eggs from the Little Manistee weir for stocking in its Lake Erie tributaries, and Indiana receives yearling steelhead from Michigan hatcheries for stocking in its Lake Michigan tributaries. Although the current egg-take program began in the late 1960's, steelhead eggs were first taken from the Little Manistee in the 1920's at an egg-take station operated near Fox Bridge from 1926-1929.

The Little Manistee River also receives a small run of migratory brown trout from Lake Michigan each fall. Since 1968, the average number captured at the Little Manistee weir has been 81 fish per year (Table 5). The largest run occurred in 1975, when 238 fish were counted at the weir. All brown trout captured at the weir are released back into the river to continue upstream. The source of the migratory brown trout is unknown; they may be naturally reproduced brown trout that originally came from the Little Manistee River, or they may be strays from MDNR brown trout stockings in the Manistee River channel just upstream from Lake Michigan. Migratory brown trout populations in Michigan have not been intensively studied, as they are usually low in number and a small component of river fisheries.

Habitat management

Besides stocking, other management actions on the Little Manistee River have included the installation of fish habitat structures, stabilization of eroding streambanks, reducing erosion at poorly designed road/stream crossings, and the excavation of sand traps. A major habitat improvement project was initiated on the Little Manistee River in 1957, in which approximately 1,700 stream improvement devices, including log jams and deflectors, were installed by MDOC crews. In 1996, the Little Manistee River Restoration Committee (LMRRC) was formed to oversee stream improvement activities (Conservation Resource Alliance 2001). The Conservation Resource Alliance (CRA), a non-profit organization based in Traverse City, administers the committee. The partnership agreement that formed the committee was signed by 20 private, public, and governmental organizations. Since 1996, the LMRRC has completed work on 35 eroding streambanks, repaired three road/stream crossings, completed one fish cover project, and constructed and maintained two sand traps (M. Johnson, CRA, personal communication). At least 5,000 cubic yards of sand have been removed from the two Little Manistee River sand traps since they were first constructed in 2002. The first, and most upstream sand trap is located just downstream from the Old Grade Campground below M-37, on Manistee National Forest Land. The USFS has been providing funding for the maintenance of this trap, and they also operate a smaller trap on Cool Creek. The second sand trap on the mainstream of the Little Manistee is maintained by the LMRRC, the Phillip Wagley Sand Trap, is located downstream on private property between Poggensee Bridge and Eighteen Mile Bridge. The LMRRC has also completed an eroding streambank inventory of the watershed (2002), a road/stream crossing inventory (2004), and a large woody debris inventory (2004).

The Little Manistee Watershed Conservation Council (LMWCC) was also formed in 1996 (CRA 2001). Its membership consists of riparian landowners, anglers, and other persons interested in the health of the Little Manistee River. The LMWCC conducts volunteer invertebrate and water quality sampling, and works with the Michigan Department of Environmental Quality (MDEQ) to interpret the results. The LMWCC advocates on issues that have the potential to impact the Little Manistee River, including MDEQ permit applications. The LMWCC also communicates with its members about proper riparian stewardship and other Little Manistee River issues.

Angling and fisheries regulations

The Little Manistee River is nationally renowned for its fishing for both potomadromous steelhead and salmon and resident brown trout. Fishing pressure is extremely heavy in the spring for steelhead, and also in the summer for Chinook salmon. Anglers targeting resident brown trout in the summer are fewer in number, although pressure can be intense during the annual "hex hatch" that usually occurs in

late June or early July, in which anglers fish at night to target large brown trout feeding on Hexagenia limbata (mayfly) adults as they hatch. The Little Manistee River also receives a fall steelhead run, with most fishing activity taking place in November and December, although fall fishing pressure is nowhere near as intense as in the spring. The Little Manistee River receives a substantial coho run in late fall and winter, although few anglers target them (most are caught incidentally by steelhead anglers).

Fishing regulations for the Little Manistee River are somewhat complicated due to the weir operation and the need to apply extra protection to the wild broodstock steelhead population. Above Spencer's Bridge, the Little Manistee River is a Type 1 stream, meaning that fishing is only allowed during the regular trout season from the last Saturday in April through September 30. The bag limit is five trout per day, with a minimum size limit of 8 inches, but no more than three fish 15 inches in length or larger. No gear restrictions are in effect on the Type 1 stretch of the river. From Spencer's Bridge downstream to Johnson's Bridge, the Little Manistee River is a Type 5 stream, which is flies-only. Two trout per day may be kept, with a 15 inch minimum size limit on brown and rainbow trout (steelhead), and a 10 inch minimum size limit on brook trout. From Johnson's Bridge downstream to Manistee Lake, the Little Manistee River is a Type 4 Stream. There are no gear restrictions, and anglers are allowed to harvest five trout and salmon, with no more than three fish 15 inches or larger. Minimum size limits are 10 inches for rainbow trout (steelhead), brown trout, coho salmon, and Chinook salmon; and 8 inches for brook trout. Due to the spawning runs and weir operation, the river is closed to fishing from September 1-November 14 and January 1-March 31 from 300 feet below the weir to Manistee Lake. The January 1-March 31 spawning closure also applies all the way upstream to Spencer's Bridge (see the MDNR Inland Trout and Salmon Guide for stream maps and further details). Another spawning closure is at the southeastern end of Manistee Lake, which is closed to fishing from September 6-October 15, or when the quota of Chinook salmon eggs has been taken at the weir. The MDNR has designated the Little Manistee River as a Blue Ribbon Trout Stream, a title which is only given to the best trout streams in Michigan. The "Blue Ribbon" designated stretch of the Little Manistee River is from King's Highway (County Road 633) downstream to the Manistee County line.

Since 1994, a total of 19 fish caught in the Little Manistee River have been entered in the MDNR Master Angler Program. Steelhead were the most commonly entered species (nine individuals entered). Five coho salmon, 4 Chinook salmon, and 1 brook trout were also entered. Particularly impressive entries include a 21.12 lb steelhead caught in 2000, a 30 lb chinook salmon caught in 1996, and a 2.19 lb brook trout caught in 1999. All of the coho salmon entries were from 1999, a year in which the coho salmon in Lake Michigan and its tributaries ran exceptionally large. Fourteen of the 19 Master Angler entries were catch and keep, and five were catch and release.

Fishery surveys

The first electrofishing surveys of the Little Manistee River were conducted in the early 1950's by the MDOC. Several sites in Lake County were surveyed in 1952 and 1953. A population estimate at one site on Indian Club property was conducted in 1954 (Table 2), although the exact location and station length of the survey are unknown. In 1956, one site in Manistee County and seven sites in Lake County were sampled. These surveys laid the groundwork for the Little Manistee River Watershed Survey Report (Wicklund and Dean 1957). In 1958, two sites in Manistee County, three sites in Mason County, and two more sites in Lake County were sampled. One more site in Lake County was

surveyed in 1959 in an attempt to evaluate habitat improvement efforts. The next round of surveys was done in 1965, when the MDOC was gathering information necessary to create a "Designated Trout Stream" list. In 1965, one site in Mason County and 23 sites in Lake County were sampled. After that, no surveys were conducted until 1977, when a brief survey was done at Johnson's Bridge. With the exception of the 1954 survey, all of the early surveys were basically one-pass surveys to estimate catch-per-effort; no population estimates were obtained. The next attempts at obtaining population estimates occurred in 1979, 1980, and 1981 (Hay 1980, 1981a, 1981b; Table 3). By 1981, the "modern" index stations used for more recent surveys (see below) had been established (Hay 1981b). The 1979-1981 population estimates were obtained in late summer/early fall.

The next major sampling effort on the Little Manistee River was undertaken in the early 1980's (Seelbach 1986). From 1981-1983, Seelbach (unpublished data) obtained steelhead population estimates at 14 sites (Table 4), including the six sites identified by Hay (1981b). In 1981, Seelbach used the data from the six MDNR sites to obtain his estimates, but calculated them differently, which explains the differences between the 1981 estimates for those six sites in Tables 3 and Table 4. The data collected by Seelbach also includes some stocked steelhead (which were identified by fin clips). However, the only station at which significant numbers of hatchery steelhead were present in the catch was the 9-Mile Bridge station (Table 4). The next MDNR sampling effort took place in September, 1995 (Hay 1995). In these surveys, population estimates were obtained at the six index stations that established in the 1981 survey (Hay 1981b). More sampling occurred on the Little Manistee River in 1997 and 1998, when Woldt and Rutherford (unpublished data) collected three steelhead population estimates at each of the fourteen sites sampled by Seelbach. Estimates were collected during July 1997, October 1997, and March 1998 (Table 4). The Woldt and Rutherford study (Woldt 1998, Woldt and Rutherford 2002) was the only instance where multiple population estimates were obtained in one year. As to be expected, the March 1998 survey resulted in a substantially lower population estimate than in the summer or fall of 1997 at most sites.

