Muskegon River Angler Survey Report, 1985 - 2005
Croton Dam to Muskegon Lake,
With Summaries of Lakes, Impoundments and Other River Sections

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by
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October 15, 2015

Introduction

The Muskegon River is part of the Lake Michigan watershed and is located in the west, central portion of Michigan's Lower Peninsula (Figure 1). Detailed information on the fisheries and management of this river can be found in the Muskegon River Watershed Assessment (O'Neal 1997).

From 1985 through 2005, the Michigan Department of Natural Resources (MDNR), Fisheries Division conducted multiple surveys to assess the level of angler-effort, fish harvest, fish catch and recreational boating effort (not related to fishing) on the lower portion of the Muskegon River, between Croton Dam and Muskegon Lake. This report summarizes the results of these surveys. Summaries of fisheries throughout the mainstem of the Muskegon River are also provided.

Methods

Angler surveys were conducted during 1985, 1986, 1987, 1988, 1989, 1999, 2000, 2001, 2002, 2003, 2004, and 2005. The survey area included 48.5 miles of the Muskegon River and was broken into two sections for analyses: 1) from Croton Dam to the Newaygo Public Access Site (PAS) at Bridge Street (Site 151), and 2) from the Newaygo PAS to Muskegon Lake (Site 152; Figure 1; Table 1). Site 151had a surface area of 142.5 acres, a river distance of 15.0 miles and a 3.5 ft/mi gradient (Table 2). Site 152 was 33.5 miles long, with a surface acreage of 288.3 and gradient of 1.5 ft/mi. Measures of river miles, acreage and elevation change were made using 1:24000 topographic maps and Arcview GIS with a 3 arc second digital elevation model. One section of river was surveyed by two creel clerks (MDNR) each day.

Surveys were conducted during various months from February 1 through December 31. From 1985 through 1989, Site 152 was not surveyed and surveys in Site 151 were conducted only during spring and fall periods. Site 152 was not sampled during all months (especially summer), from 2001 through 2005, due to personnel limitations. Surveys during February and December were dependent on snow and ice conditions and sometimes included only part of the month.

Each creel clerk worked 40-hours per week to complete the surveys using a progressive roving-access points design with a roving-progressive count method (Lockwood et al. 1999). Two weekend days and three randomly selected weekdays were sampled each week. No holidays were sampled. One eight-hour shift (between 6:00 am and 4:00 pm or between 10:30 am and 10:00 pm) was worked each sampling day, with starting and ending times varying each month to adjust for changing daylight period. Only daylight periods were surveyed. Both shore anglers (including those who were wading) and anglers fishing from boats were counted and interviewed. Angler effort and fish catch was estimated from the angler interview and count information. The non-fishing recreational boats were also interviewed and counted separately during 2003.

The starting point within a river section for collecting interviews and performing a count was alternated daily following a randomized schedule. Angler counts were made each day by boat, starting at the most upstream location of the site and motoring downstream to the lower end of the site. Counts were made of shore and boat anglers separately. From 1985 through 1989, counts of shore and boat anglers were made from shore, and sometimes trailer counts were used to estimate boat effort. Direct comparisons between the 1985 − 1989 and 1999 − 2005 periods may not be appropriate because of the different count methods. Effort may have been underestimated during the 1985 – 1989 period because all areas of the river were not accessible to make counts of boat and shore anglers.

One count of boat and shore anglers was made each survey day for the section of river sampled. Clerks interviewed each individual shore fishing angler or boat anglers (combined) that returned to the access sites during the scheduled shift. Date, time and interview site were recorded for all interviews. When the boater did not fish, that was recorded on the form as a non-fishing party and the interview was ended. When fishing occurred, anglers were queried as to their mode of fishing (i.e., boat or shore), where they fished, how long they fished, what they fished for, the numbers (by species) of fish they caught and numbers kept, and the number of fishing trips they made or intended to make that day. Anglers were usually interviewed at the end of their fishing trip, rather than during their fishing trip, to insure the most complete amount of information was obtained. Interviews were collected at 16 locations on the river (Table 1).

Estimates of three measures of fishing effort: angler-hours, angler-trips and angler-days were generated from these angler surveys. An angler-trip was one completed fishing excursion, having a required minimum restriction of at least one hour of fishing. An angler-day was composed of one or more angler-trips during a 24−hour period. Other estimates generated from these creel surveys included: number of fish harvested (caught and kept by anglers), number of fish caught (combined harvested and released by anglers) and species-specific harvest and catch rates. Separate estimates were made for both boat and shore modes of fishing, for each month (Appendices 1−33). Estimates of fish released included fish that were legal (meeting minimum size regulations) and sub-legal fish. Standard mathematical formulas for creel surveys were used to calculate all estimates (Lockwood et al. 1999). Uncertainty values for all catch and effort estimates in this report are defined as two standard deviations of their mean estimates (2 times the square root of the variance for an estimate).

Non-fishing (recreational) boating hours were also estimated during 2003. However, because non-fishing boat interviews did not include a question for boat occupancy, a total person effort estimate (every occupant multiplied by the number of hours each occupant spent boating) for non-fishing boat hours could not be generated. Therefore, direct comparisons between the total estimated angler-hours and non-

fishing person-hours were not applicable. Also, during 2003, the numbers of anglers fishing with guides were identified during the interview process.

Using the results of the angler surveys, we were also able to estimate the dollar value of fillets from harvested fish estimates. Total harvested fish weight was estimated using the minimum legal harvest length (largemouth bass, smallmouth bass, northern pike, trout, salmon, walleye, northern muskellunge and channel catfish) or the assumed minimum harvest size (panfish, bullheads, rainbow smelt, whitefish and suckers) and standard length-weight equations (Schneider et al. 2000). Fillet weights were estimated at 30% of total weight for all species. The Food and Agriculture Organization of the United Nations (2014) estimated whole weight to fillet weight conversions of 11 species of fish from 30% to 50% (catfish were 35%). By using the minimum length and fillet conversion values we assumed the total estimated fillet weight would be conservative for fish harvested in the Muskegon River. The value of all fillets was assumed to be $8.00 per pound based on current values listed in local Michigan grocery stores.

Fish stocking may have affected the level of fishing and catch in this river section during the survey period. Although walleye stocking varied somewhat during this period, the walleye population has been relatively stable between 1986 and 2002 (Table 3; Day 1991; O'Neal 1998; Hanchin et al. 2007). Steelhead (rainbow trout that migrate to and from Lake Michigan) stocking was relatively stable and Chinook salmon stocking varied somewhat. Chinook salmon populations declined significantly in the mid to late 1980s in Lake Michigan as a result of low forage and disease issues (Bunnell 2012). Brown trout and rainbow trout, stocked primarily to provide summer river fisheries, ranged from 35,000 to 65,000 from 1985 − 1989. Trout stocking began to increase in 1993 to provide better summer angling opportunities. From 1998 through 2005, the number of stocked rainbow and brown trout ranged from 198,150 to 229,895. The 1998 increase was made to determine if greater annual carryover of stocked trout could be achieved through greater stocking densities, for the purpose of providing more large trout for anglers. The Muskegon River has water temperatures that are marginal for trout management. Natural reproduction of steelhead in this river is low due to high mortalities of juveniles during the first summer of life (Godby et al. 2007; Albrecht 2014).

Changes in fishing regulations may also have affected fishing effort and fish catch in the river during the survey period. Prior to 2000 both sites had the same fishing regulations. The daily harvest limit for trout and salmon, from the last Saturday in April through September 30, was 10 fish 8 inches and larger, but no more than 3 fish ≥ 16 inches. The remainder of the year the harvest limit was 3 fish ≥ 16 inches. Beginning in 2000, two new regulations were implemented in the river. A Type 3 regulation allowed fishing all year, with a 5 fish harvest limit but no more than 3 fish ≥ 16 inches, and the minimum size limit for brown and rainbow trout was 15 inches, and 10 inches for Chinook salmon. This regulation is used in streams that have fall to winter migrations of brown trout from the Great Lakes. A Type 4 regulation allowed fishing all year; with a 5 fish harvest but no more than 3 fish ≥ 16 inches; and the minimum size limit for brown trout, rainbow trout and Chinook salmon was 10 inches; and brown trout fishing was closed from October 1 through the last Saturday in April. The Type 4 regulation is typically used for streams that have fall to spring migrations of steelhead from the Great Lakes. From 2000 through 2004, the Type 4 regulation was applied to the river section from Croton Dam to the Thornapple Street PAS (the upper section of Site 151). The Type 3 regulation was applied from the Thornapple Street PAS to Muskegon Lake (the lower portion of Site 151 and all of Site 152). Beginning in 2005, The Type 4 regulation was applied to all of Site 151 and the Type 3 regulation was continued for all of Site 152. The reason for these regulation changes were summarized by O'Neal (2003a).

Results

Angler surveys, from 1985 through 1989, were only conducted at Site 151(Croton Dam to Newaygo at Bridge Street) during spring and fall months (Table 4). Angler surveys were conducted at both Sites from 1999 through 2005, but Site 152 (Newaygo to Muskegon Lake) was not sampled during June 2001, or from June through August during 2002 through 2005.

The average number of angler-hours at Site 151, from 1985 – 1989, during the months of March, April, May, August, October and November, was estimated at 94,016 (Table 4). For the same months during 1999 through 2005, Site 151 had an estimated average number of 208,555 angler-hours. Although this indicates that angler effort was 2.2 times greater during 1999 - 2005, effort during the 1985 − 1989 was potentially underestimated because counts were made from shore and all areas of the river were not counted. However, this information suggests that effort may not have decreased between the early and later sampling periods.

The greatest number of angler-hours measured on the river was 441,777 during 2000, for both Sites combined (Table 4; Figure 2). The average number of angler-hours expended on the river, from 1999 – 2005, was 265,121 at Site 151, 74,354 at Site 152, and 339,475 at both sites combined. The average number of angler-hours per acre, for those same years, at Site 151 (1,860/acre) was 7.2 times greater than at Site 152 (258/acre; Table 5).

Seasonally, average angler-hours were highest during April and October, for 1999 through 2005 (Table 4). Boat fishing accounted for 61% of total effort during all years from 1999 through 2005, and was relatively consistent throughout the period (Table 6).

The estimated number of non-fishing watercraft-hours expended between Croton Dam and Muskegon Lake was 25,138, during 2003 (Table 7). This estimate of watercraft use was low because only individual watercrafts were counted and more than one person was present in some of the watercraft. Anglers fishing with commercial guides accounted for 7.2% of the interviews conducted during 2003, from Croton Dam to Muskegon Lake (Table 8).

The average harvest rate of fish at Site 151 was similar during 1985 – 1989 and 1999 – 2005 (Table 9). However, the average harvest rates of Chinook salmon and yellow perch were higher during 1985 – 1989 and the average harvest rate of rainbow trout and brown trout were greater during 1999 – 2005. More harvested fish were recorded at Site 151 during 1999 – 2005 compared to 1985 – 1989, but this direct comparison is not appropriate because the survey period covered a longer period (more months) than during 1985 – 1989.

During the period from 1999 – 2005, the total number of fish caught at Sites 151 and 152 was 900,648 (Table 10). Three species accounted for 95.9% of the catch, including rainbow trout (71%), Chinook salmon (13.4%) and brown trout (11.5%). These three species also accounted for 91.3% of harvested fish. The release rate of fish was 2.7 times greater than the harvest rate (Table 10). For every 100 hours of fishing, 40 fish were captured, 29 fish were released and 11 fish were harvested. Species of fish that were harvested at a greater rate than were released included northern pike, pumpkinseed, rock bass, yellow perch and other unidentified species (probably suckers). Walleye were harvested and released at a

similar rate. The release rate of smallmouth bass was 7.2 times higher than the harvest rate, followed by brown trout (3.8 times higher), rainbow trout (3.0 times higher) and Chinook salmon (2.0 times higher).

The total number of released fish at Site 151 was 3.0 times greater than harvested fish during 1999 − 2005 (Table 10). Species of fish with the greatest harvest at Site 151 were rainbow trout, Chinook salmon, brown trout and yellow perch. The total number of harvested fish at Site 152 was 2.2 times greater than released fish (Table 10). Species of fish with the greatest harvest at Site 152 were rainbow trout, Chinook salmon, walleye and pumpkinseed. The number of fish caught per acre at Site 151 was 6,008 (858/acre/year), and 154 per acre (22/acre/year) at Site 152 (Table 10).

The total release rates of fish at Site 151, from 1999 – 2005, were higher than total harvest rates during all months (Table 11; Figure 3). Both release and harvest rates were the highest from May through October. Brown trout and rainbow trout were caught during all months, and walleye and yellow perch during most months (Table 11). Chinook salmon were caught primarily during fall, northern pike during spring, and largemouth bass, pumpkinseed, rock bass and smallmouth bass during summer.

The total harvest rates of fish at Site 152, from 1999 – 2005, were higher than total release rates during all months except June (Table 12; Figure 4). The harvest rate was highest during fall and the highest release rate occurred during June. Rainbow trout were caught mostly during spring and fall, Chinook salmon during fall, and brown trout in June. Walleye, smallmouth bass, pumpkinseed, and northern pike were caught from spring through early fall.

The harvest rates of principal fish species varied annually during the period from 1985 through 2005. The average harvest rate of rainbow and brown trout at Site 151 was higher during the later period (1999 – 2005) than the earlier period (1985 – 1989), but rates during 1986 and 1989 were similar to rates found in the later period (Table 13). The average Chinook salmon harvest rate was higher during the earlier period, but rates during 1985 and 1988 were similar to the later period. Release rates for these same species at Site 151, from 1999 through 2005, also had substantial annual variations (Table 14).