The Little Manistee River is one of a number of streams in Michigan that has tested positive for Myxobolus cerebralis, the parasitic microorganism that causes whirling disease. Whirling disease is present in a number of other states, and has devastated some trout fisheries in western states. In 1999, steelhead and brook trout from three of five Little Manistee River sample sites tested positive for M. cerebralis. Several sites on the Little Manistee River were again sampled in 2003, but this time no fish tested positive for the disease. Other rivers where trout have recently tested positive include the Manistee (and tributaries including the Pine and the North Branch), Sturgeon, Jordan, Pigeon, Au Sable, Au Train, Rifle, East Branch of the Ontonagon, and Hunt Creek. Fortunately, despite the fact that whirling disease has been found in Michigan since 1968, no mortalities due to the disease have been recorded to date, nor do any fish exhibit physical symptoms. It is unclear why, but one hypothesis is that M. cerebralis spore counts are low enough that the fish do not receive serious physical damage from the parasite. It is not possible to eradicate M. cerebralis from a stream once it is established, as the spores can lie dormant in sediments for up to 30 years.

Current Status

The analysis below presents the results of all recent (2002-2004) MDNR electrofishing surveys on the Little Manistee River below M-37, and compares the results with those from prior surveys. The stations surveyed were established in 1981 (Hay 1981b; Figure 3). Data are presented sequentially

starting with the most upstream site sampled and proceeding downstream. All recent sampling was done with a tow barge electrofishing unit equipped with three probes, using pulsed DC up to 250 volts. With the exception of the Johnson's Bridge station, all sites were sampled in the summer of 2002. Only trout and salmon were counted; adult salmon were observed but not captured or included in population estimates. Brown trout and steelhead ages were determined through scale analysis.
All recent population estimates discussed in this report were derived using the Chapman modification of the Petersen mark-recapture method (Ricker 1975). Two electrofishing passes through the survey station were made. All fish collected during the first electrofishing pass (marking run) were counted, given a unique mark (often a small fin clip at the top of the tail), and released back into the stream. During the second electrofishing pass (recapture run), all fish that were captured were examined for marks, counted, and released. A population estimate of the total number (and pounds) of fish in the sampled stream was then generated by assuming that the proportion of marked fish in the second sample is representative of the proportion of marked fish in the total population. Rainbow trout (steelhead) smaller than 4 inches total length were not measured in some of the surveys. This makes direct comparison of those estimates with other recent estimates difficult, particularly for juvenile steelhead. In some years the majority of the steelhead catch (numerically) consists of 2 and 3 inch fish, which most affects estimates of numbers/acre. Therefore, those population estimates without rainbow trout smaller than 4" in length will not be included in this report. In this report, brown trout will be discussed primarily in terms of lbs/acre as it is a better measure of the "catchable" adult population, although estimates of number/acre are available (Tables 4-9). Because most of the surveys were conducted during August or September, and the rainbow trout population in the Little Manistee River at this time consists mostly of juveniles, rainbow trout will be discussed primarily in terms of number/acre; discussion will center on those estimates with all inch groups included. Similarly, juvenile coho salmon and Chinook salmon will also be discussed in terms of number/acre. Although rainbow trout and coho salmon will not be discussed in terms of lbs/acre, those estimates are available (Tables 4-9).

All sites except for the Johnson's Bridge station were selected to replicate similar surveys done in 1981 and 1995 (Hay 1995, 1981b). The Johnson's Bridge survey was chosen to be a permanent long-term index site for the Stream Status and Trends Program (Wills et al. in review). Accordingly, the station was shocked consecutively for three years starting in 2002. All fish species other than salmonids were collected during the first year, and an intensive stream habitat evaluation was completed as well. Temperature data were collected at Johnson's Bridge during the summer of 2002, and in the winter of 2002/2003.

Old Grade Campground

Population estimates were obtained at the Old Grade Campground site in 1979. The exact station location is unknown. Records indicate that 984' of river were shocked, covering an area of .98 acres. Physical characteristics of the river here were not measured. This stretch of river was shocked again in 1999 and 2003 to obtain samples for Whirling Disease testing, but population estimates have not been obtained here since 1979.

In the 1979 survey, the brown trout population at Old Grade Campground was estimated at 32 lbs/acre (Table 3), and the rainbow trout (steelhead) population estimate was 420 fish/acre (Table 3).

Spencer's Bridge

Spencer's Bridge was the most upstream site sampled in 2002 (Figure 3). The station is located about 3.75 miles downstream from M-37, and is the upstream boundary for the Type 5 flies only stretch of the river. The survey station is located on state land. The station length is 650 feet, and the average width of the river was measured at 33.3 feet (Hay 1995). Area for the station is 0.5 acres. Average depth was 1.70 feet, with the deepest hole being about 3.5 feet deep. The streambanks are mostly forested; overhanging tag alders provide some fish cover, along with logjams, stumps, and undercut grassy banks. Aquatic macrophytes were present, including Elodea spp. and Potamogeton spp. Hay (1995) estimated the substrate composition to be 85% sand, 10% silt, and 5% gravel, and calculated gradient as 1.8 feet/mile, which is relatively low compared to other trout streams around the state. The Spencer's Bridge site had the lowest gradient of all sites sampled. During the marking run on July 29, 2002 the air temperature was 77oF, and the water temperature was 64.5oF. During the recapture run on July 30, 2002 the air temperature was 73oF, and the water temperature was 62oF.

In the 2002 survey, the brown trout population at Spencer's Bridge was estimated at 114 lbs/acre (Table 3). Previous population estimates were 58 lbs/acre in 1981 and 88 lbs/acre in 1995. In the 2002 survey, the rainbow trout (steelhead) population estimate at Spencer's Bridge was 2,465 fish/acre (Table 3). The previous MDNR population estimate was 564 fish/acre in 1981. Seelbach (unpublished data) estimated the steelhead populations at Spencer's Bridge at 727 fish/acre in 1981, 481 fish/acre in 1982, and 1165 fish/acre in 1983 (Table 4). Woldt and Rutherford (unpublished data) estimated the steelhead population at Spencer's Bridge in July 1997 at 336 fish/acre (Table 4). The MDNR coho salmon estimate for Spencer's Bridge was 335 fish/acre in 2002 (Table 3).

Indian Club Station #9.5

This survey station is located on Indian Club property, between Spencer's Bridge and Indian Bridge within the Type 5 flies-only stretch of the river (Figure 3). The survey station is 595 feet long, and the average width of the river is 37.9 feet (Hay 1995). Area for the station is 0.52 acres, and average depth was measured as 1.4 feet. The streambanks in this station are mostly forested, with some grassy areas. The substrate composition was not estimated, but consists of sand, gravel, and cobble. Gradient was calculated at 9.0 feet per mile (Hay 1995), making this the survey station with the highest gradient. During the marking run on August 1, 2002 the air temperature was 74.5oF, and the water temperature was 63.5oF. During the recapture run on August 2, 2002 the air temperature was 77oF, and the water temperature was 63oF. Two adult Chinook salmon were observed.

In the 2002 survey, the brown trout population at Indian Club Station #9.5 was estimated at 184 lbs/acre (Table 3). Previous population estimates were 62 lbs/acre in 1981 and 82 lbs/acre in 1995. In the 2002 survey, the rainbow trout (steelhead) population estimate at Indian Club Station #9.5 was 3,177 fish/acre (Table 3). The previous MDNR population estimate was 2,465 fish/acre in 1981. Seelbach (unpublished data) estimated the steelhead populations at the Indian Club Station #9.5 at 2,064 fish/acre in 1981, 2,379 fish/acre in 1982, and 2,569 fish/acre in 1983 (Table 4). Woldt and Rutherford (unpublished data) estimated the steelhead population at the Indian Club Station #9.5 in

July 1997 at 696 fish/acre (Table 4). The coho salmon population estimate for Indian Club Station #9.5 was 3,273 fish/acre in 2002 (Table 3).

Indian Club Station #5

This survey station is located on Indian Club property, between Spencer's Bridge and Indian Bridge, downstream of Indian Club Station 9.5, within the Type 5 flies-only stretch (Figure 3). The station is 876 feet long, and the average width of the river is 44.1 feet (Hay 1995). Area for the station is 0.89 acres, and average depth was measured as 1.3 feet. The streambanks in this station are mostly forested, with some grassy areas, and there is one fairly long eroding streambank which was stabilized with riprap. The substrate composition was estimated at 50% sand, 35% gravel, 10% silt, and 5% cobble, and gradient was calculated at 7.5 feet per mile (Hay 1995). During the marking run on August 1, 2002 the air temperature was 88oF, and the water temperature was 65oF. During the recapture run on August 2, 2002 the air temperature was 72oF, and the water temperature was 64oF. One adult Chinook salmon was observed.

In the 2002 survey, the brown trout population at Indian Club Station #5 was estimated at 116 lbs/acre (Table 3). Previous population estimates were 61 lbs/acre in 1981 and 64 lbs/acre in 1995. In the 2002 survey, the rainbow trout (steelhead) population estimate at Indian Club Station #5 was 2,048 fish/acre (Table 3). The previous MDNR rainbow trout population estimate was 645 fish/acre in 1981. Seelbach (unpublished data) estimated the steelhead populations at the Indian Club Station #5 at 1,543 fish/acre in 1981, 2,170 fish/acre in 1982, and 1,555 fish/acre in 1983 (Table 4). Woldt and Rutherford (unpublished data) estimated the steelhead population at the Indian Club Station #5 at 617 fish/acre in July 1997 (Table 4). The coho and Chinook salmon population estimates for Indian Club Station #5 were 1854 fish/acre and 6 fish/acre, respectively, in 2002 (Table 3).