Rainbow trout had the highest harvest rate at Site 152 during all years from 1999 through 2005 (Table 15). With the exception of 2005, chinook salmon had the second highest harvest rates at Site 152, followed by walleye. Rainbow trout also had the highest release rates at Site 152 during all years from 1999 through 2005 (Table 16). Chinook salmon had the second highest average release rate at Site 152, but released fish were recorded in only three of the seven years. Walleye and brown trout had low release rates, occurring in only one year. Smallmouth bass and brown trout were the only species that were released at a greater rate than harvested at Site 152. Smallmouth bass were released in all but one year.

Discussion

The section of the Muskegon River, from Croton Dam to Muskegon Lake, provides a significant multiple-species fishery. Based on the average number of angler-days (88,828), from 1999 through 2005, the annual value of this fishery to the local economy was $2,576,012 (using a value of $29 per angler-day from: U.S. Department of the Interior 2013). An estimated average of 78.1% of this effort was expended between Croton Dam and Newaygo (Site 151). The amount of fishing effort was 7.2 times higher per acre and 8.0 times higher per mile at Site 151 compared to Site 152. A significant amount of fishing occurred from boats (average = 61%), as well as from shore (average = 39%). Seasonally, average angler

effort was greatest during April and October, during the peak steelhead and Chinook salmon spawning runs. These estimates do not include fishing that occurred after dark or during the winter season.

The angler surveys conducted from 1999 through 2005 provide the most complete and recent angler-use information for this section of river. Some comparisons to the 1985 through 1989 surveys were available for Site 151 during spring and fall months. Although effort could not be directly compared between the two periods because of incomplete angler counts during 1985 – 1989, the estimates suggest that effort was similar between the early and latter periods.

Angler effort on the Muskegon River is comparable to other Michigan streams with Great Lakes migratory trout and salmon fisheries. The number of trips per mile at Site 151 (4,482) was above the average of 3,596 trips per mile for seven streams that have migratory trout and salmon (Table 17). Site 152 on the Muskegon River had a lower average number of trips per mile at 725. The higher level of effort at Site 151 resulted from the better habitat located in that river section for spawning steelhead and salmon, as well as the higher densities of stocked trout that provide summer fisheries. A similar situation occurs for the Manistee River between sites 130 and 341 (Table 17).

Michigan streams that do not have Great Lakes trout and salmon spawning runs have a lower average angler effort of 519 trips per mile (Table 18). This demonstrates the importance of the migratory spawning runs of salmon and steelhead to the fisheries in these streams, from fall through spring. The highest amount of effort in the lower Muskegon River occurs in April and October, during the peak steelhead and salmon spawning runs (Table 4). The lower sections of the Muskegon (Site 152) and Manistee (Site 341) Rivers have angler effort values more similar to the inland streams during the summer season, from May – September (Table 17). The upper sections of the Muskegon (Site 151) and Manistee (Site 130) Rivers have relatively high levels of angler effort during May – September. The higher effort results from the high density trout stocking that occurs in the upper sections of both rivers, and the stocked summer-run steelhead fishery in the Manistee River.

The total harvest rate of fish during 1985 − 1989 was higher than in 1999 − 2005 (Table 9). The higher harvest rates during the early period resulted from high harvest rates of Chinook salmon and yellow perch. The abundance of Chinook salmon in Lake Michigan was much higher in the 1980s than during the latter period, and this likely effected harvest rates. Yellow perch are a species that are transported to the river from Croton Impoundment and there is insufficient information to determine the reason for the higher catch rates during the 1980s. The harvest of rainbow trout (includes steelhead) and brown trout were higher during the latter period. Stocking rates of steelhead were comparable during the two periods. Rainbow trout and brown trout stocking was much greater during the latter period (range = 198,000 to 230,000) than the early period (range = 35,000 to 65,000; Table 3). In addition, a much greater percentage of brown and rainbow trout were stocked at Site 152 during the early period compared to the latter period. The higher stocking rates likely improved the harvest rates of rainbow trout and brown trout during 1999 − 2005. However, individual years during the two periods had similar catch rates for these two species (Table 13). In addition, fishing regulation changes may have had effects on harvest between the two periods that cannot be determined from the creel survey data.

The total fish catch, number harvested and number released, at both sites during 1999 – 2005, was dominated by rainbow trout, Chinook salmon and brown trout. However, the fishery at the two sites differed substantially. The total fish catch was 19 times higher and total catch rate was 4 times higher at Site 151 than Site 152. The release rate of fish was 3 times higher than the harvest rate at Site 151, and at

Site 152, the harvest rate was twice as high as the release rate. There are a number of factors contributing to these differences. Site 151 has moderate stream gradient (Table 2) with large areas of stone and cobble substrate intermixed with sand that is favorable to spawning trout and salmon. Site 152 has low stream gradient with predominantly sand substrate, although the portion of this segment from Newaygo to the Felch Street access has substantial cobble substrate. Water temperatures are marginal for trout survival within Site 151 and mortality of naturally produced juveniles is very high (Godby et al. 2007; Albrecht 2014). The average summer water temperatures increase by another 0.5° F to 1.0° F at Site 152, resulting in more thermal stress (O'Neal 2001). Because of the more favorable habitat conditions, trout stocking is much higher within Site 151 than Site 152. Lake Michigan migratory steelhead and Chinook salmon spawn predominantly within Site 151. Site 151 is also better for shore fishing because it is shallow and has more public access. The minimum size limit for fish harvest was higher within Site 152 (15 inches compared to 10 inches at Site 151) for brown and rainbow trout, however, brown trout fishing was closed during fall through spring within Site 151. All of these factors contributed to the higher angler effort, fish catch, harvest rate and release rate of fish at Site 151. The two peaks in angler effort emphasize the importance of the migratory steelhead and Chinook salmon fisheries within Site 151 (Table 4). Although, the steelhead and salmon fisheries are also important within Site 152, angler effort is more stable throughout the year in Site 151. The higher release rate of fish within Site 151 is most likely the result of more sublegal fish in the catch due to the higher stocking rates of brown and rainbow trout.

Commercial fishing guide services are provided by an unknown number of businesses operating on the river. During 2003, the number of anglers that were fishing with guides was estimated through the interview process (Table 8). The number of guided anglers represented a low percentage (7.2%) of total anglers, and most guiding occurred during the spring and fall months during the steelhead and salmon spawning runs.

During 2003, the number of non-fishing watercraft was estimated to help determine the amount of recreational use on the river. An estimated 25,138 watercraft hours were expended on the river between Croton Dam and Muskegon Lake (Table 7). This value is not directly comparable to the number of fishing hours estimated because the number of people in each watercraft was not counted. Even if we assume there were two people in each non-fishing watercraft, the total number of non-fishing watercraft hours would be only about 15% of the total fishing hours expended on the river during 2003. Most of the non-fishing watercraft use occurred during July and August. Law enforcement activities related to non-fishing watercraft use has increased in recent years (2014) and it's likely that non-fishing watercraft use has increased in this river section since 2003.

The average annual value of harvested fish fillets from the Muskegon River section between Croton Dam and Muskegon Lake was estimated at $112,643 (Table 19). This estimate is considered a minimum value because minimum lengths were used to estimate weight, and a conservative value was used to estimated fillet weight from whole fish weight. Most harvested fish are larger than the legal minimum size limit.

Fish stocking considerations

A substantial number of fish are stocked into the lower Muskegon River each year (Table 3). Use of the fisheries by anglers is one measure that can help determine the benefits of fish stocking. The total annual cost of fish stocking in the lower Muskegon River, for all species allocated in the Fisheries Division Management Prescription during 2014, was $286,495. The cost by species is as follows: walleye spring fingerlings at 105,800 per year − $4,655; steelhead yearlings at 55,000 per year − $91,300; Chinook salmon spring fingerlings at 18,000 per year − $7,740; rainbow trout yearlings at 85,000 per year −

$129,200; and brown trout yearlings at 40,000 per year − $53,600. The total cost of the annual fish stocking into this river section is far exceeded by the estimated $2.58 million in average annual angler-use, along with the estimated annual harvested fish fillet value of $112,643.

Fish stocking in Michigan follows the criteria and recommendations provided in the Michigan Fish Stocking Guidelines II; with Periodic Updates (Dexter and O'Neal 2004). Fish stocking in the Muskegon River is also guided by the recommendations provided in the Muskegon River Watershed Assessment (O'Neal 1997) and the Muskegon River Watershed Plan (O'Neal 2003b). Important native fish species that are currently under study and included in management and stocking decisions include walleye, lake sturgeon, river redhorse, Great Lakes muskellunge, white bass and smallmouth bass, along with many other non-game species including the sucker family that dominates fish biomass in the river. The benefits to the fisheries in the lower Muskegon River of stocking the naturalized species of trout and salmon are clearly evident in the angler catch information. The fisheries in Muskegon Lake and Lake Michigan must also be considered because many species have seasonal migrations to and from these lakes.

Prior to 1960, the walleye spawning run in the Muskegon River was very large, reaching peak levels of over 120,000 adult fish. By 1975, spawning run abundance declined to about 2,000 fish. Fisheries Division began a stocking program in 1978 and the spawning run increased to 43,000 fish in 1986 (Day 1991). The abundance of spawning walleye has remained fairly stable since that time (Hanchin et al. 2007). Walleye fingerling stocking levels were increased from 1991 through 2000 to determine if population levels could be increased (Table 3). Walleye fingerling stocking was returned to standard levels (50/acre every other year) beginning in 2001 because juvenile production did not improved with increased stocking (O'Neal 2014). Natural reproduction of walleye continues to remain at low levels (Allison and Ruetz 2011; Rutherford et al. 2011; O'Neal 2014). Presently, fishing for walleye occurs in the Muskegon River during late spring through the winter, in Muskegon Lake from summer through the winter, and in Lake Michigan near the piers during fall and spring. The annual movements of Muskegon River walleye in Lake Michigan typically range from Leland to the Indiana border (Hanchin et al. 2007) and they also contribute to fisheries within this area. In addition to the average (1999 – 2005) harvest of 486 walleye in the Muskegon River, an estimated 2,082 walleyes were harvested in the summer and winter fisheries in Muskegon Lake, from April 2002 through March 2003 (Hanchin et al. 2007). The greatest harvest of walleyes probably occurs during the spring and fall fisheries in Lake Michigan near the piers, but harvest estimates are not available for this portion of the fishery, or in other areas along the Lake Michigan coast because most of the walleye fishing occurs at night and during the late fall to early spring when creel surveys are not conducted.

Chinook salmon were first successfully stocked in Michigan in 1967, and the Muskegon River was one of the two streams where they were introduced. By the late 1970s, approximately 300,000 natural Chinook salmon smolts were being produced in the Muskegon River (Carl 1980). Similar levels of Chinook salmon natural reproduction in the Muskegon River were estimated during 2003 − 2004, although annual production of smolts varies by a multiple of ten (Rutherford, E., unpublished data). Chinook salmon fingerling stocking in the river ranged from about 100,000 to 300,000 from 1980 through 2005. Chinook salmon populations in Lake Michigan began to decline in the late 1980s due to various factors, and lake-wide stocking level reductions began in 1999. Stocking levels in the Muskegon River declined to 18,000 fingerlings in 2014. The river continues to produce natural smolts. Even though Lake Michigan Chinook salmon populations declined substantially, fishing for them on the Muskegon River continued at high levels through 2005, as indicated by the October peak in angler-hours (Table 4).

Steelhead (Michigan strain rainbow trout that migrate to Lake Michigan) stocking levels in the lower Muskegon River were stable from 1980 through 2014 (Table 3). Steelhead provide a fishery in the Muskegon River from the fall through spring months, and also contribute to the Lake Michigan pier, shore and boat fisheries. The steelhead fishery in the Muskegon River is one of the best in the Michigan (Jonas et al. 2009), and is also one of the most consistent fisheries over time. Although steelhead spawn and produce large numbers of juveniles in the river, survival of natural fish is low because summer water temperatures in the Muskegon River are too high (Godby et al. 2007). Rainbow trout were the species with the highest angler catch, and number of fish harvested and released in the lower Muskegon River during 1999 − 2005. The angler survey reported the combined catch of all rainbow trout, and this included steelhead and the Eagle Lake strain that is stocked to provide summer fisheries. However, most of the late fall through the spring peak in angler-use is primarily comprised of anglers fishing for steelhead. The spring steelhead fishery has been present for many years, and we continue (2014) to observe heavy angler-use for this species while DNR crews collect walleye eggs in the river each spring.

Rainbow trout (primarily Eagle Lake strain) and brown trout (primarily Wild Rose strain) are stocked into this river section primarily to provide summer fisheries. Rainbow and brown trout stocking increased substantially in 1993 (from 74/acre to 134/acre; Table 3). The objective of this stocking level increase was to improve the overall catch of trout in the summer fisheries. Stocking rates were increased to 211,500 (490/acre) in 1998, with the primary purpose of increasing the annual carryover of trout to provide larger fish for anglers. This stocking increase did not improve the annual carryover of trout (O'Neal 2001, 2003a). During this period, the angler survey data indicated few trout were captured within Site 152, so most of the stocked trout were moved to Site 151. Beginning in 2008, trout stocking was reduced to 125,000 (290/acre), with all but 5,000 brown trout stocked within Site 151. This level of stocking is within the rates recommended in the Michigan fish stocking guidelines (maximum of 300/acre), for the section of river from Croton Dam to Muskegon Lake. At the same time, the level of brown trout stocking was reduced to a total of 40,000. The level of brown trout stocking was reduced because studies found that brown trout feed on juvenile Chinook salmon in the Muskegon River (Krueger et al. 2011), and rainbow trout feed mostly on invertebrates.

The 2014 annual stocking cost for rainbow and brown trout was $182,800. The summer (June, July, and August) fishery accounted for 25.8% of the annual angler-hours during 1999 through 2005. Based on this percentage, the summer fishery was valued at approximately $664,611 (total year = $2.58 million), substantially exceeding the value of stocking. Rainbow and brown trout are caught throughout the year. The total number of brown stocked during 1999 – 2005 was 586,291 (Table 3), and the total number caught was 103,350 (Table 10), or 17.6% of the number stocked. The total number of rainbow trout stocked during 1999 – 2005 was 1,268,812 (Table 3), and the total number caught was 639,167 (Table 10), or 50.4% of the number stocked. Rainbow trout are more readily caught by anglers in the Muskegon River because they primarily feed during daylight hours. Brown trout tend to feed from late evening through early morning and there is night fishery. Brown trout catch may have been underestimated more than rainbow trout catch because of the difference in their feeding patterns. Our surveys were not conducted after dark or during the winter months, so overall catch was underestimated for both species.

The Eagle Lake strain of rainbow trout has been used for many years in the Muskegon River. These fish produced consistently good rates for both harvest and release of fish during 1999 through 2005 (Tables 13 and 14). The highest harvest rate of rainbow trout occurred in 1999, when the minimum size limit for harvest was 8 inches. The highest release rate of rainbow trout occurred during 2005 followed by 1999. The Wild Rose strain of brown trout has been used for many years in the Muskegon River. This strain has

produced consistently good harvest and release rates of fish, from 1999 through 2005. The highest harvest and release rates of brown trout occurred during 1999, when the minimum size limit for harvest was 8 inches. Paired comparisons of marked Wild Rose strain brown trout and Gilchrist Creek strain brown trout found that the Wild Rose strain performed better in the fishery (O'Neal 2001).

Fishing regulations

Beginning in 2000, the standard Type 3 and Type 4 fishing regulations were applied to the entire Muskegon River between Croton Dam and Muskegon Lake. The Type 3 regulation has consistently been used through 2014 for Site 152. This regulation allows the harvest of migratory steelhead and brown trout throughout the year. The Type 3 regulation establishes a higher size limit of 15 inches for brown trout and rainbow trout. The higher size limit does not affect the fishery because the number of trout smaller than 15 inches is low in this river section.

Within Site 151, from 2000 through 2004, the Type 4 regulation was applied from Croton Dam to the Thornapple Street DNR Access Site. The Type 3 regulation was applied from the Thornapple Street DNR Access to the Newaygo DNR Access Site at Bridge Street in Newaygo. The Type 3 regulation was implemented in the lower part of Site 151 to determine if higher numbers of larger trout could be maintained with the more restrictive (15 inches vs. 10 inches) minimum size limits. Evaluations of the size structure of the trout populations between these two sections found that higher numbers of large fish were not achieved using the Type 3 regulation (O'Neal 2003a). Beginning in 2005 and continuing through 2014, the Type 4 regulation has been applied to all of Site 151.

The changes in fishing regulations that occurred within Site 151 in 2000 affected the harvest of both brown trout and rainbow trout as indicated by the reduction in harvest rates. The Type 4 regulation changed the minimum size limit from 8 inches in 1999 to 10 or 15 inches from 2000 through 2004. The total harvest of rainbow trout was reduced from 50,000 fish in 1999 to less than 50% of that value in following years (Table 9). The total harvest of brown trout was reduced from 9,000 fish to less than 26% of that value in following years (Table 9). Harvest and release rates of both species also declined, with the exception that release rates for both species increased again in 2005 (Tables 13 and 14). Although angler-effort increased in 2000, it then declined to levels lower than 1999 during all the following years (Figure 2). Stocking rates remained the same during this period. Mortality rates of trout in the Muskegon River are high as a result of high water temperatures, so there is little carryover of fish from one summer to the next. Returning the minimum harvest size to 8 inches within Site 151 is an option that can allow a greater harvest of fish for anglers without affecting the fishery. This is a viable option considering the annual cost of stocking these two species is $182,800.

Fisheries comparisons throughout the Muskegon River

Angler surveys of all sections of the mainstem of the Muskegon River were conducted between 1999 and 2008 (Table 2; Figure 5). Angler surveys were conducted on Higgins Lake (O'Neal 2002), Houghton Lake (Clark et al. 2004) and Muskegon Lake (Hanchin et al. 2007); four impounded river sections that include Reedsburg Impoundment (O'Neal and Kolb 2014c), Rogers Impoundment (O'Neal and Kolb 2014c), Hardy Impoundment (O'Neal and Kolb 2014b) and Croton Impoundment (O'Neal and Kolb 2014a); the river segment from Reedsburg Dam to Rogers Impoundment (O'Neal and Kolb 2014c); and the river segment from Croton Dam to Muskegon Lake.

These angler surveys provide information that can be used to assess and compare the fisheries in the different lake and stream portions of the mainstem. There were differences in the annual survey period

for each of the angler surveys (Table 2). Higgins Lake, Houghton Lake, and Muskegon Lake were surveyed during the summer and winter (ice) periods, and the lower river (Croton Dam to Muskegon Lake) was sampled during all of the year when ice and snow conditions permitted (some months were partially sampled). The upper river sections, from Houghton Lake to Rogers Impoundment, Rogers Impoundment, Hardy Impoundment, and Croton Impoundment were only sampled from spring through fall. There was some fishing that occurred during winter that was not measured, especially on the impoundments. In addition, the angler surveys did not evaluate fishing that occurred after dark, except at dusk and dawn. There are substantial night fisheries in some locations. Higgins Lake has a night fishery for rainbow smelt that was only partially evaluated in the survey. Muskegon Lake has a night fishery for walleye, as well as a harbor fishery near the piers in Lake Michigan. The lower Muskegon River has a night fishery for brown trout during the summer period. The Muskegon port fishery (Lake Michigan and piers) will not be summarized in this report, but many of the fish caught in the port fishery come from the Muskegon River and Muskegon Lake. Despite these limitations, the angler surveys provide a conservative and reasonable assessment of the annual fisheries characteristics and angler effort in the various sections of the mainstem of the Muskegon River.

The estimated annual catch of fish in the 11 river and lake sections of the mainstem was 1,820,610 (Table 20). Twenty-eight species of fish were caught, with yellow perch, bluegill, rainbow smelt, pumpkinseed and rainbow trout comprising 85.4% of the total. Other species that had more than 10,000 fish in the annual catch estimates included rock bass, smallmouth bass, black crappie, northern pike, walleye, Chinook salmon, brown trout, and largemouth bass. The estimated number of fish released was 454,276, with yellow perch, bluegill, and rainbow trout accounting for 71.5% (Table 21). Other species that had more than 10,000 fish in the annual release estimates included smallmouth bass, northern pike, brown trout, Chinook salmon, largemouth bass and walleye. The estimated number of fish harvested was 1,366,334, with yellow perch, rainbow smelt, bluegill, and pumpkinseed accounting for 87.7% (Table 22). Other species that had more than 10,000 fish in the annual harvest estimates included rock bass, black crappie, rainbow trout, walleye, northern pike, and smallmouth bass. Higgins Lake, Houghton Lake, and Muskegon Lake accounted for 81.7% of total catch and 92.4% of total harvest. Higgins Lake, Muskegon Lake, and the river section from Croton Dam to Newaygo accounted for 68.1% of total released fish.

For every 100 hours of fishing, 124 fish were caught, 93 were harvested and 31 were released (Tables 20 – 22). The catch rate (per hour) of fish was high in the river section from Reedsburg Dam to Dolph Road and Higgins Lake, and relatively high in Muskegon Lake (Table 20). The release rate of fish was high in the river section from Reedsburg Dam to Dolph Road and Reedsburg Impoundment, and relatively high in the river section from Dolph Road to Temple, Muskegon Lake, Hardy Impoundment and Croton Impoundment (Table 21). The harvest rate of fish was high in Higgins Lake, the section of river from Reedsburg Dam to Dolph Road and Muskegon Lake (Table 22).

Based on the fish harvest estimates provided in Table 22, the annual value of harvested fish fillets by anglers in the mainstem of the Muskegon River was approximately $707,889 (Table 23). Houghton Lake, Higgins Lake, the river section between Croton Dam and Newaygo, and Muskegon Lake accounted for 91% of this value. Yellow perch, bluegill, northern pike, rainbow trout, walleye, pumpkinseed, Chinook salmon, and smallmouth bass accounted for 88.7% of the total fish fillet value.

An estimated 1,473,420 angler-hours were expended on the river during a one year period (Table 24). The number of angler-hours per acre was very high for the river section from Croton Dam to Newaygo,

and high for the river sections from Newaygo to Muskegon Lake and Reedsburg Dam to Dolph Road. The number of angler-hours per acre was very low in the river segment from Dolph Road to Temple.

The number of non-fishing watercraft-hours was highest in Hardy Impoundment and lowest in Reedsburg Impoundment (Table 24). Non-fishing watercraft-hour use rates per acre were greatest in the two river sections from Croton Dam to Muskegon Lake, and lowest in Reedsburg Impoundment and Croton Impoundment. Non-fishing watercraft hours were not measured for Higgins Lake, Houghton Lake and Muskegon Lake. Estimates for these lakes were made using the value for Hardy Impoundment (29/acre; Table 24). Higgins Lake, Houghton Lake and Muskegon Lake are highly developed and receive a great amount of recreational boating. The value of 29 watercraft-hours per acre may be conservative for these lakes. For comparison, Silver Lake is a highly developed lake located about 50 miles north of Muskegon that has intensive recreational boating. The average estimated number of watercraft-hours per acre for Silver Lake was 44.2 during 1996 and 1997 (Lockwood 2000a). The numbers of non-fishing person hours were not estimated in the Muskegon River surveys because interviews did not include enumeration of non-fishing persons per watercraft. Assuming there was an average of two people for each non-fishing watercraft, the annual estimated non-fishing person hours was 2.4 million for the entire mainstem (Table 24). This may be a conservative estimate because there were an estimated 4.7 non-fishing person-hours per watercraft-hour in Silver Lake, Michigan (Lockwood 2000a).

Based on the value of $29 per angler-day (Department of the Interior 2013), the annual economic value of the fisheries in the mainstem of the Muskegon River was $12.4 million (Table 25). Houghton Lake, the river section from Croton Dam to Newaygo, Higgins Lake, and Muskegon Lake had the highest total economic fishery values. The fishery value per acre in the river section from Croton Dam to Newaygo was very high, and high values were also found in the river sections from Newaygo to Muskegon Lake and from Reedsburg Dam to Dolph Road. The very high fishery values found in the river section from Croton Dam to Newaygo is the result of Lake Michigan migratory steelhead and salmon runs producing fall fisheries, and stocked rainbow and brown trout that produce summer fisheries. This section of river has moderate gradient with substantial areas of gravel substrate and cool water temperatures that are favorable for trout and salmon. Croton Dam, Hardy Dam and Rogers Dam block migratory fish from movement into upper river segments. The impoundments cover 36.4 miles of river that have the highest gradients in the mainstem, and block another 33.1 miles of river from Rogers Impoundment upstream to Evart that has similar gradient to the area downstream of Croton Dam (Table 2). There is the potential for significant increases in fisheries use (60%) and economic value of the fisheries with removal of the three hydroelectric dams, based on the fishery value per mile measured downstream of Croton Dam (Table 25). Removal of Reedsburg Impoundment may result in a lower fishery economic value in that river segment because of the large reduction in surface acreage of water.

Conclusions and Management Recommendations

Management of the Muskegon River fishery requires consideration of many factors including the life history of the ecologically and recreationally important fish that inhabit the system, the physical habitat characteristics of the watershed, and the integrated fisheries and issues with Muskegon Lake and Lake Michigan. These considerations guide the management recommendations presented below. The Muskegon River has one of the largest watersheds in Michigan. There are currently 89 species of fish in the watershed that include important sport fish, threatened and endangered species, and invasive species. The lower Muskegon River has one of the richest fish communities in the system because of the connections between the river-estuary complex, Muskegon Lake and Lake Michigan. Muskegon Lake is

a large drowned river mouth lake that is part of the Lake Michigan coastal wetland system. The principal guiding documents for management of the fisheries resources are the Muskegon River Watershed Assessment and the Muskegon River Watershed Plan.

1. Angler-use of the lower Muskegon River is very high. The amount of angler effort per acre is the highest among all of the river sections and lakes in the mainstem. The fishery provides substantial economic benefits to the local economy, as well as fresh fish for consumption. Fishing occurs throughout the year, with high levels from March through November, and peaks that occur in April and October that are associated with steelhead and Chinook salmon spawning runs. Substantial angling occurs from boats and from shore. Non-fishing watercraft use is also substantial in this river section. Angler access can be improved in some locations.

Recommendation: Acquiring additional shore fishing access is a high priority, especially between Croton Dam and Newaygo. Road and parking improvements should be made at the 72nd Street walk-in access, located just downstream of the Pine Street boat launch. Additional boat ramp access should be acquired at these locations: between the Felch Road boat ramp and Warner Road boat ramp (distance = 10.3 miles); between the Pine Street boat ramp and the Thornapple Street boat ramp (distance = 5.5 miles); between the Thornapple Street boat ramp and the Henning Park boat ramp (distance = 6.4 miles); and between the Warner Road boat ramp and the Maple Island Road boat ramp (distance = 6.4 miles).

Recommendation: Angler surveys should be conducted to determine if changes have occurred in the fishery and use of the fishery. These surveys should include measures of guided anglers and non-fishing watercraft use (person hours). Including survey periods after dark would provide information to evaluate the amount of night fishing effort and fish catch occurring in the river.