Indian Bridge

The Indian Bridge survey station is located downstream of the Indian Club Station #5 (Figure 3). The northern bank of the upstream half of this shocking station is state land, and the southern bank is privately owned. The downstream half of this shocking station flows through Indian Club property. The entire Indian Bridge station is within the Type 5 flies-only stretch of the river. The station is 984 feet long (492 feet upstream and 492 feet downstream of Indian Bridge), and the average width of the river here was 31.3 feet (Hay 1995). Area for the station is 0.71 acres, and average depth measured as 2.0 feet. The streambanks in this station are mostly forested, with tag alders and brush present as well. The substrate composition was estimated at 60% sand, 20% gravel, 10% silt, and 10% cobble, and gradient was calculated at 4.6 feet per mile (Hay 1995). During the marking run on August 6, 2002 the air temperature was 75oF, and the water temperature was 58oF. During the recapture run on August 7, 2002 the air temperature was 61oF, and the water temperature was 56oF. One adult Chinook salmon was observed.

In the 2002 survey, the brown trout population at the Indian Bridge station was estimated at 209 lbs/acre (Table 3). Previous brown trout population estimates were 181 lbs/acre in 1980, 161 lbs/acre in 1981, and 125 lbs/acre in 1995. In the 2002 survey, the rainbow trout (steelhead) population

estimate at the Indian Bridge station was 1,601 fish/acre (Table 3). Previous MDNR rainbow trout population estimates were 525 fish/acre in 1980 and 325 fish/acre in 1981. Seelbach (unpublished data) estimated the steelhead populations at Indian Bridge at 566 fish/acre in 1981, 885 fish/acre in 1982, and 838 fish/acre in 1983 (Table 4). Woldt and Rutherford (unpublished data) estimated the steelhead population at the Indian Bridge station at 996 fish/acre in July 1997 (Table 4). The coho and Chinook salmon population estimates for the Indian Bridge station in 2002 were 1,030 fish/acre and 6 fish/acre, respectively (Table 3).

Johnson's Bridge

Johnson's Bridge is the next survey station downstream from Indian Bridge and is the downstream boundary for the Type 5 flies-only stretch of river (Figure 3). The river flows through private property at this station.

A habitat survey was completed at Johnson's Bridge on July 18, 2002 using the Stream Status and Trends Program protocol (Wills et al. in review). Habitat data were collected from a 1200 foot station upstream from the bridge, where the river ranged from 31 to 43.4 feet and averaged 35.32 feet in width. The majority of the station was run habitat (92.31%) and the rest was riffle. The mean depth of the station was 1.85 feet, while the mean thalweg depth (the deepest point of the channel) was 2.58 feet. The deepest point recorded in the station was 3.8 feet. Riparian vegetation consisted of tag alder types (46.15%), yard/lawn (34.62%), large deciduous trees (15.38%), and large coniferous trees (3.85%). The streambanks were relatively stable, as 80.77% were rated as "good" (less than 25% of the streambank is bare soil). Of the remainder, 15.38% were recorded as having "fair" stability (25-50% of the streambank is bare soil), and only 3.85% had "poor"stability (50-75% of the streambank is bare soil). Seven undercuts were documented. The dominant substrate in the station was sand (49.23%). Other substrates present included gravel (15.38%), detritus/silt (15.38%), small cobble (12.31%), large cobble (6.15%), and boulder (1.54%). A total of 46 pieces (420 linear feet) of woody debris were noted. Seven natural log jams (1,520 square feet), five wing deflectors (78.6 square feet), and six stump clumps (70 square feet) were also documented. Stream volume was measured as 61.19 cubic feet per second. Hay (1995) measured the gradient in the station at 2.8 feet/mile.

Summer 2002 and winter 2002/2003 temperature data in this station were collected at hourly intervals by a continuous recording temperature logger. The mean July temperature in 2002 was 63.1oF, and the warmest recorded temperature in that month (and the entire summer) was 70.5oF. The coolest temperature recorded in July was 56.6oF. The mean January temperature was 34.0oF, and the coldest recorded temperature during the month was 31.9oF. The warmest recorded temperature in January was 39.3oF.

Population estimates have been collected from a 984 foot reach covering 0.90 acres at the Johnson's Bridge station in six different years including 1979, 1981, 1995, and 2002-2004 (Table 3). For brown trout, population estimates have ranged between 51 lbs/acre (1979) and 136 lbs/acre (2002). Rainbow trout (steelhead) population estimates ranged between 211 fish/acre in 1979 and 1,965 fish/acre in 2003. Seelbach (unpublished data) estimated the steelhead population at Johnson's Bridge at 689 fish/acre in 1981, 2144 fish/acre in 1982, and 1,972 fish/acre in 1983 (Table 4). Woldt and Rutherford (unpublished data) estimated the steelhead population at the Johnson's Bridge Station at 1950 fish/acre

in July 1997 (Table 4). Coho salmon population estimates were obtained in the 2002-2004 surveys, and they varied widely (Table 3). In 2002, the population estimate for coho salmon was 1,271 fish/acre, while in 2004 only 13 fish/acre were found.

Because the Johnson's Bridge station was selected to be a rotating permanent index station under the MDNR Fisheries Division's Stream Status and Trends Program (Wills et al. in review), age and growth information were collected in 2002, 2003, and 2004 (Table 8). In all three years, brown trout up to age 5 were aged. In all three years, growth for brown trout of ages 1-4 was near the state average length-at-age. Brown trout population estimates by age and survival estimates can be seen in Table 9. Steelhead parr were also growing slightly below the state average (Table 8). The vast majority of the steelhead aged were either age-0 or age-1, with only a few age-2 fish present. All of the coho salmon parr and all but one of the Chinook salmon parr were age-0; one Chinook salmon parr was age-1 (Table 8). Population estimates for migratory salmonids by age group are shown in Table 10.

In the 2002 survey of the Johnson's Bridge station, non-game species were collected for the first half of the station during the marking run. Species collected included blacknose dace, creek chub, golden shiner, and sculpin. Only sculpin were represented in the catch by more than a few individuals.

DeWitt's Bridge

The Little Manistee River at the DeWitt's Bridge station flows through privately owned land (Figure 3). The station covers an area of 0.87 acres 984 feet upstream from the bridge and is under Type 4 regulations. DeWitt's Bridge is the only station sampled that is not within the Type 5 flies-only stretch of river. The streambanks in this station are mostly brush and tag alder, with several cottages present. The substrate composition was estimated at 65% sand, 12% gravel, 13% silt, and 11% cobble, while gradient was calculated at 2.1 feet per mile (Hay 1995). During the marking run on August 6, 2002 the air temperature was 69oF and the water temperature was 61oF. During the recapture run on August 7, 2002 the air temperature was 64oF and the water temperature was 60oF. At least one adult Chinook salmon was observed.

Population estimates have been collected at the DeWitt's Bridge station in five different years including 1979-1981, 1995, and 2002 (Table 3). For brown trout, population estimates have ranged between 58 lbs/acre (1995) and 130 lbs/acre (2002). Rainbow trout (steelhead) population estimates ranged between 457 fish/acre in 1981 and 1,645 fish/acre in 2002 (Table 3). Seelbach (unpublished data) estimated the steelhead population at DeWitt's Bridge at 755 fish/acre in 1981, 2,363 fish/acre in 1982, and 1,749 fish/acre in 1983 (Table 4). Woldt and Rutherford (unpublished data) estimated the steelhead population at the DeWitt's Bridge station at 791 fish/acre in July 1997 (Table 4). A coho salmon population estimate of 1,171 fish/acre was obtained in the 2002 survey (Table 3).

Tributaries

All named and some unnamed Little Manistee tributaries were sampled by MDNR fisheries crews in 2001 and 2002 (Tonello 2003). Results of those surveys can be found in Tonello, 2003.

2004 Creel Census

A creel census of the Little Manistee River was conducted from June 1 through August 31, 2004. Three different stations were assessed. The most upstream station was from the Driftwood Valley Campground downstream to the Nine Mile Bridge (Fig. 2). The second station was from Nine Mile Bridge downstream to the Little Manistee Weir (Fig. 2), and the most downstream station was from the Little Manistee Weir downstream to the mouth of the river (Fig. 2). Fish species reported as caught by anglers included Chinook salmon, rainbow trout, brown trout, and brook trout (Table 11). An estimated total of 6,605 angler trips took place on the stretch of river surveyed during those three months, resulting in an estimated total of 20,551 angler hours generated. Fishing pressure was generally light during the survey, and most anglers encountered were targeting summer-run Chinook salmon. All of the rainbow trout recorded in the survey (Table 11) were juvenile steelhead.

Analysis and Discussion

Based on the results of recent survey efforts, it can be concluded that the Little Manistee River continues to be one of the best wild trout streams in Michigan. By comparison with recent Stream Status and Trends Program surveys on other Lower Peninsula trout streams (Table 12), it is clear that the Little Manistee River consistently produces large numbers of wild trout and salmon. With brown trout population estimates often exceeding 100 lbs/acre and sometimes even 200 lbs/acre, the Little Manistee River is comparable to any of the other famous wild brown trout streams in Michigan, including those without migratory salmonid species. The recent survey data also show the ability of the Little Manistee River to produce juvenile steelhead and coho salmon, with population estimates often exceeding 2000 fish/acre for steelhead and 1000 fish/acre for coho salmon. Although recent MDNR research (A. Nuhfer, MDNR Fisheries Division, unpublished data) has shown that juvenile steelhead suppress resident brown trout populations in Hunt Creek, Michigan through competition for resources, that does not appear to be happening in the Little Manistee River. In the Little Manistee River, there are enough resources to support a high biomass of resident brown trout along with large numbers of juvenile steelhead and coho salmon. Another factor is that the juvenile steelhead and salmon likely provide an excellent source of forage for brown trout, which are known to be highly piscivorous.

Brown trout population estimates at all stations in 2002 were the highest recorded to date (Table 3). The subsequent decrease in the population estimates during 2003 and 2004 at the Johnson's Bridge station may indicate that 2002 was an exceptional year for brown trout in the Little Manistee River. Across all years and out of all the stations surveyed, Indian Bridge had the highest population of brown trout.

One interesting phenomenon regarding the brown trout population in the Little Manistee River is the number of large brown trout caught in recent years. In 1981, during the marking runs at all six stations, a total of eight brown trout larger than 15 inches were caught. In contrast, 31 brown trout larger than 15 inches were caught during the marking runs at each of the six stations in 1995, and a total of 81 brown trout larger than 15 inches (seven of which were larger than 20 inches) were caught during the marking runs at the six stations in 2002. It is unclear why there were more large brown trout in the population in 2002, but it may have to do with fishing regulations, ethics, or a combination of the two. In 2000, trout fishing regulations in Michigan became more restrictive. Although the

majority of the survey stations have been under flies-only regulations since 1973, they had a five fish daily bag limit and an 8 inch minimum size limit on brown trout. In 2000, the regulation for brown trout switched to a two fish daily bag limit and a 15 inch minimum size limit. Also, anglers may presently release more trout than they did in years past, allowing fish to live longer and grow to a larger size. Finally, the increase in large brown trout may be due to weather-related phenomenon (A. Nuhfer, MDNR Fisheries Division, personal communication).

Steelhead population estimates in 2002 were also some of the highest recorded to date, especially when compared to MDNR estimates from 1995 and 1981. In 2002, population estimates at all sites exceeded 1,000 fish/acre, and three of the sites exceeded 2,000 fish/acre (Table 3). The Indian Club #9.5 station produced the highest estimate at 3,177 fish/acre. Data from 1981-1983 (Seelbach, unpublished data) also shows population estimates often over 2,000/acre (Table 4). It is clear that in most years, the Little Manistee River produces large numbers of young-of-year steelhead. Seelbach (1986) found that most steelhead smolt out of the Little Manistee River after spending two summers in the river. Age and growth analysis from the 2002-2004 Johnson's Bridge surveys (Table 8) concurs with this finding, as only a few steelhead older than age-1 were caught.

The population estimate for steelhead at Johnson's Bridge in 2004 was quite a bit lower than that from the previous two years. Likewise, the population estimate for the nearby, and hydrologically similar, Pere Marquette River was also lower than the previous two years (Table 12). In both cases, the drop in the population estimate was primarily among young-of- year. A hypothesis for the smaller 2004 steelhead year class in both of these rivers is the high flows that occurred during the spring of 2004 (T. Wills, MDNR Fisheries Division, personal communication). Seelbach (1986, 1993) and Swank (2005) also hypothesized that winter severity may be a cause of significant mortality among juvenile steelhead prior to smolting.

Far less data exists on the coho salmon population of the Little Manistee River than on brown trout and steelhead populations. Population estimates for coho salmon were only collected in the 2002 surveys (Table 3), and the 2003 and 2004 Johnson's Bridge surveys. The 2002 coho salmon year class appears to have been a good one, as coho population estimates were over 1,000 fish/acre at all sites except for Spencer's Bridge. However, the Johnson's Bridge estimate fell from 1,271 fish/acre in 2002 to 328 fish/acre in 2003, and then to a paltry 13 fish/acre in 2004. It is possible that the high flows of the spring of 2004 had some impact on the juvenile coho salmon, resulting in the poor catch at Johnson's Bridge in 2004. Although population estimates were not generated in 1981 or 1995, coho salmon were caught and counted during the marking runs of these years. In 1981, fair numbers of coho salmon were caught during the marking runs at each station with the exception of Spencer's Bridge. However, in 1995, only a few coho salmon were caught during the marking run at each station. Thus, it appears that coho salmon reproduction in the Little Manistee River is variable.

Reproductive potential for Chinook salmon that make it past the Little Manistee River weir is high. Seelbach (1985b) estimated the number of Chinook smolts leaving the river for three years, from 1982-1984. His estimates ranged from 32,190 to 121,239 individuals (Table 6). Woldt and Rutherford (University of Michigan, unpublished data) estimated the number of wild coho salmon smolts outmigrating from 1996-1998, and their estimates ranged from 59,876 to 128,774 individuals per year (Table 6). Those levels of natural reproduction were achieved with the majority of Chinook salmon

adults being harvested at the weir. If more adult Chinook salmon were allowed past the weir, it is likely that the Little Manistee River would produce many more wild Chinook salmon smolts.

Management Direction

Because the Johnson's Bridge station on the Little Manistee River was selected to be a "fixed", long-term index site for Fisheries Division's Stream Status and Trends Program (Wills et al. in review), the site will again be sampled from 2007-2009. At some point during those three years, other index stations on the Little Manistee River should be surveyed again. However, because the historical index stations are in such close proximity, not all of them need to be sampled. Stations that should continue to be sampled (in addition to Johnson's Bridge) include Spencer's Bridge and DeWitt's Bridge. At least two other index stations should be established further downstream, perhaps using the stations first sampled by Seelbach (MDNR Fisheries Division, unpublished data). Bear Track Campground may be a good site, as well as somewhere within the 6-Mile to 9-Mile reach.

The results of the 2002-2004 surveys confirm that the Little Manistee River continues to be one of Michigan's top streams for resident brown trout and migratory steelhead despite the fact that neither species is stocked. Therefore, MDNR should continue with the current policy of maintaining the Little Manistee River as a wild trout stream. No brown trout or steelhead should be stocked. In fact, the only fish that will continue to be stocked at this point are Chinook salmon. Although forage base concerns on Lake Michigan may necessitate further Chinook salmon stocking cuts, enough Chinook salmon should be stocked to ensure that enough adults return to the Little Manistee weir each fall for egg-take purposes.

Because it has the habitat to produce large numbers of wild resident trout, steelhead, and salmon, management efforts for the Little Manistee River should center on protecting and improving habitat. Seelbach (1993) reported that habitat for older steelhead parr may be reduced in the Little Manistee River due to the stream's excessive sand bedload. The same likely holds true for other salmonids, including resident brown trout. Maintaining and improving the habitat in the Little Manistee River includes repairing and maintaining eroding streambanks and improving poorly designed road/stream crossings that deliver sand and sediment to the river. We must also continue to operate the three existing sand traps in the watershed, in an effort to remove sand already in the system (from the two Luther Dam failures in particular). Other projects should include woody debris maintenance and improvement as well as providing overhead fish cover in areas where it is currently lacking. These goals will be accomplished by continuing to work with the USFS, LMRRC, LMWCC, and the CRA. Michigan Department of Natural Resources Fisheries Division personnel will participate in project prioritization and planning, and will also provide labor and financial support when it is feasible and necessary.

Since large portions of the Little Manistee River watershed lie within the Pere Marquette State Forest and Manistee National Forests, Best Management Practices should be followed by MDNR and USFS personnel when they propose timber harvests. Fisheries Division personnel should analyze and comment when necessary on proposed timber harvests that pertain to the Little Manistee River watershed. Trees with the potential to fall into the Little Manistee River or any of its tributaries should not be cut. Forested areas along important tributary streams like Twin Creek should not be managed for young successional aspen. Instead, management for coniferous species and late seral stages of

deciduous species should be encouraged. Young aspen is a prime food source for beaver, and beavers have the potential to severely degrade and even completely block small streams like Twin Creek. Therefore, every possible effort should be made to discourage beavers from colonizing and blocking tributary streams. Beaver dams degrade small trout streams by blocking upstream fish migrations, warming the water, blocking downstream movement of woody debris and organic material, and interfering with drift of aquatic insects.

Large woody debris is a critical habitat component of a trout stream, and is particularly necessary for producing large brown trout. Therefore, it is important that canoeists, anglers, and landowners do not remove woody cover from the Little Manistee River. Trees that fall into the river should not be cut up and allowed to go downstream. Instead, they should remain intact to provide necessary overhead cover for resident brown trout and steelhead. While in some cases it may be necessary to do some cutting to maintain a channel for navigability, such cutting should be done judiciously and to the minimum extent possible. United States Forest Service guidelines for other rivers in the Manistee National Forest call for a maximum cutting width of 8 feet, which will allow for safe navigation of canoes, kayaks, and other watercraft suitable for a small river like the Little Manistee.

Improper development and poor land-use practices are the number one threat to the Little Manistee River. Therefore, MDNR Fisheries Division personnel must continue to work with the MDEQ to protect the Little Manistee River watershed. Improper development and poor land-use practices have the potential to degrade the Little Manistee River, namely through increased runoff, less shade, and more erosion at road/stream crossings. Newcomb (1998) found a negative relationship between spring flow and the number of age-0 steelhead present on the Betsie River. This relationship likely exists for the Little Manistee River as well. Therefore, stormwater runoff from any new development should not be allowed to enter the river. While the Little Manistee River currently has one of the most stable flow regimes in Michigan, runoff from development could change that in the future. If that happens, the capacity of the Little Manistee River to produce wild salmonids will decrease.