2. Two standard fishing regulations (Type 3 and Type 4) have been used in this river segment since 2000. Evaluations of these regulations indicated that the Type 3 regulation was appropriate for the section of river from Newaygo to Muskegon Lake (Site 152). This regulation allows the harvest of migratory brown trout during the fall-winter period, and there is a fishery during this period. The Type 3 regulation also places a higher minimum size limit (15 inches) on trout that does not affect the fishery because few smaller trout are present in this river segment. The Type 4 regulation is used from Croton Dam to Newaygo (Site 151). This regulation has a smaller minimum size limit for trout (10 inches), but closes the brown trout harvest season from fall through spring. The smaller size limit on trout is appropriate for this river section because large numbers of trout are stocked, mortality rates are high during summer, and there is a low level of carryover to the following year. Even though the minimum size limit for trout was lower within Site 151, the release rate of fish was three times higher than the harvest rate. The harvest rate was higher than the release rate in Site 152.

During 1999, the minimum size limit on trout within Site 151 was 8 inches. After implementation of the 10 inch size limit on trout in 2000, the harvest of trout declined substantially. An 8 inch size limit for

trout would allow greater harvest of trout in this river section without having an effect on the fishery. Substantial funds are used to stock this section of river with trout each year.

Recommendation: The Type 3 and Type 4 regulations are appropriate for these two sections of the Muskegon River. Reducing the minimum size limit for trout in the Type 4 section to 8 inches could increase the number of harvested trout and angler effort.

3. Three of the eleven species of fish caught in the lower Muskegon River dominate the catch, including rainbow trout (migratory steelhead and a non-migratory strain), Chinook salmon and brown trout. All three of these species are maintained or partially supported by stocking. This segment of the Muskegon River is classified as a coolwater system, and water temperatures are marginal for survival of trout. Few naturally reproduced juvenile rainbow and brown trout are able to survive, but larger stocked fish are able to survive and create summer fisheries. Summer mortality rates of trout are high and there is a low level of carryover to the following year. Stocked steelhead migrate to Lake Michigan during spring, as well as naturally reproduced and stocked Chinook salmon, and these fish are not exposed to the high water temperatures in the river. Walleye are a native fish that are stocked into the river because natural reproduction remains at very low levels.

Recommendation: The Muskegon River walleye population supports fisheries in the Muskegon River, Muskegon Lake, in the channel and near the Muskegon piers, and along the entire Lake Michigan coast from Leland to the Indiana border. The Muskegon River has the largest spawning run of walleye in Lake Michigan south of Green Bay. The population suffered a severe decline in the early 1960s and a moderate size population of fast growing fish was restored after a stocking program began in 1978. The spawning run has been relatively stable since 1986. Natural reproduction continues to be very low in the river and stocked fish presently (2014) support the population. The Muskegon River population is the brood-stock source for walleye stocked along the east shore of Lake Michigan. Stocking levels have been adjusted and evaluated over the past 21 years and the results indicate that stocking 211,600 spring fingerlings (50 per acre) every other year supports the present population. Higher stocking rates did not increase juvenile abundance in Muskegon Lake.

Recommendation: Michigan strain steelhead have been stocked into the lower river since at least 1966. The steelhead fishery in the Muskegon River is one of the best in the Michigan, and angling occurs from October through May. Steelhead from the Muskegon River also support the fishery in Lake Michigan. The river fishery has been relatively stable over many years. Stocking has been relatively stable since 1980. The present stocking level of 55,000 should be continued, although this level may be adjusted along with Lake Michigan collaborative stocking allocations. All of the steelhead are stocked at the Pine Street access, located just downstream of Croton Dam, based on the studies that show this stocking location produces the highest return to the fishery. Summer run steelhead were stocked into the river for several years and were discontinued when evaluations found that few fish returned to the river.

Recommendation: The fall Chinook salmon fishery in the Muskegon River is heavily used by anglers. Chinook salmon that have been stocked or naturally produced in the Muskegon River also support fisheries in Muskegon Lake and Lake Michigan. Chinook salmon have been stocked into the Muskegon

River since they were first successfully introduced in 1967. Natural reproduction in the Muskegon River produced approximately 300,000 smolts annually, from the late 1970s through 2004, although annual variations are substantial. Fingerling stocking levels varied from 100,000 to 300,000 from 1980 through 2005, than were reduced to 18,000 in 2014. Recent stocking reductions resulted from a collaborative, multiple agency lake-wide stocking plan to decrease pressure on the forage base in Lake Michigan. Chinook salmon stocking levels in the Muskegon River should continue at the appropriate levels necessary to provide a river fishery and to maintain adequate forage in Lake Michigan.

Recommendation: Various strains of rainbow trout have been stocked into the Muskegon River since 1976. The Eagle Lake strain has been consistently used since 1997. The primary intent of stocking the Eagle Lake strain of rainbow trout is to provide a summer fishery, because most of them do not migrate from the river to Lake Michigan like steelhead. These fish have produced very popular summer fisheries during daylight periods and many are caught by anglers. Stocking levels and locations have been adjusted over the past 20 years to provide cost effective fisheries that provide the best returns to anglers.

Various strains of brown trout have been stocked into the river since 1975. The Wild Rose strain has been stocked consistently since 1997, and comparisons of the Wild Rose strain to the Gilchrist Creek strain found that the Wild Rose strain provided better returns to anglers. Brown trout tend to feed from dusk to dawn and the catch of brown trout is much lower than rainbow trout. Brown trout are also piscivorous and juvenile Chinook salmon are a preferred prey when they are present in the Muskegon River. The number of brown trout stocked into the lower Muskegon River was reduced for this reason.

Total rainbow and brown trout stocking in the lower Muskegon River is presently (2014) 125,000 fish (85,000 rainbow trout and 40,000 brown trout). The stocking density at this number of fish is 290 per acre, for the entire river from Croton Dam to Muskegon Lake. However, most (120,000) of the trout are stocked from Croton Dam to Newaygo, and this equates to a stocking level of 842 per acre. Although some movement of fish occurs into the downstream section (Site 152), both brown trout and rainbow trout catch is very low, at less than 5% of Site 151. The stocking rate of 300 per acre is considered high for Michigan streams, and stocking 42,750 trout within Site 151 would meet this objective. However, the lower Muskegon River is very productive, and this is evident from the very fast growth of stocked trout within Site 151. Mortality rates are also high for stocked trout due to thermal stress from high water temperatures. Because of the high growth rate of trout, high summer mortality rate and high angler use, a stocking rate higher than 300 per acre may be acceptable in this river segment. Any reduction in stocking should follow a stepped approach (e.g. 30%) and remain unchanged for several years. Brown trout stocking levels should remain at or below 45% of the number of rainbow trout stocked. If possible, angler surveys should be conducted to determine if significant changes occur following changes in stocking levels.

4. The fisheries within the 11 river and lake segments encompassing the mainstem of the Muskegon River provide substantial recreational and economic benefits to the watershed. The lower river section, from Croton Dam to Muskegon Lake, has the most intensive angler-use rates. Angler effort is high in this river section because of the good quality habitat, the Lake Michigan migratory spawning runs of steelhead and Chinook salmon, and the stocking of trout for summer fisheries. Based on the existing river fisheries downstream of Croton Dam, there is the potential for significant fisheries improvements in the 70 miles of river between Croton Dam and Evart

with fish passage and dam removals. These include both economic benefits related to increased angler use, as well as ecological benefits to multiple species of native fish.

Recommendation: The information provided in the angler-survey reports for the Muskegon River watershed should be used to focus on collecting and summarizing additional information that is needed to fully assess the effects of these dams on the river. Angler use information, along with other resource information, should be used to promote dam removal and fish passage. Presently, the Federal Energy Settlement Agreement allocates funding for fish passage at the principal hydroelectric dams in the Muskegon River.

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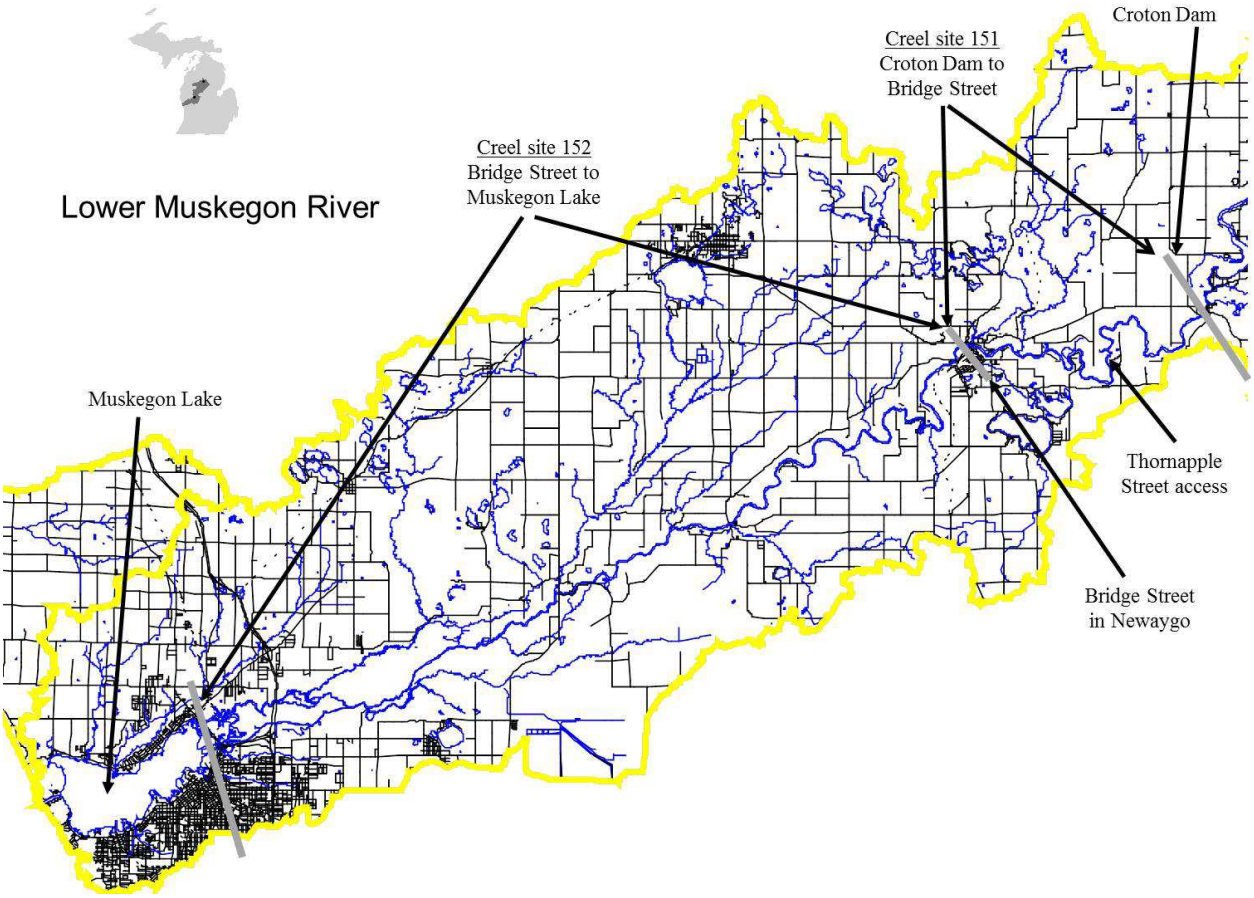

Figure 1. Angler survey sites used on the Lower Muskegon River.

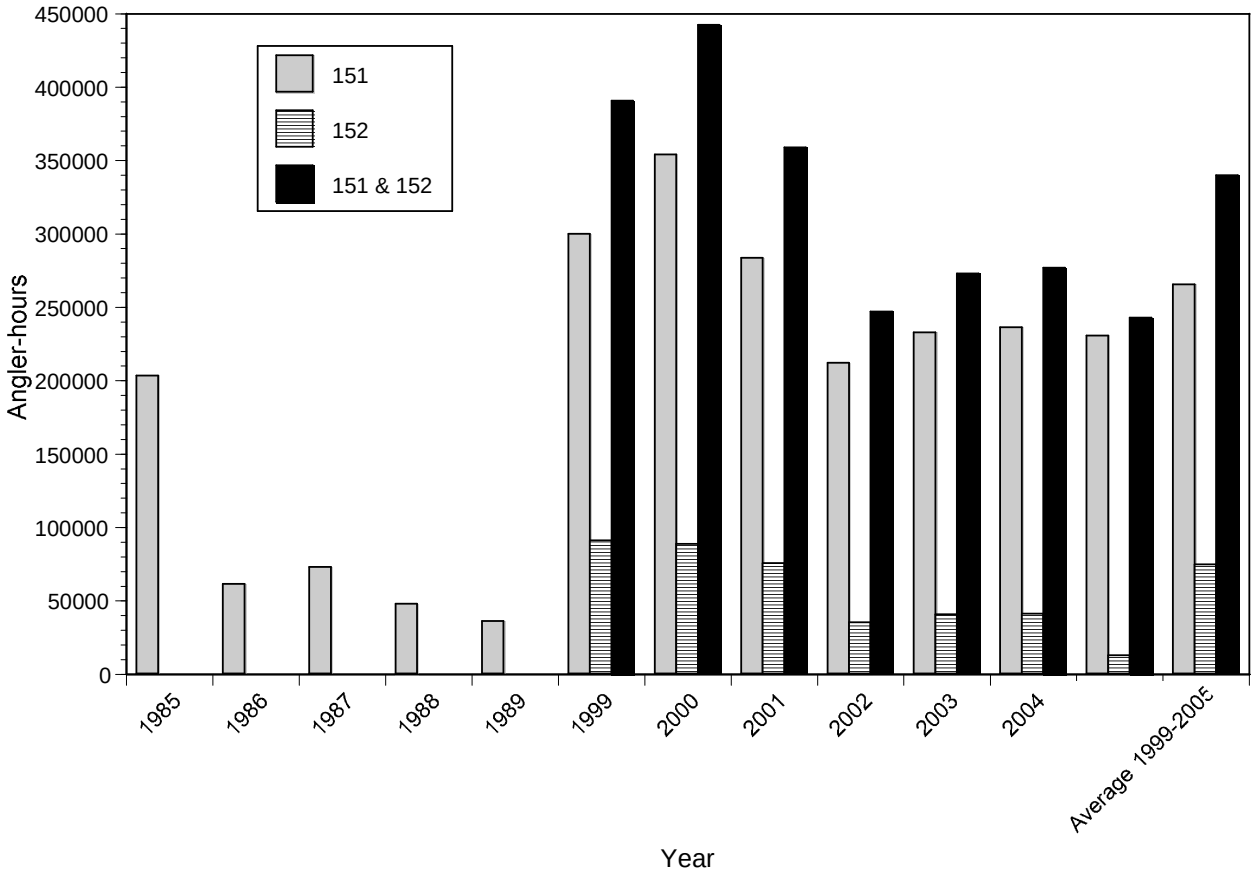

Figure 2. The estimated angler-effort expended on the Muskegon River at Site 151 (Croton Dam to Newaygo) and Site 152 (Newaygo to Muskegon Lake), from 1985 through 2005. Surveys were conducted only at Site 151 from 1985 through 1989, and only during spring and fall months (Table 4). From 2002 through 2005, Site 152 was not surveyed during June, July, and August (Table 4).