Another way to help maintain the stable flow regime of the Little Manistee River is to protect its wetlands. Wetlands associated with the Little Manistee River act as a filter, removing pollutants, slowing erosion, and recharging groundwater aquifers by storing water and then slowly releasing it, reducing the flashiness of the river. Degrading the wetlands will increase the flashiness of the river, increase erosion, and make the stream less hospitable for sensitive species like trout. Wetlands also add biological productivity to streams in the form of invertebrates, reptiles, amphibians, and other species. Therefore, all wetlands within the Little Manistee River Watershed should be protected.

Natural Rivers designation is another protective tool that should be explored for the Little Manistee River. Nearby rivers like the Pere Marquette, Pine, White, Upper Manistee, and Betsie are all state-designated Natural Rivers. The Natural Rivers program uses private land zoning and proper public land management practices to ensure that the river is protected from unwise use and development activities. The Natural Rivers program has a proven track record and has been extremely effective in protecting other rivers in Michigan. The program also protects and even increases property values for landowners along designated streams (Leefers and Jones 1996). Designating the Little Manistee River as a Natural River would ensure that the Little Manistee River remains one of the best wild trout and steelhead streams in Michigan.

References

Bullen, W. H. 1974. The trout streams of Michigan: the Little Manistee River. Michigan Department of Natural Resources, Fisheries Technical Report 74-2, Ann Arbor.

Conservation Resource Alliance, 2001. Little Manistee Watershed Management Plan. Traverse City, MI.

Hay, R. L. 1980. 1979 fisheries survey, Little Manistee River, Lake County. Michigan Department of Natural Resources, Cadillac.

Hay, R. L. 1981a. Population estimates and growth rates of trout in the Little Manistee River, Lake County, 1979 and 1980. Michigan Department of Natural Resources, Cadillac.

Hay, R. L. 1981b. Stream surveys, Little Manistee River, 1981. Michigan Department of Natural Resources, Cadillac.

Hay, R. L. 1995. Stream surveys, Little Manistee River, 1995. Michigan Department of Natural Resources, Cadillac.

Leefers, L. A., and D. M. Jones. 1996. Phase II Final Report: Assessing changes in private property values along designated natural rivers in Michigan. Michigan State University, East Lansing.

MacCrimmon, H. R., and B. L. Gots. 1972. Rainbow trout in the Great Lakes. Ontario Ministry of Natural Resources, Toronto.

Mershon, W. B. 1923. Recollections of my fifty years hunting and fishing. Stratford Co., Boston.

Newcomb, T. J. 1998. Productive capacity of the Betsie River watershed for steelhead smolts. Ph D. Dissertation, Michigan State University. East Lansing. 166 p.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada, Bulletin 191.

Seelbach, P. W. 1985a. Smolting success of hatchery-raised steelhead in a Michigan tributary of northern Lake Michigan. Michigan Department of Natural Resources, Fisheries Research Report 1934, Ann Arbor.

Seelbach, P. W. 1985b. 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. 1986. Population biology of steelhead in the Little Manistee River, Michigan. PHD Dissertation, the University of Michigan, Ann Arbor.

Seelbach, P. W. 1993. Population biology of steelhead in a stable-flow, low gradient tributary to Lake Michigan. Transactions of the American Fisheries Society 122:179-198.

Swank, D. R. 2005. Life-history variation and management of wild great lakes steelhead populations. PHD dissertation, the University of Michigan, Ann Arbor.

Tonello, M. A. 2003. Upper Little Manistee River and Little Manistee River tributary fisheries surveys, 2001-2002. Michigan Department of Natural Resources, Fisheries Division, Cadillac.

USDA Forest Service. 2001. Ecosystem analysis of the Little Manistee River. Manistee National Forest, Cadillac, MI.

Wicklund, R. G., and B. C. Dean. 1957. Little Manistee River Watershed: Survey and plans report. Michigan Department of Conservation, Fish Division, Lake and Stream Improvement Section, Lansing.

Wills, T. C., T. G. Zorn, and A. J. Nuhfer. In review. Michigan Department of Natural Resources Fisheries Division Survey Manual Chapter: Stream Status and Trends Program sampling protocols. Submitted to Michigan Department of Natural Resources, Fisheries Division internal publication.

Woldt, A. P. 1998. Production of juvenile steelhead in two northern Lake Michigan tributaries. M. S. Thesis, the University of Michigan, Ann Arbor.

Woldt, A. P., and E. S. Rutherford. 2002. Production of juvenile steelhead in two central Lake Michigan tributaries. Michigan Department of Natural Resources, Fisheries Research Report 2060, Ann Arbor.

Table 1. Fish stocked into the Little Manistee River, 1873-2004.

Year	Species	Number	Size	Strain	County
1873	Atlantic salmon	3,000	Fry	Penobscot	Unknown
1895	Steelhead	5,000	Fry		Unknown
1895	Cutthroat trout?	5,000	Fry		Unknown
1897	Brook trout	10,000	Fry		Lake
1898	Brook trout	12,000	Fry		Lake
1934	Brook trout	20,550	6 mo.		Lake
	Brown trout	10,000	3 mo.		Lake
	Brown trout	55,000	4 mo.		Lake
	Brown trout	22,400	Yearling		Lake
1935	Brook trout	13,800	7 mo.		Lake
	Brown trout	1,000	Yearling		Lake
	Brown trout	31,440	7 mo.		Lake
1936	Brown trout	8,000	7 mo.		Lake
	Brown trout	20,300	Yearling		Lake
	Brown trout	10,000	1 mo.		Lake
1937	Brown trout	15,000	Fry		Lake
	Brown trout	10,000	Yearling		Lake
	Brown trout	10,000	3 mo.		Lake
	Brook trout	12,500	8 mo.		Manistee
1938	Brook trout	5,000	8 mo.		Lake
	Brook trout	500	Yearling		Lake
	Brown trout	15,000	8 mo.		Lake
	Brown trout	4,950	Adult		Lake
	Rainbow trout	500	Yearling		Lake
1939	Brook trout	250	Yearling		Lake
	Brook trout	5,000	8 mo.		Lake
	Brown trout	14,500	8 mo.		Lake
	Brown trout	8,900	Adult		Lake
1940	Brook trout	800	7 mo.		Lake
	Brook trout	500	Yearling		Lake
	Brook trout	1,000	Adult		Lake
	Brown trout	12,000	7 mo.		Lake
	Brown trout	10,100	Adult		Lake
	Brown trout	20,000	2 mo.		Lake
	Brook trout	5,052	Yearling		Manistee
1941	Brown trout	20,000	Yearling		Lake
	Brook trout	21,000	7 mo.		Lake
	Brown trout	8,600	Yearling		Manistee
	Brook trout	4,606	8 mo.		Manistee
1942	Brown trout	3,200	Adult		Lake
	Brook trout	1,300	Yearling		Manistee
1943	Brown trout	1,550	Adult		Lake
	Brook trout	2,200	Yearling		Manistee
1944	Brown trout	3,656	Adult		Lake
	Brook trout	300	Adult		Manistee
	Brown trout	1,400	Adult		Manistee
1945	Brook trout	4,474	Adult		Lake
	Brown trout	432	Adult		Lake
	Brook trout	1,600	Adult		Manistee
	Brown trout	700	Adult		Manistee

Table 1. Fish stocked into the Little Manistee River, 1873-2004, cont'd.

Year	Species	Number	Size	Strain	County
1946	Brook trout	4,940	Adult		Lake
	Brown trout	6,533	Adult		Lake
	Brook trout	2,025	Adult		Manistee
1947	Brown trout	2,100	Adult		Manistee
	Brook trout	200	Yearling		Manistee
	Brown trout	8,267	Legal		Lake
	Brook trout	2,800	Legal		Lake
1948	Brown trout	1,000	Legal		Manistee
	Brook trout	1,000	Legal		Manistee
	Brown trout	4,000	Spring fingerling		Lake
	Brown trout	5,000	Legal		Lake
	Brook trout	1,300	Legal		Lake
1949	Brown trout	2,000	Legal		Manistee
	Brown trout	3,000	Spring fingerling		Lake
	Brown trout	11,650	Legal		Lake
1950	Brown trout	2,200	Legal		Manistee
	Brown trout	9,000	Legal		Lake
1951	Brown trout	4,400	Legal		Manistee
	Brown trout	12,000	Legal		Lake
1952	Brown trout	4,000	Legal		Manistee
	Rainbow trout	1,500	Legal		Lake
	Brown trout	1,500	Legal		Lake
1953	Rainbow trout	1,400	Legal		Manistee
	Brown trout	700	Legal		Manistee
	Rainbow trout	1,200	Legal		Lake
	Brown trout	1,800	Legal		Lake
1954	Rainbow trout	2,100	Legal		Manistee
	Brown trout	10,000	Spring fingerling		Lake
	Brown trout	2,600	Legal		Lake
	Rainbow trout	2,000	Legal		Lake
	Brook trout	6,000	Legal		Lake
1955	Rainbow trout	4,597	Legal		Manistee
	Rainbow trout	9,300	Legal		Lake
	Brook trout	5,200	Legal		Lake
1956	Rainbow trout	3,184	Legal		Manistee
	Rainbow trout	1,000	Legal		Mason
	Brook trout	1,000	Legal		Mason
	Rainbow trout	5,500	Legal		Lake
	Brook trout	10,000	Legal		Lake
1957	Brook trout	2,000	Legal		Mason
	Brook trout	15,500	Legal		Lake
1958	Rainbow trout	3,000	Legal		Mason
	Brown trout	8,160	Legal		Lake
	Rainbow trout	24,500	Legal		Lake
1959	Rainbow trout	2,050	Legal		Mason
	Brook trout	300	Legal		Mason
	Rainbow trout	17,150	Legal		Lake
	Brook trout	6,200	Legal		Lake
1960	Rainbow trout	3,000	Legal		Mason
	Rainbow trout	24,500	Legal		Lake

Table 1. Fish stocked into the Little Manistee River, 1873-2004, cont'd.