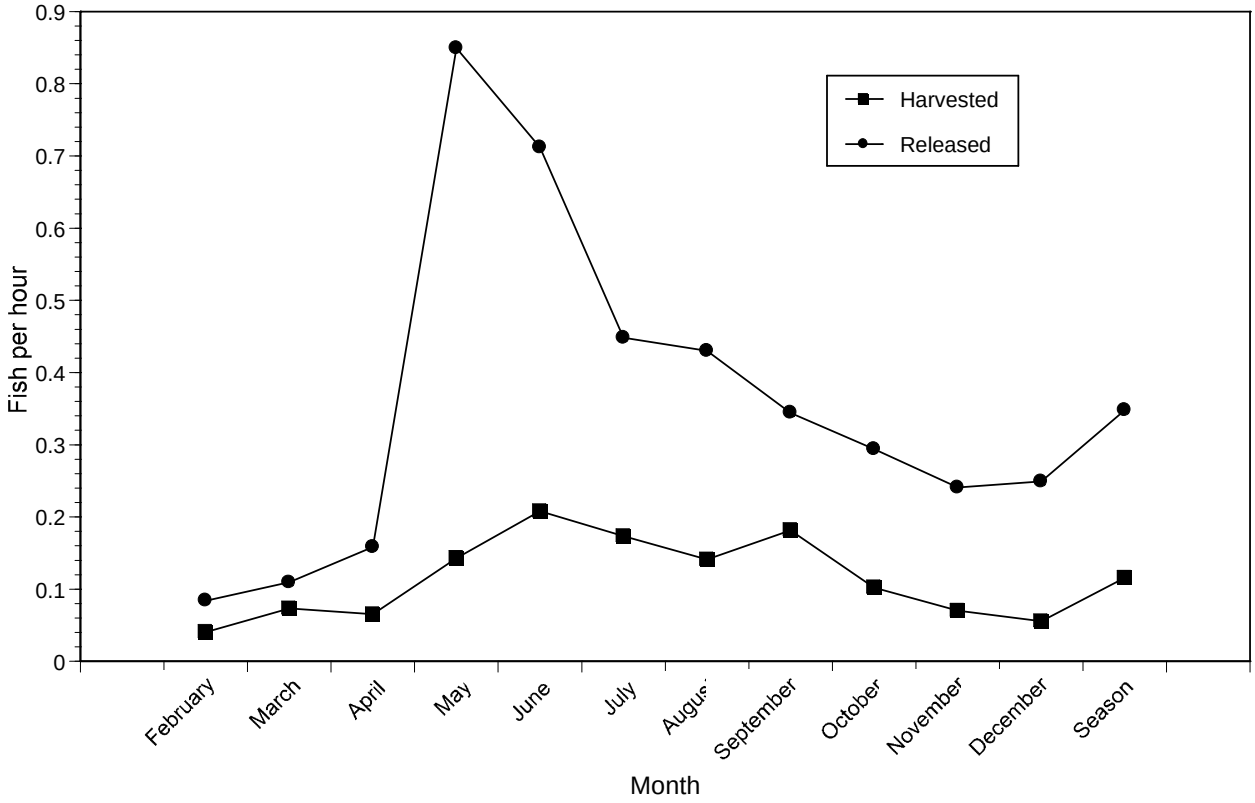

Figure 3. The estimated average rates of harvested and released fish at Site 151 on the Muskegon River, from 1999 through 2005.

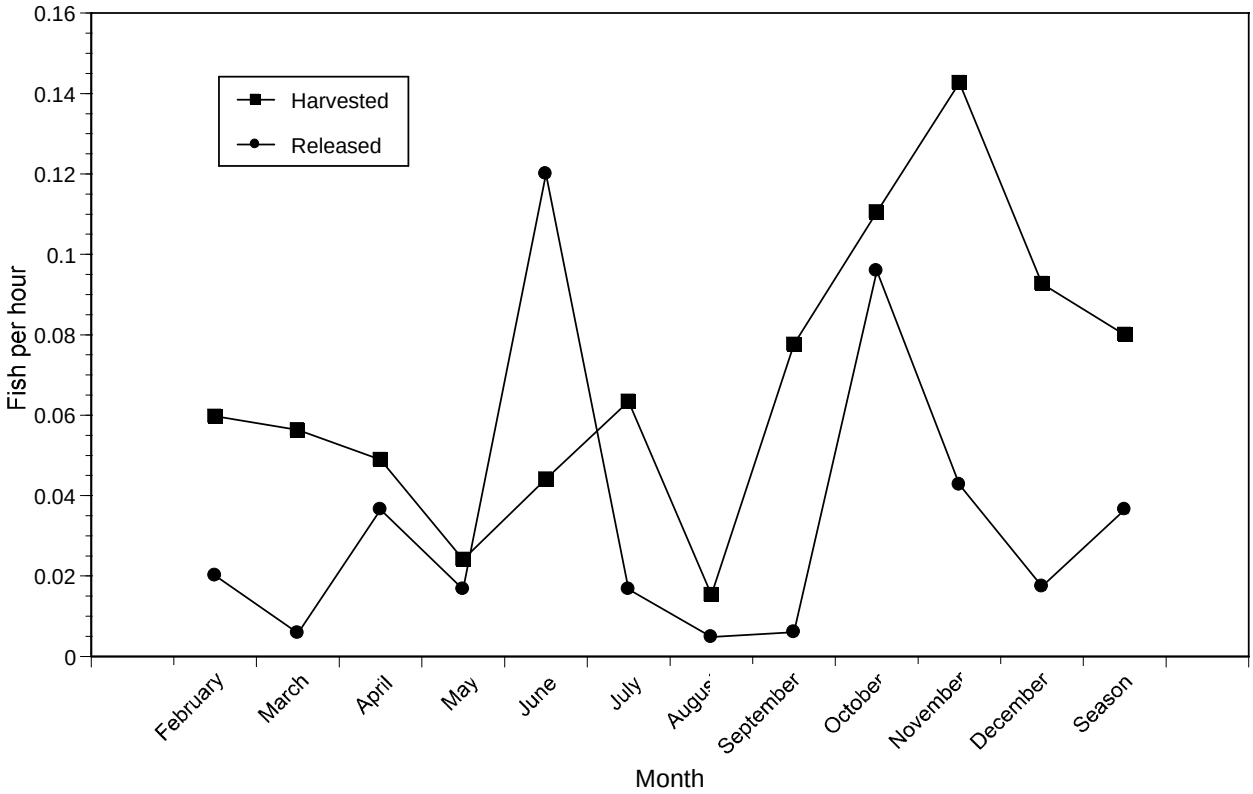

Figure 4. The estimated average rates of harvested and released fish at Site 152 on the Muskegon River, from 1999 through 2005.

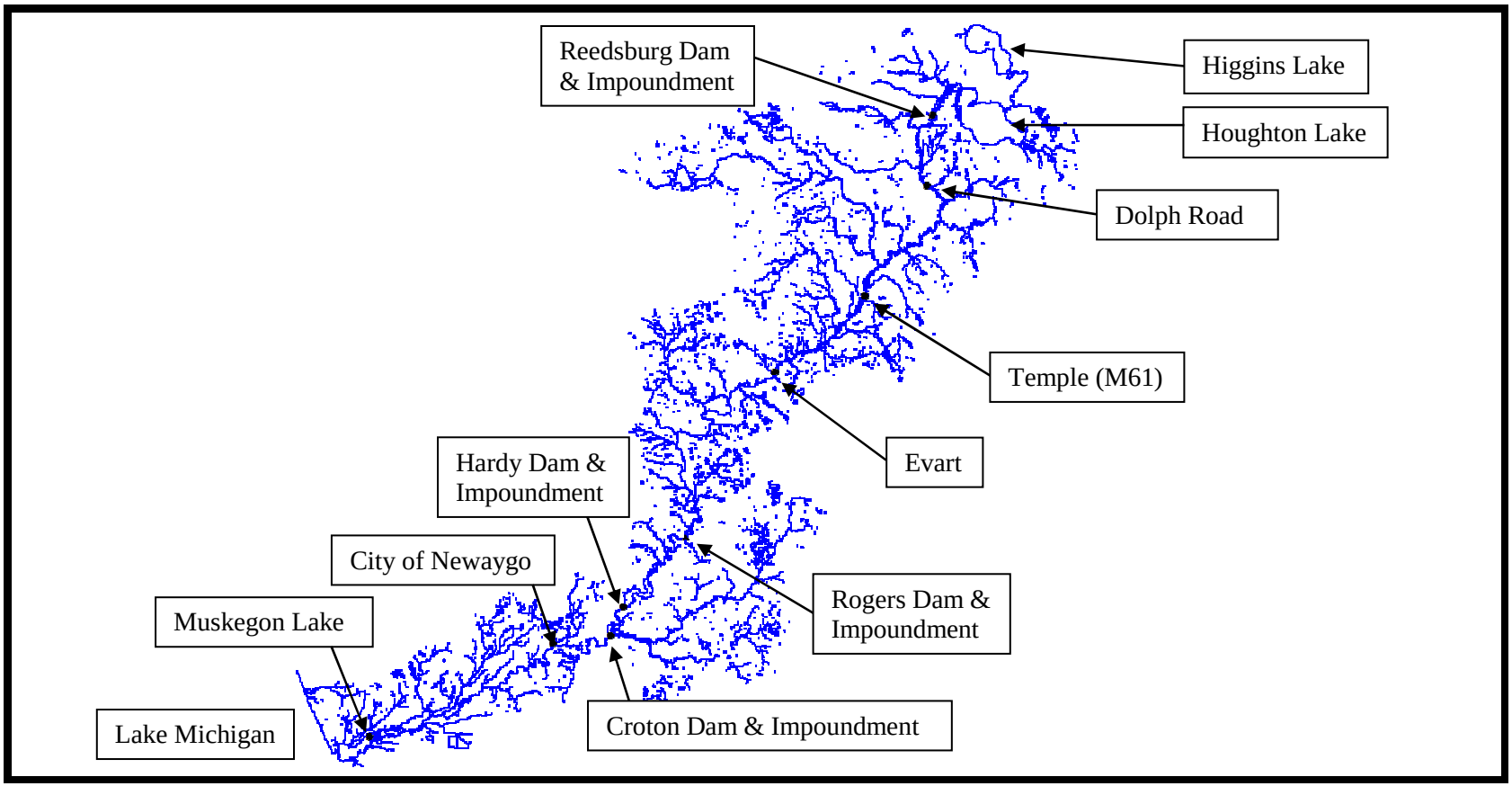

Figure 5. Angler survey locations of lakes, impoundments and river segments in the mainstem of the Muskegon River.

Table 1. Interview locations for the Lower Muskegon River angler surveys.

Location	County	Site number	Boat ramp	Shore fishing
Croton Dam access, Consumers Energy	Newaygo	151	X	X
DNR access, Pine Street	Newaygo	151	X	X
DNR access, Pine Street Walk-in	Newaygo	151		X
DNR access, Thornapple Street	Newaygo	151	X	X
DNR access, Thornapple Street Walk-in	Newaygo	151		X
Henning Park (Newaygo County)	Newaygo	151	X	X
Newaygo City Park	Newaygo	151		X
DNR Access, Bridge Street	Newaygo	151 & 152	X	X
DNR Access, Felch Street	Newaygo	152	X	
Warner Road (Bridgeton Twsp.)	Newaygo	152	X	X
DNR access, Maple Island Road	Newaygo	152	X	
DNR access, Holton-Duck Lake Road	Muskegon	152	X	X
Mill Iron Road	Muskegon	152	X	
DNR access, Sheridan Road	Muskegon	152	X	X
Creston Road	Muskegon	152	X	X
M120 above Muskegon Lake	Muskegon	152	X	X

Table 2. Distance, gradient, width and area measurements for the Muskegon River angler survey sites. Area (for impoundments), distance and gradient were measured using 1:24,000 topographic maps with ArcView GIS and a 3 arc-second digital elevation model. Average river width was determined in a 2009 habitat study (DNR Fisheries Division, unpublished data) of the Muskegon River, where n equals the number of transects used to measure width within each section. There were 10 width measurements within each one mile transect. River mile distances within impoundments were estimated by assuming wide meanders between banks, and these estimates may be lower than actual. Higgins Lake, Houghton Lake and Muskegon Lake surface acres were obtained from Breck (2004). Note that some months were only partially surveyed, especially during the beginning and end of winter.

River section	Survey years	Survey months	River miles	Gradient (ft./mi)	Average width (ft.)	Surface area (acres)
Higgins Lake	2001-2002	Apr-Sept., Jan.-March				10,186
Houghton Lake	2001-2002	Apr-Sept., Jan.-March				20,075
Reedsburg Impoundment	2008	April-October	7.3			573
Reedsburg Dam to Dolph Road	2008	April-October	22.8	1.4	25.0 (n=4)	69
Dolph Road to Temple Campground	2008	April-October	49.8	1.5	41.1 (n=4)	248
Temple Campground to Evart (U.S. 10)	2008	April-October	24.1	1.6	51.7(n=4)	186
Evart to Rogers Impoundment	2008	April-October	33.1	3.6	71.7(n=6)	256
Rogers Impoundment	2008	April-October	7.6	5.8		610
Hardy Impoundment	2006	April-October	22.1	4.5		3,971
Croton Impoundment	2007	April-October	6.7	6.0		1,380
Croton Dam to DNR Newaygo PAS (Bridge St.)	1999-2005	February-December	15.0	3.5	78.6 (n=4)	142
Newaygo PAS to Muskegon Lake (M120)	1999-2005	February-December	33.5	1.5	70.9 (n=10)	288
Muskegon Lake	2002-2003	Apr-Nov., Jan.-March				4,232
Total			221.9			42,216

Table 3. Fish stocked into the Muskegon River, from Croton Dam through Muskegon Lake, 1980 – 2014. Walleye were predominantly spring fingerlings with some fall fingerlings (mostly stocked into Muskegon Lake); Chinook salmon were spring fingerlings; and steelhead (Michigan strain migratory rainbow trout), brown trout and rainbow trout were yearlings. Various strains of brown and rainbow trout were stocked.

Year	Walleye	Steelhead	Chinook salmon	Brown trout	Rainbow trout
1980	155,664	50,000	300,000	0	15,000
1981	8,000	50,008	250,140	0	15,000
1982	0	50,022	275,064	15,000	5,200
1983	71,000	95,015	200,000	25,000	6,000
1984	82,026	58,085	100,000	27,000	0
1985	191,556	50,000	97,016	7,500	27,000
1986	207,898	69,997	100,092	7,500	30,000
1987	18,765	64,058	116,793	5,390	30,000
1988	73,910	51,739	100,000	15,000	60,000
1989	799	51,150	337,191	35,000	30,000
1990	46,766	78,010	250,080	19,895	29,992
1991	520,056	47,000	208,835	20,455	26,787
1992	392,841	63,655	176,064	19,488	29,989
1993	550,579	56,000	224,969	48,975	120,225
1994	585,800	55,000	250,100	48,999	84,993
1995	588,971	66,000	245,616	48,614	74,965
1996	388,124	59,877	250,687	49,278	74,969
1997	568,785	55,206	255,900	52,999	80,897
1998	406,714	55,440	227,534	81,596	120,117
1999	594,588	55,208	147,505	84,600	113,550
2000	621,010	55,000	147,557	84,600	122,388
2001	69,113	55,002	97,076	84,600	126,895
2002	351,885	55,099	97,208	84,600	126,900
2003	50,210	55,000	146,303	84,600	120,384
2004	98,141	55,004	142,779	78,691	123,087
2005	0	60,000	147,789	84,600	145,295
2006	191,536	61,022	59,409	84,600	126,900
2007	0	55,500	59,525	54,668	125,343
2008	204,780	59,097	57,456	40,000	112,100
2009	0	57,475	59,416	41,600	91,800
2010	201,089	60,500	59,453	42,600	88,000
2011	0	56,304	60,823	42,000	88,100
2012	211,996	65,013	61,547	46,640	100,500
2013	0	57,506	18,059	41,021	78,224
2014	196,160	61,353	18,349	44,000	86,570

Table 4. The estimated number of angler-hours expended on the Muskegon River between Croton Dam and Muskegon Lake at Sites 151 and 152, from 1985 through 2005. A dash indicates surveys were not conducted.

Year	Site	February	March	April	May	June	July	August	September	October	November	December	Season
1985	151	-	-	44,660	3,458	-	-	1,654	38,738	109,828	4,628	-	202,966
1986	151	-	-	24,979	6,912	-	-	-	-	25,278	3,730	-	60,899
1987	151	-	7,252	20,194	-	-	-	-	10,884	34,180	-	-	72,510
1988	151	-	5,514	12,176	-	-	-	-	5,960	21,428	2,370	-	47,448
1989	151	-	1,580	9,100	-	-	-	-	7,022	16,163	1,860	-	35,725
1999	151	-	17,843	55,134	31,116	40,049	33,425	21,332	20,753	56,259	20,620	2,981	299,513
	152	-	8,379	7,755	8,502	6,125	11,355	10,177	11,249	12,662	9,219	5,161	90,583
	151 + 152	-	26,222	62,889	39,618	46,174	44,780	31,509	32,001	68,922	29,839	8,142	390,096
2000	151	10,540	53,320	39,568	16,534	31,273	33,118	15,554	31,825	93,541	24,465	3,822	353,560
	152	2,037	11,842	7,260	2,232	5,153	10,290	8,897	13,145	14,850	11,732	780	88,217
	151 + 152	12,577	65,161	46,828	18,766	36,425	43,408	24,451	44,970	108,391	36,197	4,602	441,777
2001	151	-	30,661	68,218	18,492	23,443	22,748	14,357	28,612	53,618	19,496	3,549	283,192
	152	-	11,494	9,006	4,701	-	8,561	5,353	10,668	9,397	12,516	3,432	75,128
	151 + 152	-	42,154	77,223	23,193	-	31,309	19,710	39,280	63,015	32,012	6,981	358,320
2002	151	4,107	14,001	50,573	14,485	23,001	12,749	15,981	12,015	50,860	11,445	2,429	211,647
	152	1,134	4,450	5,751	740	-	-	-	3,856	6,355	11,023	1,538	34,847
	151 + 152	5,241	18,451	56,324	15,225	-	-	-	15,871	57,215	22,467	3,967	246,494
2003	151	1,459	13,497	56,096	21,090	18,054	20,101	11,229	13,442	54,210	19,676	3,426	232,279
	152	-	1,866	12,144	1,486	-	-	-	4,286	9,914	7,913	2,669	40,277
	151 + 152	-	15,362	68,239	22,577	-	-	-	17,727	64,124	27,589	6,095	272,557
2004	151	5,594	16,699	58,969	10,849	19,694	21,899	13,337	17,415	50,129	17,814	3,339	235,738
	152	-	7,680	6,528	747	-	-	-	4,188	9,713	9,930	1,843	40,629
	151 + 152	-	24,379	65,497	11,596	-	-	-	21,603	59,842	27,744	5,182	276,367
2005	151	2,841	9,347	58,082	22,039	18,044	21,138	15,235	12,196	48,598	19,259	3,323	230,100
	152	-	5,523	-	-	-	-	-	-	-	6,316	468	12,307
	151 + 152	-	14,870	-	-	-	-	-	-	-	25,575	3,791	242,407
Averages													
1985-1989	151	-	4,782	22,222	5,185	-	-	1,654	15,651	41,375	3,147	-	94,016
1999-2005	151	4,908	22,195	55,234	19,229	24,794	23,597	15,289	19,465	58,174	18,968	3,267	265,121
1999-2005	152	1,586	7,319	8,074	3,068	5,639	10,069	8,142	7,899	10,482	9,807	2,270	74,354
1999-2005	151 + 152	6,494	29,514	63,308	22,297	30,433	33,666	23,431	27,364	68,655	28,775	5,537	339,475

Table 5. The estimated average number of angler-hours, angler-trips, and angler-days expended on the Muskegon River between Croton Dam and Muskegon Lake at Sites 151 and 152, from 1985 through 2005. Note that surveys were not conducted during all months from 1985 – 1989 (Table 4).

Years	Site	Angler-hours			Angler-trips			Angler-days		
		Total	Per acre	Per mile	Total	Per acre	Per mile	Total	Per acre	Per mile
1985-1989	151	94,016	660	6,268	19,402	136	1,293	19,875	139	1,325
1999-2005	151	265,121	1,860	17,675	67,233	472	4,482	65,196	458	4,346
1999-2005	152	74,354	258	2,220	24,286	84	725	23,632	82	705
1999-2005	151 + 152	339,475	788	6,999	91,519	212	1,887	88,828	206	1,832

Table 6. The estimated number of angler-hours expended on the Muskegon River between Croton Dam and Muskegon Lake (Sites 151 and 152 combined), for boat and shore fishing, from 1999 through 2005. Uncertainty values (two standard errors) are given in parentheses.

Year	Boat	Shore	Total	% Boat	% Shore
1999	227,382	162,714	390,096	58.3	41.7
	(78,355)	(49,701)	(128,056)		
2000	247,853	193,923	441,777	56.1	43.9
	(112,181)	(76,321)	(188,502)		
2001	227,507	130,813	358,320	63.5	36.5
	(84,134)	(47,036)	(131,170)		
2002	156,814	89,680	246,494	63.6	36.4
	(62,773)	(35,983)	(98,755)		
2003	170,331	102,226	272,557	62.5	37.5
	(74,126)	(35,115)	(109,241)		
2004	166,887	109,480	276,367	60.4	39.6
	(61,974)	(42,052)	(104,026)		
2005	146,926	95,482	242,407	60.6	39.4
	(55,569)	(39,523)	(95,092)		
Average				60.7	39.3

Table 7. The estimated number of non-fishing watercraft hours expended on the Muskegon River between Croton Dam and Muskegon Lake (Sites 151 and 152 combined), during 2003. Non-fishing watercraft included boats, canoes, kayaks, rafts and float tubes. Total person-hours were underestimated because some watercraft had multiple individuals that were not counted.

Month	Hours
February	0
March	26
April	150
May	112
June	2,196
July	9,936
August	11,373
September	912
October	405
November	28
December	0
Total	25,138

Table 8. Total anglers and anglers with commercial fishing guides interviewed on the Muskegon River between Croton Dam and Muskegon Lake (Sites 151 and 152 combined), during 2003.

	Number of anglers		
Month	Total	Guided	% Guided
February	32	0	0.0
March	212	37	17.5
April	313	30	9.6
May	144	6	4.2
June	94	0	0.0
July	71	0	0.0
August	64	0	0.0
September	94	0	0.0
October	244	11	4.5
November	164	15	9.1
December	50	8	16.0
Total	1482	107	7.2

Table 9. The estimated annual fish harvest and harvest rate in the Muskegon River, between Croton Dam and Newaygo (Site 151), from 1985 through 2005. Note that surveys were only conducted during spring and fall months during 1985 through 1989 (Table 4).

													Average Total		Average Harvest per hour	
Species	1985	1986	1987	1988	1989	1999	2000	2001	2002	2003	2004	2005	1985-1989	1999-2005	1985-1989	1999-2005
Brown trout	418	529	0	0	470	9,013	1,989	2,320	2,088	1,999	2,183	1,595	283	3,027	0.0045	0.0112
Chinook salmon	17,499	6,662	2,867	880	1,563	6,761	9,893	1,181	2,911	4,793	6,059	3,233	5,894	4,976	0.0457	0.0184
Coho salmon	0	3	0	77	0	0	0	0	0	0	0	0	16	0	0.0003	0.0000
Largemouth bass	0	0	0	0	0	0	22	0	95	0	0	0	0	17	0.0000	0.0001
Northern Pike	58	36	0	0	0	0	0	0	210	8	0	44	19	37	0.0001	0.0002
Other	0	0	0	0	0	0	0	0	0	547	43	0	0	84	0.0000	0.0004
Pumpkinseed	0	0	0	0	0	267	3,652	419	0	0	0	167	0	644	0.0000	0.0019
Rainbow trout	8,843	2,946	480	831	2,640	50,239	21,899	12,049	9,453	16,872	11,982	18,783	3,148	20,182	0.0310	0.0746
Rock bass	0	0	0	0	0	87	0	838	737	344	0	106	0	302	0.0000	0.0012
Smallmouth bass	0	0	0	52	0	201	0	41	0	331	373	159	10	158	0.0002	0.0006
Walleye	0	73	0	26	0	342	632	82	69	0	84	27	20	176	0.0003	0.0006
Yellow perch	1,225	3,767	299	7,883	927	73	3,672	1,495	135	238	329	543	2,820	926	0.0519	0.0030
Total	28,043	14,016	3,646	9,749	5,600	66,982	41,758	18,425	15,700	25,130	21,053	24,656	12,211	30,529	0.1341	0.1122

Table 10. The estimated total number of fish and rates of fish harvested and released during the seven year period, from 1999 – 2005, on the Muskegon River between Croton Dam and Muskegon Lake