Year	Species	Number	Size	Strain	County
1961	Rainbow trout	3,000	Legal		Mason
	Rainbow trout	22,500	Legal		Lake
1962	Rainbow trout	3,000	Legal		Mason
	Rainbow trout	22,500	Legal		Lake
1963	Rainbow trout	3,000	Legal		Mason
	Rainbow trout	22,500	Legal		Lake
1964	Rainbow trout	3,000	Legal		Mason
	Rainbow trout	30,500	Legal		Lake
1967	Chinook salmon	590,830	Spring fingerling	Toutle R. (WA)	Manistee
	Coho salmon	433,215	Yearling	Toutle R. (WA) and/or Cascade R. (OR)	Manistee
1968	Chinook salmon	321,912	Spring fingerling	Michigan	Lake
	Coho salmon	148,365	Yearling	Michigan	Lake
1969	Chinook salmon	300,000	Spring fingerling	Michigan	Lake
	Coho salmon	700,002	Yearling	Michigan	Lake
1970	Coho salmon	550,012	Yearling	Michigan	Manistee
	Chinook salmon	308,900	Spring fingerling	Michigan	Lake
1971	Chinook salmon	301,868	Spring fingerling	Michigan	Manistee
	Coho salmon	91,674	Yearling	Michigan	Manistee
	Brown trout	1,500	Yearling		Lake
	Brook trout	1,000	Yearling		Lake
1972	Chinook salmon	300,908	Spring fingerling	Michigan	Manistee
	Coho salmon	150,067	Yearling	Michigan	Manistee
	Brown trout	6,127	Yearling		Manistee
	Brown trout	1,008	Yearling		Lake
1973	Chinook salmon	356,140	Spring fingerling	Michigan	Manistee
	Coho salmon	165,714	Yearling	Michigan	Manistee
	Brown trout	6,000	Yearling		Manistee
1974	Chinook salmon	356,140	Spring fingerling	Michigan	Manistee
	Coho salmon	150,067	Yearling	Michigan	Manistee
	Steelhead	100,188	Fall Fingerling	Little Manistee	Manistee
1975	Chinook salmon	300,144	Spring fingerling	Michigan	Manistee
	Coho salmon	200,601	Yearling	Michigan	Manistee
1976	Chinook salmon	301,300	Spring fingerling	Michigan	Manistee
	Coho salmon	400,282	Yearling	Michigan	Manistee
1977	Chinook salmon	250,200	Spring fingerling	Michigan	Manistee
	Coho salmon	358,832	Yearling	Michigan	Manistee
	Atlantic salmon	2,997	Yearling	Quebec	Manistee
	Atlantic salmon	4,500	Yearling	Cross	Manistee
1978	Chinook salmon	400,028	Spring fingerling	Michigan	Manistee
	Coho salmon	302, 980	Yearling	Michigan	Manistee
	Atlantic salmon	10,000	Yearling	Quebec	Manistee
	Atlantic salmon	5,000	Yearling	Cross	Manistee
1979	Chinook salmon	603,098	Spring fingerling	Michigan	Manistee
	Coho salmon	675,000	Yearling	Michigan	Manistee
1980	Chinook salmon	550,272	Spring fingerling	Michigan	Manistee
	Coho salmon	400,158	Yearling	Michigan	Manistee
	Brown trout	1,000	Fall Fingerling		Lake

Table 1. Fish stocked into the Little Manistee River, 1873-2004, cont'd.

Year	Species	Number	Size	Strain	County
1981	Chinook salmon	500,204	Spring fingerling	Michigan	Manistee
	Coho salmon	202,815	Yearling	Michigan	Manistee
	Steelhead	35,200	Yearling	Little Manistee	Manistee
	Steelhead	100,000	Fall Fingerling	Little Manistee	Manistee
	Steelhead	1,850	Fall Fingerling	Little Manistee	Lake
1982	Chinook salmon	600,294	Spring fingerling	Michigan	Manistee
	Coho salmon	200,000	Yearling	Michigan	Manistee
	Steelhead	30,000	Yearling	Little Manistee	Manistee
	Steelhead	100,386	Fall Fingerling	Little Manistee	Manistee
	Atlantic salmon	25,030	Yearling	Sebago	Manistee
1983	Chinook salmon	677,250	Spring fingerling	Michigan	Manistee
	Coho Salmon	429,612	Yearling	Michigan	Manistee
	Steelhead	16,428	Yearling	Little Manistee	Manistee
1984	Chinook salmon	175,773	Spring fingerling	Michigan	Manistee
	Coho Salmon	500,066	Yearling	Michigan	Manistee
	Steelhead	4,817	Yearling	Umpqua	Manistee
	Steelhead	5,079	Yearling	Siletz	Manistee
	Steelhead	5,000	Yearling	Rogue	Manistee
1985	Chinook salmon	500,012	Spring fingerling	Michigan	Manistee
	Coho Salmon	375,283	Yearling	Michigan	Manistee
1986	Chinook salmon	469,994	Spring fingerling	Michigan	Manistee
	Coho Salmon	343,121	Yearling	Michigan	Manistee
1987	Chinook salmon	435,646	Spring fingerling	Michigan	Manistee
	Coho Salmon	266,914	Yearling	Michigan	Manistee
1988	Chinook salmon	601,543	Spring fingerling	Michigan	Manistee
	Coho Salmon	358,250	Yearling	Michigan	Manistee
1989	Chinook salmon	720,352	Spring fingerling	Michigan	Manistee
	Coho Salmon	400,883	Yearling	Michigan	Manistee
1990	Chinook salmon	787,429	Spring fingerling	Michigan	Manistee
	Coho Salmon	225,007	Yearling	Michigan	Manistee
1991	Chinook salmon	680,331	Spring fingerling	Michigan	Manistee
	Coho Salmon	355,403	Yearling	Michigan	Manistee
1992	Chinook salmon	878,348	Spring fingerling	Michigan	Manistee
	Coho Salmon	300,440	Yearling	Michigan	Manistee
	Brook trout	500	Fall Fingerling	Private plant	Lake
1993	Chinook salmon	701,610	Spring fingerling	Michigan	Manistee
	Brook trout	600	Adult	Private plant	Lake
1994	Chinook salmon	742,961	Spring fingerling	Michigan	Manistee
	Brook trout	550	Adult	Private plant	Lake
1995	Chinook salmon	758,903	Spring fingerling	Michigan	Manistee
1996	Chinook salmon	750,653	Spring fingerling	Michigan	Manistee
1997	Chinook salmon	722,159	Spring fingerling	Michigan	Manistee
	Steelhead	500	Yearling	Little Manistee	Manistee
1998	Chinook salmon	701,945	Spring fingerling	Michigan	Manistee
1999	Chinook salmon	491,393	Spring fingerling	Michigan	Manistee
2000	Chinook salmon	497,534	Spring fingerling	Michigan	Manistee
2001	Chinook salmon	493,684	Spring fingerling	Michigan	Manistee
2002	Chinook salmon	491,525	Spring fingerling	Michigan	Manistee
2003	Chinook salmon	591,323	Spring fingerling	Michigan	Manistee
2004	Chinook salmon	495,499	Spring fingerling	Michigan	Manistee
2005	Chinook salmon	495,422	Spring fingerling	Michigan	Manistee

Table 2. Brown and rainbow trout Chapman-Petersen population estimates for an unidentified 0.57 acre survey station on the Little Manistee River, Indian Club property, October 1954. The station length is unknown.

Species	no./acre	lbs/acre
Brown trout	951	88
Rainbow trout	728	29

Table 3. Chapman-Petersen population estimates (total) for survey stations on the Little Manistee River.