	Number									Number per hour		
Site		151			152			151 & 152			151 & 152	
Species	Harvest number	Release number	Catch number	Harvest number	Release number	Catch number	Harvest number	Release number	Catch number	Harvest per hour	Release per hour	Catch per hour
Brown trout	21,188	81,223	102,411	278	662	940	21,465	81,885	103,350	0.0096	0.0368	0.0464
Chinook salmon	34,831	78,838	113,668	5,337	1,919	7,256	40,168	80,757	120,924	0.0180	0.0362	0.0543
Largemouth bass	117	267	384	30	0	30	147	267	414	0.0001	0.0001	0.0002
Northern Pike	262	73	336	436	405	841	698	478	1,176	0.0003	0.0002	0.0005
Other	589	0	589	375	0	375	965	0	965	0.0004	0.0000	0.0004
Pumpkinseed	4,505	0	4,505	1,415	0	1,415	5,920	0	5,920	0.0027	0.0000	0.0027
Rainbow trout	141,277	468,337	609,615	20,183	9,369	29,552	161,460	477,707	639,167	0.0725	0.2144	0.2869
Rockbass	2,112	0	2,112	0	0	0	2,112	0	2,112	0.0009	0.0000	0.0009
Smallmouth bass	1,104	9,880	10,984	347	1,518	1,865	1,451	11,398	12,850	0.0007	0.0051	0.0058
Walleye	1,235	3,824	5,059	2,168	58	2,226	3,403	3,882	7,285	0.0015	0.0017	0.0033
Yellow perch	6,485	0	6,485	0	0	0	6,485	0	6,485	0.0029	0.0000	0.0029
Total	213,705	642,442	856,147	30,569	13,932	44,501	244,274	656,374	900,648	0.1096	0.2946	0.4042
per acre	1,500	4,508	6,008	106	48	154	567	1,524	2,091			
per mile	14,247	42,829	57,076	913	416	1,328	5,037	13,533	18,570			

Table 11. The estimated total number of fish caught by month, and average fish catch, harvest, and release rates for Site 151 on the Muskegon River, from 1999 through 2005.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0555	492	1,227	5,602	24,886	27,342	11,232	5,710	11,879	5,671	7,362	1,008	102,411
Chinook salmon	0.0616	0	0	0	337	0	0	46	3,326	108,159	1,800	0	113,668
Largemouth bass	0.0002	0	29	0	95	147	0	113	0	0	0	0	384
Northern Pike	0.0002	88	8	210	0	0	0	29	0	0	0	0	336
Other	0.0003	0	547	43	0	0	0	0	0	0	0	0	589
Pumpkinseed	0.0024	0	0	0	0	463	0	375	3,667	0	0	0	4,505
Rainbow trout	0.3302	2,294	25,672	77,217	107,983	128,526	84,719	50,785	47,657	47,224	31,733	5,805	609,615
Rockbass	0.0011	0	0	0	0	1,575	192	0	0	0	344	0	2,112
Smallmouth bass	0.0060	0	0	0	226	1,126	6,138	2,744	709	0	41	0	10,984
Walleye	0.0027	107	589	3,396	77	0	352	270	242	0	26	0	5,059
Yellow perch	0.0035	80	313	0	0	469	43	1,023	4,165	238	0	154	6,485
Total	0.4638	3,060	28,386	86,467	133,603	159,648	102,677	61,095	71,645	161,293	41,306	6,967	856,147
Catch/hour		0.1247	0.1827	0.2236	0.9926	0.9199	0.6216	0.5708	0.5258	0.3961	0.3111	0.3046	0.4638
Harvest/hour		0.0406	0.0733	0.0653	0.1431	0.2080	0.1735	0.1409	0.1816	0.1022	0.0703	0.0556	0.1158
Release/hour		0.0841	0.1094	0.1584	0.8494	0.7118	0.4481	0.4299	0.3442	0.2939	0.2408	0.2491	0.3480

Table 12. The estimated total number of fish caught by month, and average fish catch, harvest, and release rates for Site 152 on the Muskegon River, from 1999 through 2005.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0025	0	102	0	0	779	0	0	0	30	21	8	940
Chinook salmon	0.0190	0	0	0	0	0	0	0	2,756	4,281	219	0	7,256
Largemouth bass	0.0001	0	0	0	0	0	0	0	0	30	0	0	30
Northern Pike	0.0022	0	301	0	12	0	169	58	0	301	0	0	841
Other	0.0010	0	375	0	0	0	0	0	0	0	0	0	375
Pumpkinseed	0.0037	0	0	0	0	185	454	0	776	0	0	0	1,415
Rainbow trout	0.0774	253	2,041	3,796	361	677	0	0	0	8,198	12,485	1,741	29,552
Smallmouth bass	0.0049	0	0	341	295	171	503	117	299	140	0	0	1,865
Walleye	0.0058	0	366	0	83	37	1,292	316	132	0	0	0	2,226
Total	0.1165	253	3,184	4,137	750	1,850	2,418	491	3,963	12,980	12,725	1,750	44,501
Catch/hour		0.0798	0.0622	0.0854	0.0408	0.1640	0.0801	0.0201	0.0836	0.2064	0.1854	0.1101	0.1165
Harvest/hour		0.0597	0.0563	0.0489	0.0241	0.0441	0.0634	0.0153	0.0776	0.1105	0.1427	0.0927	0.0800
Release/hour		0.0201	0.0058	0.0365	0.0167	0.1200	0.0167	0.0048	0.0060	0.0959	0.0427	0.0174	0.0365

Table 13. The estimated angler harvest rates of fish for Site 151 on the Muskegon River, 1985-2005.

	Year												Average	Average
Species	1985	1986	1987	1988	1989	1999	2000	2001	2002	2003	2004	2005	1985-1989	1999-2005
Brown trout	0.0004	0.0087	0.0000	0.0000	0.0132	0.0301	0.0056	0.0082	0.0099	0.0086	0.0093	0.0069	0.0045	0.0112
Chinook salmon	0.0172	0.1094	0.0395	0.0185	0.0438	0.0226	0.0280	0.0042	0.0138	0.0206	0.0257	0.0140	0.0457	0.0184
Coho salmon	0.0000	0.0000	0.0000	0.0016	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000
Largemouth bass	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0004	0.0000	0.0000	0.0000	0.0000	0.0001
Northern Pike	0.0001	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0000	0.0000	0.0002	0.0001	0.0002
Other	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0024	0.0002	0.0000	0.0000	0.0004
Pumpkinseed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	0.0103	0.0015	0.0000	0.0000	0.0000	0.0007	0.0000	0.0019
Rainbow trout	0.0087	0.0484	0.0066	0.0175	0.0739	0.1677	0.0619	0.0425	0.0447	0.0726	0.0508	0.0816	0.0310	0.0746
Rock bass	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0030	0.0035	0.0015	0.0000	0.0005	0.0000	0.0012
Smallmouth bass	0.0000	0.0000	0.0000	0.0011	0.0000	0.0007	0.0000	0.0001	0.0000	0.0014	0.0016	0.0007	0.0002	0.0006
Walleye	0.0000	0.0012	0.0000	0.0005	0.0000	0.0011	0.0018	0.0003	0.0003	0.0000	0.0004	0.0001	0.0003	0.0006
Yellow perch	0.0012	0.0619	0.0041	0.1661	0.0259	0.0002	0.0104	0.0053	0.0006	0.0010	0.0014	0.0024	0.0519	0.0030
Total	0.0276	0.2302	0.0503	0.2055	0.1568	0.2236	0.1181	0.0651	0.0742	0.1082	0.0893	0.1072	0.1341	0.1158

Table 14. The estimated angler release rates of fish for Site 151 on the Muskegon River, 1999-2005. Released fish were not estimated prior to 1999.

	Year												Average	Average
Species	1985	1986	1987	1988	1989	1999	2000	2001	2002	2003	2004	2005	1985-1989	1999-2005
Brown trout	-	-	-	-	-	0.0800	0.0231	0.0369	0.0610	0.0153	0.0216	0.0742	-	0.0446
Chinook salmon	-	-	-	-	-	0.0373	0.0633	0.0077	0.0494	0.0386	0.0584	0.0431	-	0.0425
Largemouth bass	-	-	-	-	-	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	-	0.0001
Northern Pike	-	-	-	-	-	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	-	<0.0001
Rainbow trout	-	-	-	-	-	0.3810	0.1568	0.1080	0.2171	0.1237	0.0906	0.7482	-	0.2608
Smallmouth bass	-	-	-	-	-	0.0028	0.0004	0.0006	0.0030	0.0018	0.0029	0.0304	-	0.0060
Walleye	-	-	-	-	-	0.0046	0.0000	0.0006	0.0000	0.0000	0.0061	0.0037	-	0.0021
Total	-	-	-	-	-	0.5062	0.2437	0.1537	0.3305	0.1794	0.1798	0.9003	-	0.3480

Table 15. The estimated angler harvest rates of fish for Site 152 on the Muskegon River, 1999-2005. Harvested fish were not estimated prior to 1999.

	Year							Average
Species	1999	2000	2001	2002	2003	2004	2005	1999-2005
Brown trout	0.0019	0.0000	0.0014	0.0000	0.0000	0.0000	0.0000	0.0005
Chinook salmon	0.0093	0.0107	0.0095	0.0033	0.0276	0.0395	0.0000	0.0143
Largemouth bass	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	<0.0001
Northern Pike	0.0019	0.0017	0.0000	0.0000	0.0003	0.0000	0.0085	0.0018
Other	0.0000	0.0000	0.0000	0.0000	0.0093	0.0000	0.0000	0.0013
Pumpkinseed	0.0156	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0022
Rainbow trout	0.0531	0.0370	0.0486	0.0924	0.0563	0.0537	0.0644	0.0579
Smallmouth bass	0.0020	0.0000	0.0012	0.0016	0.0005	0.0000	0.0000	0.0008
Walleye	0.0027	0.0066	0.0138	0.0000	0.0000	0.0049	0.0085	0.0052
Total	0.0869	0.0559	0.0745	0.0973	0.0940	0.0982	0.0815	0.0800

Table 16. The estimated angler release rates of fish for Site 152 on the Muskegon River, 1999-2005. Released fish were not estimated prior to 1999.

	Year							Average
Species	1999	2000	2001	2002	2003	2004	2005	1999-2005
Brown trout	0.0073	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010
Chinook salmon	0.0023	0.0072	0.0000	0.0000	0.0268	0.0000	0.0000	0.0052
Northern Pike	0.0000	0.0008	0.0000	0.0086	0.0000	0.0000	0.0028	0.0018
Rainbow trout	0.0215	0.0222	0.0162	0.0363	0.0368	0.0192	0.0587	0.0301
Smallmouth bass	0.0093	0.0004	0.0019	0.0059	0.0008	0.0064	0.0000	0.0035
Walleye	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
Total	0.0410	0.0306	0.0180	0.0508	0.0644	0.0256	0.0616	0.0365

Table 17. Estimated angler effort on streams with Great Lakes migratory trout and salmon fisheries in Michigan. Data from MDNR Fisheries Division (2013) and Peck (1992). Site 151 was from Croton Dam to the Newaygo MDNR Public Access, site 152 was from the Newaygo MDNR Public Access to Muskegon Lake, site 130 was from Tippy Dam to the mouth of Bear Creek, and site 341 was from the mouth of Bear Creek to Stronach.

River	County	Site number	Sample period	Sample Year	Angler trips	Angler trips/mi
Muskegon	Newaygo	151	Feb-Dec	1999-2005	67,233	4,482
Muskegon	Newaygo & Muskegon	152	Feb-Dec	1999-2005	24286	725
Muskegon		151 & 152	Feb-Dec	1999-2005	91,519	1,887
Manistee	Manistee	130	Feb-Dec	1999-2004	97,846	5,789
Manistee	Manistee	341	Feb-Dec	1999-2004	24,318	1,961
Manistee		130 & 141	Feb-Dec	1999-2004	122,164	4,169
AuSable	Iosco		Mar-Dec	1999	77,448	7,593
St. Joseph	Berrien		Feb-Dec	1997-1999	138,661	2,201
St. Joseph	Berrien		Feb-Dec	2001	85,514	1,357
Dead	Marquette		Jan-Dec	1984-1997	8,131	8,131
Carp	Marquette		Jan-Dec	1984-1997	3,010	753
Chocolay	Marquette		Jan-Dec	1984-1997	4,448	2,965
Average					53,090	3,596
Muskegon	Newaygo	151	May-Sept	1999-2005	29,453	1,964
Muskegon	Newaygo & Muskegon	152	May-Sept	1999-2005	12,081	361
Manistee	Manistee	130	May-Sept	1999-2004	40,648	2,405
Manistee	Manistee	341	May-Sept	1999-2004	10,175	820

Table 18. Estimated angler effort on Michigan inland coldwater trout streams, from April-September. Data from Alexander and Shetter (1957, 1958, 1959, 1960, 1961, 1962, 1963), Alexander et al. (1964), Bacon et al. (1958), Clark and Alexander (1992), Latta (1959a, 1959b, 1961a, 1961b, 1962, 1963, 1964, 1965), Lemmien et al. (1957), Lockwood (2000a, 2000b, 2001), Wagner et al. (1994), Waters (1957a, 1957b, 1957c), Williams et al. (1966).

River	County	Year	Angler trips/mile
E. Br. Escanaba	Marquette	1988-92	69
W. Br. Escanaba	Dickinson	1988-93	38
M. Br. Ontonogan	Gogebic	1988-94	85
Iron River	Iron	1988-95	150
Augusta Creek	Kalamazoo	1949-55	983
Pigeon River	Otsego	1951-64	300
Hunt Creek	Montmorency	1951-64	348
Fuller Creek	Montmorency	1951-64	74
FishDam River	Delta Co.	1995	133
Indian River	Schoolcraft	1995	119
Manistee River	Crawford, Kalkaska	1998	113
Manistee River	Crawford, Kalkaska	1998	265
Manistee River	Crawford, Kalkaska	1998	65
Rogue	Kent	1994, 95, 98	1,253
Rogue	Kent	1994, 95, 98	1,810
Rogue	Kent	1994, 95, 98	971
AuSable River	Oscoda, Alcona	1999	147
AuSable River, S. Branch	Crawford	1981-82 & 85-90	1,173
AuSable River, S. Branch	Crawford	1981-82	1,103
AuSable River, S. Branch	Crawford	1985-90	755
AuSable River, N. Branch	Crawford	1981-82 & 85-90	951
Average			519

Table 19. Average annual estimated minimum dollar value of fish harvested within the Muskegon River, from Croton Dam to Muskegon Lake during February through December, 1999 - 2005. Estimated weight based on minimum harvest size and standard length-weight equations from Schneider et al. (2000). Fillet weight was estimated at 30% of total weight.