Station (Dimensions)	Year	Brown trout no./acre (lbs/acre)	Rainbow trout no./acre (lbs/acre)	Coho salmon no./acre (lbs/acre)	Chinook salmon no./acre (lbs/acre)
Old Grade Campground (984', 0.98 acres)	1979	166 (32)	420 (39)		
Spencer's Bridge (650', 0.50 acres)	1981	296 (58)	564 (25)		
	1995	510 (88)	N/A[a]		
	2002	876 (114)	2465 (32)	335 (1)	
Indian Club #5 (876', 0.89 acres)	1981	406 (61)	645 (24)		
	1995	589 (64)	N/A[a]		
	2002	835 (116)	2048 (29)	1854 (6)	6 (0)
Indian Club #9.5 (595', 0.52 acres)	1981	566 (62)	2465 (47)		
	1995	383 (82)	N/A[a]		
	2002	1134 (184)	3177 (42)	3272 (9)	
Indian Bridge (984', 0.71 acres)	1980	978 (181)	525 (22)		
	1981	725 (161)	315 (17)		
	1995	519 (125)	N/A[a]		
	2002	1253 (209)	1601 (21)	1030 (4)	
Johnson's Bridge (984', 0.90 acres)	1979	348 (51)	211 (5)		
	1981	364 (83)	390 (18)		
	1995	392 (107)	N/A[a]		
	2002	687 (136)	1354 (18)	1271 (5)	
	2003	556 (99)	1964 (18)	328 (1)	10 (0)
	2004	628 (88)	768 (17)	13 (0)	
DeWitt's Bridge (984', 0.87 acres)	1979	337 (72)	1205 (29)		
	1980	298 (71)	728 (40)		
	1981	307 (96)	457 (28)		
	1995	155 (58)	N/A[a]		
	2002	564 (130)	1645 (29)	1171 (5)	

[a]Fish smaller than 4" were not measured. The population estimate is excluded from this table.

Table 4. Rainbow trout (steelhead) population estimates (no./acre) for the Little Manistee River from 1981-1983 (P. Seelbach, unpublished data) and 1997-1998 (A. Woldt and E. Rutherford, unpublished data).

	Year					
Station	1981 August	1982 Aug/Sept	1983 Aug/Sept	1997 July	1997 October	1998 March
Below 6-Mile Bridge	937	2602	3080	1795	791	603
Mackins Cabin	859	1828	1479	1129	893	668
9-Mile Bridge	1131	982	968	1307	1320	878
Above 9-Mile Bridge	428	592	361	578	672	544
Beartrack Camp	864	1074	894	396	570	152
Driftwood Valley Camp	1706	2299	2322	1003	907	667
DeWitt's Bridge	755	2363	1749	791	502	402
Johnson's Bridge	689	2144	1972	1950	1170	625
Indian Bridge	566	885	838	996	557	239
Indian Club Station #5	1543	2170	1555	617	663	342
Indian Club Station #9.5	2064	2379	2569	696	587	336
Spencer's Bridge	727	481	1165	336	378	874
Snowmobile Bridge	384	374	328	72	168	180
Luther	N/A	1016	967	830	1860	980

Table 5. Number of trout and salmon counted at the Little Manistee weir, 1968-2005[a].

Year	Spring steelhead	Chinook salmon	Coho salmon	Fall steelhead	Fall brown trout
1968	1,640	11,230	60,248	1,322	28
1969	996	26,288	25,186	3,043	36
1970	1,405	34,190	108,400	7,411	123
1971	5,031	21,213	59,123	7,622	69
1972	7,403	24,994	2,314	3,561	5
1973	6,588	16,476	11,872	1,926	48
1974	3,684	24,156	6,129	3,488	161
1975	7,183	29,228	15,863	6,121	238
1976	1,874	16,159	24,505	578	106
1977	10,480	11,136	25,255	2,031	98
1978	7,240	20,230	23,696	320	51
1979	3,540	22,925	27,925	640	100
1980	4,505	15,761	50,004	1,111	28
1981	6,307	11,811	14,656	849	101
1982	4,100	14,358	18,458	347	62
1983	5,091	39,359	26,968	3,100	43
1984	7,950	32,632	33,982	1,909	141
1985	6,517	34,006	15,256	6,356	177
1986	7,036	22,131	16,724	4,720	99
1987	6,315	31,841	15,101	1,450	48
1988	8,432	12,519	4,467	1,050	27
1989	5,102	18,338	14,023	1,130	29
1990	4,411	19,499	10,030	1,521	55
1991	6,109	21,067	12,300	3,666	113
1992	4,597	15,866	13,441	3,054	104
1993	6,156	12,911	18,096	1,702	118
1994	4,411	11,886	562	2,849	126
1995	3,553	13,004	394	351	31
1996	9,057	17,090	2,572	5,249	174
1997	7,096	15,433	781	915	123
1998	4,005	7,170	1,463	888	28
1999	4,324	18,621	519	662	39
2000	4,239	13,029	600	319	74
2001	7,029	18,279	911	2,262	59
2002	6,290	19,385	538	120	38
2003	3,209	14,419	616	1,404	43
2004	2,571	15,618	1,102	1,074	60
2005	3,388	11,075	2100	665	53
Total	198,864	735,333	666,180	86,786	3,056
Average	5,233	19,352	17,531	2,284	80

[a] The numbers found in Table 5 do not represent the entire annual run of each species. The numbers include only those which were harvested or passed through the weir. For example, the weir is typically removed in early to mid-November, and it is well known that many fall-run steelhead and coho salmon enter the river after the weir is removed. Similarly, many steelhead often ascend the river in early spring before the weir is put in place. And finally, many Chinook salmon ascend the Little Manistee River in the summer, again when the weir is not in place. Any fish that ascends the Little Manistee River while the weir is not in place does not get counted.

Table 6. Estimates of the number of wild Chinook and coho salmon smolts outmigrating from the Little Manistee River in 1982-1984 (Seelbach, 1985b), and 1996-1998 (Woldt and Rutherford, unpublished data).

Year	Chinook salmon	Coho salmon
1982	32,409	37,192
1983	32,190	24,717
1984	121,239	9,272
1996	73,333	2,350
1997	128,774	111,494
1998	59,876	78,568

Table 7. Percentage of the steelhead run that consisted of wild and hatchery fish at the Little Manistee weir, 1991-2003, as determined by Ratio 23 analysis of scale samples.

	Fall		Spring	
Year	Wild	Hatchery	Wild	Hatchery
1991	76.5	23.5	87.3	12.7
1992	83.6	16.4	80.8	19.2
1993	82.0	18.0	76.6	23.4
1994	77.4	22.6	72.6	27.4
1995	84.8	15.2	82.7	17.3
1996	77.9	22.1	71.3	28.8
1997	72.4	27.6	57.1	42.9
1998	89.0	11.0	76.8	23.2
1999	89.0	11.0	74.5	25.5
2000	85.8	14.2	68.1	31.9
2001	87.2	12.8	86.9	13.1
2002	82.7	17.3	78.8	21.2
2003	91.1	8.9	81.9	18.1
2004	76.4	24.6	59.0	41.0
Average	82.0	18.0	75.5	24.5

Table 8. Average total length-at-age and growth (relative to the state average, in inches) for fish sampled from Johnson's Bridge, Little Manistee River, August 2002-2004.

Year	Species	Age	Number aged	Length Range (in.)	Weighted mean length (in.)	Mean growth index (in.)
2002	Brown trout	0	19	2.2-3.3	2.8	+0.1
		1	41	4.4-7.8	6.2	-
		2	30	8.0-11.5	9.6	-
		3	39	10.4-15.2	12.7	-
		4	18	13.1-18.8	14.7	-
		5	1	20.5-20.5	20.5	-
	Chinook salmon	1	1	5.5-5.5	5.5	-
	Coho salmon	0	27	2.3-3.9	3.0	-
	Rainbow trout (steelhead)	0	30	1.2-3.7	2.2	-0.4
		1	39	4.0-7.7	5.3	
		2	2	8.3-8.4	8.4	
2003	Brown trout	0	26	2.4-4.8	3.2	-0.4
		1	25	4.1-7.5	6.2	-
		2	37	7.2-11.3	9.0	-
		3	25	10.1-13.2	11.9	-
		4	15	13.2-16.7	14.5	-
		5	2	13.4-15.3	14.5	-
	Chinook salmon	0	7	3.6-4.1	3.9	-
	Coho salmon	0	28	2.3-4.5	3.0	-
	Rainbow trout (steelhead)	0	33	1.2-3.7	2.1	-0.6
		1	39	4.3-8.3	6.1	
2004	Brown trout	0	20	2.3-3.7	2.9	-0.4
		1	33	4.8-7.8	6.3	-
		2	19	7.6-10.5	9.1	-
		3	30	8.8-13.3	11.7	-
		4	8	11.9-16.3	14.3	-
		5	2	15.1-20.6	17.9	-
	Chinook salmon	0	1	3.3-3.3	3.3	-
	Coho salmon	0	5	3.3-3.8	3.5	-
	Rainbow trout (steelhead)	0	30	1.2-3.5	2.4	-0.3
		1	43	4.0-8.4	5.9	

[a]Growth index is the deviation from the state average length; at least five individuals must be aged from any one age group to make the comparison.

Table 9. Brown trout population estimates by age, percent by age, and annual survival at Johnson's Bridge, Little Manistee River, 2002-2004.

	Population estimate by age (no./acre)						
Year	0	1	2	3	4	5	Total
2002	264	267	56	70	29	1	687
2003	290	71	128	41	22	3	556
2004	358	148	39	67	13	3	628

	Percent of population by age						
Year	0	1	2	3	4	5	Total
2002	38.5	38.8	8.1	10.2	4.2	0.2	100.0
2003	52.2	12.8	23.0	7.4	4.0	0.6	100.0
2004	57.0	23.5	6.2	10.6	2.1	0.5	100.0

	Percent survival					
Year	Age 0 to age 1	Age 1 to age 2	Age 2 to age 3	Age 3 to age 4	Age 4 to age 5	Age 5 to age 6
2002	26.9	47.9	74.0	31.7	11.5	-
2003	51.0	54.7	52.2	32.4	15.0	-
2004	-	-	-	-	-	-

Table 10. Population estimates, by age, of migratory salmonids at Johnson's Bridge, Little Manistee River, 2002-2004.

		Population estimate by age (no./acre)			
Species	Year	0	1	2	Total
Rainbow trout	2002	1152	200	2	1354
	2003	1838	127	0	1964
	2004	603	164	0	768
Coho salmon	2002	1271	0	0	1271
	2003	328	0	0	328
	2004	13	0	0	13
Chinook salmon	2002	-	1	-	0
	2003	10	0	0	10
	2004	-	-	-	0

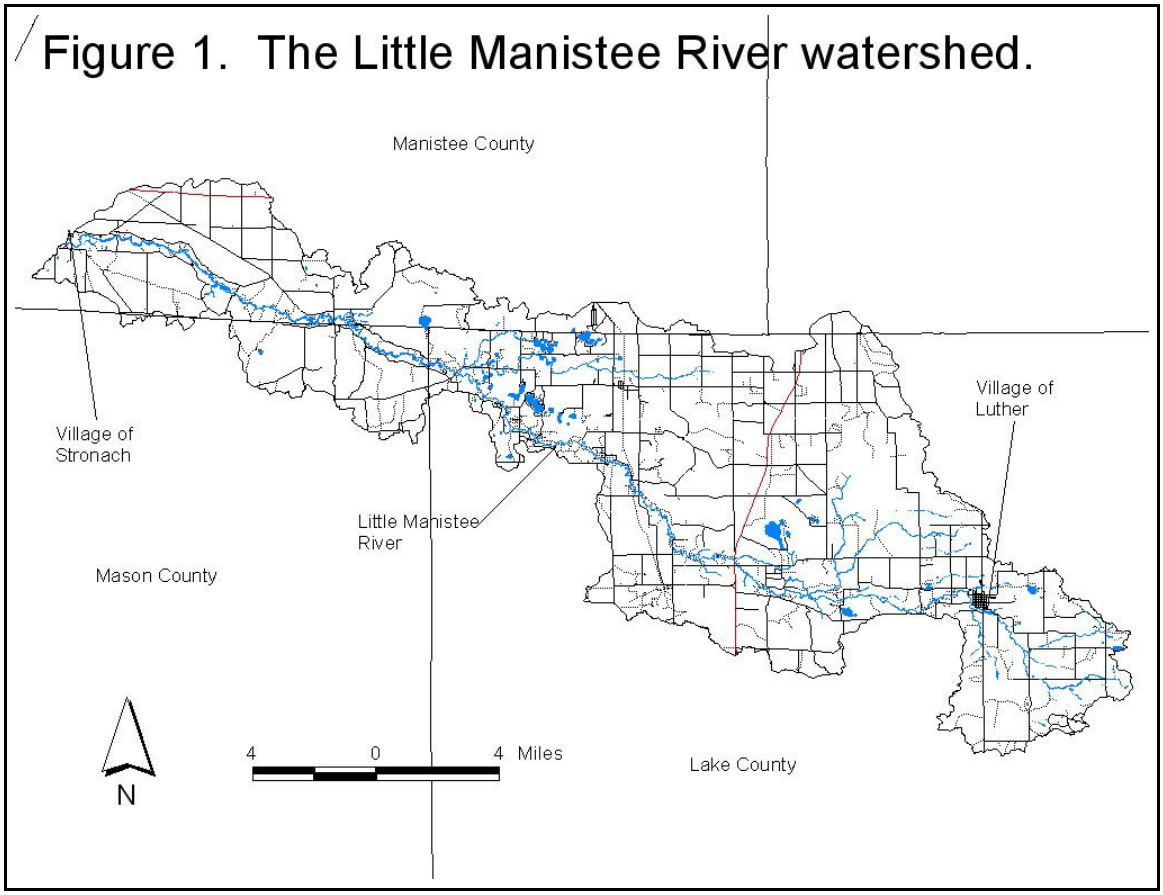
Table 11. MDNR creel census data for the Little Manistee River from Driftwood Valley Campground to Manistee Lake, summer 2004, all sites combined.				
	Chinook salmon	Rainbow trout	Brown trout	Brook trout
Estimated number of fish harvested	640			187
Estimated number of fish released	191	1,355	257	

Table 12. Population estimates for trout and juvenile salmon from northern Michigan trout streams, 2002-2004.

		Brown trout		Rainbow trout	Brook trout	Coho salmon	Chinook salmon
River (Station)	Year	no./acre	lbs/acre	no./acre	no./acre	no./acre	no./acre
Little Manistee River	2002	689	135.58	1,354		1,271	
(Johnson's Bridge)	2003	556	98.61	1,965		238	10
	2004	628	88.16	768		13	
Platte River	2002	380	110.20	1,924		235	
(upper US-31 crossing)	2003	339	102.64	676		719	
	2004	297	77.88	2,611		639	
Pere Marquette River	2002	143	67.81	2,210		70	8
(Baldwin River mouth)	2003	233	103.18	2,551		167	177
	2004	180	83.96	922		44	18
Upper Manistee River	2002	1,369	121.76		309		
(Cameron Bridge)[a]	2003	1,518	85.77		427		
	2004	1,492	80.81		599		
Boardman River	2002	205	38.21	2	463		
(Ranch Rudolf)[a]	2003	200	33.68	1	496		
	2004	201	43.15	1	346		
Au Sable River	2002	1,243	135.14	861	463		
(Stephan Bridge)[a]	2003	876	89.4	649	292		
	2004	994	91.7	688	402		

[a]Survey station not accessible to migratory fish from the Great Lakes.

Figure 1. The Little Manistee River watershed.



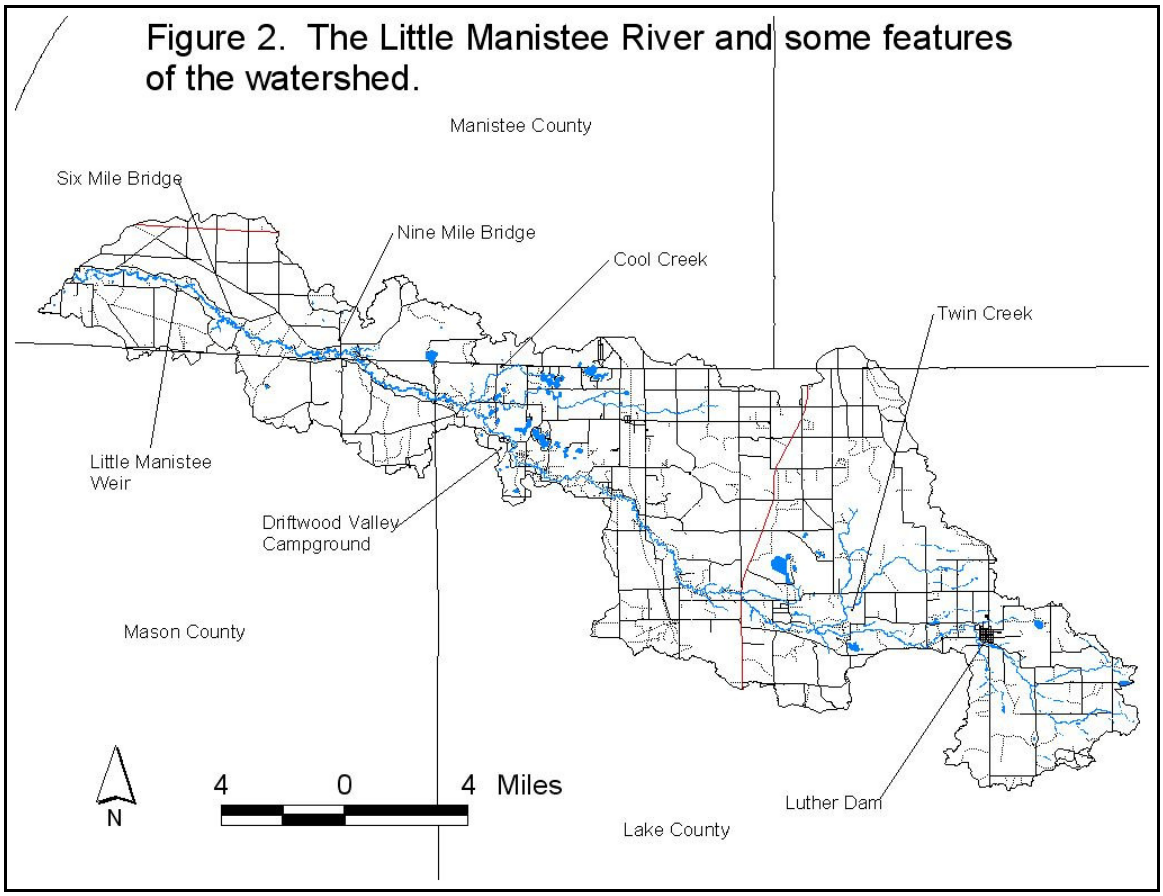


Figure 2. The Little Manistee River and some features of the watershed.
Manistee County
Six Mile Bridge
Nine Mile Bridge
Cool Creek
Twin Creek
Little Manistee Weir
Driftwood Valley Campground
Mason County
N
4 0 4 Miles
Luther Dam
Lake County

Figure 3. Michigan Department of Natural Resources fish sampling sites on the Little Manistee River.