Species	Number	Size (in.)	Weight (lb.)	Fillet weight (lb.)	Fillet value at $8.00/lb.
Site 151					
Bass, Largemouth	17	14	24	7	$58
Bass, Smallmouth	158	14	225	68	$540
Bass, Rock	302	6	49	15	$118
Perch, Yellow	926	7	133	40	$318
Pike, Northern	37	24	113	34	$275
Pumpkinseed	644	6	115	35	$276
Salmon, Chinook	4,976	20	14,371	4,311	$34,489
Sucker, All	84	14	91	27	$220
Trout, Brown	3,027	10	1,087	326	$2,610
Trout, Rainbow	20,182	15	24,130	7,239	$57,912
Walleye	176	15	194	58	$467
Total	30,529		40,442	12,133	$97,282
Site 152					
Bass, Largemouth	4	14	6	2	$15
Bass, Smallmouth	50	14	71	21	$170
Pike, Northern	62	24	190	57	$458
Pumpkinseed	202	6	36	11	$87
Salmon, Chinook	762	20	2,201	660	$5,285
Sucker, All	54	14	59	18	$140
Trout, Brown	40	15	48	15	$115
Trout, Rainbow	2,883	15	3,447	1,034	$8,273
Walleye	310	15	342	103	$819
Total	4,367		6,400	1,921	$15,361
Sites 151 & 152					
Bass, Largemouth	21	14	30	9	$72
Bass, Smallmouth	208	14	296	89	$709
Bass, Rock	302	6	49	15	$118
Perch, Yellow	926	7	133	40	$318
Pike, Northern	99	24	303	91	$732
Pumpkinseed	846	6	151	45	$363
Salmon, Chinook	5,738	20	16,572	4,972	$39,774
Sucker, All	138	14	150	45	$359
Trout, Brown	3,067	10 or 15	1,136	341	$2,725
Trout, Rainbow	23,065	15	27,576	8,273	$66,186
Walleye	486	15	536	161	$1,286
Total	34,896		46,932	14,081	$112,643

Table 20. The estimated number of fish caught annually and average catch per hour, at 11 locations within the mainstem of the Muskegon River, from 1999 – 2008.

Species	Higgins Lake	Houghton Lake	Reedsburg Imp.	Reedsburg Dam-Dolph R.	Dolph R.-Temple	Temple-Rogers Dam	Hardy Imp.	Croton Imp.	Croton Dam -Newaygo	Newaygo-Muskegon	Muskegon Lake	Total
Bass, Largemouth	9	1,265	3,011	823	0	75	1,234	1,047	55	4	4,423	11,946
Bass, Smallmouth	7,429	3,049	108	102	56	5,523	15,591	8,151	1,569	266	3,007	44,852
Bass, Rock	14,825	23,469	116	542	0	461	4,947	191	302		5,052	49,905
Bass, White											148	148
Bluegill		152,237	9,919	44,225	11	798	12,422	26,715			126,105	372,432
Bowfin			49	8							298	355
Bullheads					73			140				213
Carp					6		184					190
Catfish, Channel					6	73					308	387
Crappie, Black		26,108	162	5,527		4,793	1,225	1,065			2,181	41,061
Drum, Freshwater											131	131
Musky, Northern											20	20
Perch, Yellow	448,221	49,292	181	1,777		49	8,359	10,813	926		124,338	643,956
Perch, White											17	17
Pike, Northern	181	11,991	1,640	505	11	293	13,643	5,350	48	120	6,878	40,660
Pumpkinseed	42	105,129				1		1,798	644	202	18,155	125,971
Redhorse, all				36	469	596						1,101
Salmon, Chinook									16,238	1,037	1,007	18,282
Salmon, Coho											92	92
Smelt, Rainbow	318,490											318,490
Sucker, all	466	268		6		114	26	364	84	54	85	1,467
Trout, Brook						17						17
Trout, Brown	472					8			14,630	134	278	15,522
Trout, Lake	4,877											4,877
Trout, Rainbow	2,229					133			87,088	4,222	14	93,685
Walleye		19,850		19		1,278	7,173	1,258	723	318	2,736	33,355
Whitefish, Lake	1,420											1,420
Whitefish, Cisco	77											77
Total	798,720	392,658	15,187	53,569	632	14,212	64,803	56,892	122,307	6,357	295,273	1,820,610
Catch per hour	3.1826	0.7868	1.2038	4.7154	1.2345	0.4471	0.6674	1.1267	0.4638	0.1165	1.6398	1.2356

Table 21. The estimated number of fish released annually and average release rate per hour, at 11 locations within the mainstem of the Muskegon River, from 1999 - 2008.

Species	Higgins Lake	Houghton Lake	Reedsburg Imp.	Reedsburg Dam-Dolph R.	Dolph R.-Temple	Temple-Rogers Dam	Hardy Imp.	Croton Imp.	Croton Dam -Newaygo	Newaygo-Muskegon	Muskegon Lake	Total
Bass, Largemouth	9	925	2,192	766		74	1,234	986	38		4,305	10,529
Bass, Smallmouth	233	1,161	108	102	56	5,069	15,423	7,769	1,411	217	2,838	34,387
Bass, Rock	48		103	474		213	4,013	135			2,396	7,382
Bass, White											148	148
Bluegill			7,286	29,671	11	1	9,536	6,171			50,808	103,484
Bowfin			49	8							298	355
Bullheads					73			12				85
Carp					6		184					190
Catfish, Channel					6	55						61
Crappie, Black			79	4,106		1,050	606	181				6,022
Perch, Yellow	104,816		170	1,227			4,904	3,579			38,194	152,890
Pike, Northern		2,700	1,568	461	11	289	12,903	4,959	10	58	5,046	28,005
Pumpkinseed						1		12			6,351	6,364
Redhorse, all				36	156	588						780
Salmon, Chinook									11,263	274	14	11,551
Sucker, all	37			6		91	26	364			60	584
Trout, Brook						7						7
Trout, Brown	17					8			11,603	95		11,723
Trout, Lake	1,066											1,066
Trout, Rainbow	17					61			66,905	1,338		68,321
Walleye		1,585		7		934	5,650	733	546	8	654	10,118
Whitefish, Lake	240											240
Total	106,466	6,371	11,555	36,863	319	8,442	54,478	24,902	91,777	1,990	111,112	454,276
Release per hour	0.4242	0.0128	0.9159	3.2449	0.6238	0.2656	0.5611	0.4932	0.3480	0.0365	0.6171	0.3083

Table 22. The estimated number of fish harvested annually and average harvest rate per hour, at 11 locations within the mainstem of the Muskegon River, from 1999 – 2008.

Species	Higgins Lake	Houghton Lake	Reedsburg Imp.	Reedsburg Dam-Dolph R.	Dolph R. -Temple	Temple-Rogers Dam	Hardy Imp.	Croton Imp.	Croton Dam -Newaygo	Newaygo-Muskegon	Muskegon Lake	Total
Bass, Largemouth		340	819	57		1		61	17	4	118	1,417
Bass, Smallmouth	7,196	1,888				454	168	382	158	50	169	10,464
Bass, Rock	14,777	23,469	13	68		248	934	56	302		2,656	42,523
Bluegill		152,237	2,633	14,554		797	2,886	20,544			75,297	268,948
Bullheads								128				128
Catfish, Channel						18					308	326
Crappie, Black		26,108	83	1,421		3,743	619	884			2,181	35,039
Drum, Freshwater											131	131
Musky, Northern											20	20
Perch, Yellow	343,405	49,292	11	550		49	3,455	7,234	926		86,144	491,066
Perch, White											17	17
Pike, Northern	181	9,291	72	44		4	740	391	37	62	1,832	12,655
Pumpkinseed	42	105,129						1,786	644	202	11,804	119,607
Redhorse, all					313	8						321
Salmon, Chinook									4,976	762	993	6,731
Salmon, Coho											92	92
Smelt, Rainbow	318,490											318,490
Sucker, all	429	268				23			84	54	25	883
Trout, Brook						10						10
Trout, Brown	455								3,027	40	278	3,800
Trout, Lake	3,811											3,811
Trout, Rainbow	2,212					72			20,182	2,883	14	25,364
Walleye		18,265		12		344	1,523	525	176	310	2,082	23,237
Whitefish, Lake	1,180											1,180
Whitefish, Cisco	77											77
Total	692,254	386,287	3,632	16,706	313	5,770	10,325	31,990	30,529	4,367	184,161	1,366,334
Harvest per hour	2.7584	0.7740	0.2879	1.4705	0.6107	0.1815	0.1063	0.6335	0.1158	0.0800	1.0227	0.9273

Table 23. The average annual estimated dollar value of fish harvested by anglers within the Muskegon River, from Higgins Lake to Muskegon Lake, 2001 - 2008. Estimated weight based on minimum harvest size and standard length-weight equations from Schneider et al. (2000). Fillet weight was estimated at 30% of total weight.

Location Species	Higgins Lake	Houghton Lake	Reedsburg Imp.	Reedsburg Dam-Dolph R.	Dolph R. -Temple	Temple-Rogers Dam	Hardy Imp.	Croton Imp.	Croton Dam -Newaygo	Newaygo-Muskegon	Muskegon Lake	Total
Bass, Largemouth		$1,173	$2,825	$197		$3		$210	$58	$15	$407	$4,888
Bass, Smallmouth	$24,617	$6,459				$1,553	$575	$1,307	$540	$170	$578	$35,797
Bass, Rock	$5,757	$9,143	$5	$26		$97	$364	$22	$118		$1,035	$16,566
Bluegill		$54,966	$951	$5,255		$288	$1,042	$7,418			$27,186	$97,105
Bullheads								$53				$53
Catfish, Channel						$20					$350	$370
Crappie, Black		$11,526	$37	$627		$1,652	$273	$390			$963	$15,469
Drum, Freshwater											$459	$459
Musky, Northern											$1,039	$1,039
Perch, Yellow	$118,469	$17,005	$4	$190		$17	$1,192	$2,496	$319		$29,718	$169,409
Perch, White											$7	$7
Pike, Northern	$1,330	$68,250	$529	$323		$29	$5,436	$2,872	$275	$458	$13,458	$92,959
Pumpkinseed	$18	$45,149						$767	$276	$87	$5,069	$51,367
Redhorse, all					$745	$19						$764
Salmon, Chinook									$34,489	$5,285	$6,883	$46,657
Salmon, Coho											$434	$434
Smelt, Rainbow	$21,593											$21,593
Sucker, all	$1,119	$699				$60			$220	$140	$65	$2,303
Trout, Brook						$3						$3
Trout, Brown	$392								$2,610	$115	$240	$3,357
Trout, Lake	$9,865											$9,865
Trout, Rainbow	$6,347					$207			$57,912	$8,273	$40	$72,780
Walleye		$48,317		$32		$910	$4,029	$1,389	$467	$819	$5,508	$61,470
Whitefish, Lake	$3,174											$3,174
Whitefish, Cisco	$79											$79
Total	$192,761	$262,688	$4,350	$6,650	$745	$4,859	$12,911	$16,924	$97,282	$15,361	$93,439	$707,970

Table 24. The estimated amount of angler effort and non-fishing watercraft hours for lakes, impoundments and five river segments within the mainstem of the Muskegon River. The potential number of watercraft hours for Higgins Lake, Houghton Lake and Muskegon Lake were estimated based on the Hardy Impoundment estimate of 29 per acre.

Location	Surface acres	Angler hours	Angler-hours per acre	Non-fishing watercraft-hours	Non-fishing watercraft-hours per acre	Estimated non-fishing watercraft-hours at 29 per acre	Estimated non-fishing hours at 2 persons per watercraft
Higgins Lake	10,186	250,962	24.6			295,394	590,788
Houghton Lake	20,075	499,048	24.9			582,175	1,164,350
Reedsburg Impoundment	572.5	12,615	22.0	592	1		1,184
Reedsburg Dam-Dolph Road	69	11,360	164.6	2,171	31		4,342
Dolph Road-Temple	248.2	512	2.1	6,250	25		12,500
Temple- Rogers Dam	1052	31,790	30.2	26,763	25		53,526
Hardy Impoundment	3971	97,100	24.5	116,755	29		233,510
Croton Impoundment	1380	50,494	36.6	15,816	11		31,632
Croton Dam-Newaygo	142.5	265,121	1860.5	12,569	88		25,138
Newaygo-Muskegon Lake	288.3	74,354	257.9	12,569	44		25,138
Muskegon Lake	4232	180,064	42.5			122,728	245,456
Total	43,268	1,473,420					2,387,564

Table 25. The estimated annual dollar values of the fisheries to local economies within the mainstem of the Muskegon River. The value of $29 per angler-day was obtained from the U.S. Department of the Interior (2013) for inland waters in Michigan. Potential fishery values for Temple to Evart were estimated using the Dolph Road to Temple value per river mile, and the Croton Dam to Newaygo river mile values were used to estimate potential values for the sections of river from Evart through Croton Impoundment.

Location	Surface acres	River miles	Angler hours	Angler trips	Angler days	Fishery value at $29/day	Angler-hours per acre	Fishery value/acre	Fishery value/river mile	Potential fishery value without dams
Higgins Lake	10,186.0	-	250,962	60,248	53,232	$1,543,728	24.6	$152	-	$1,543,728
Houghton Lake	20,075.0	-	499,048	199,056	190,690	$5,530,010	24.9	$275	-	$5,530,010
Reedsburg Impoundment	572.5	7.3	12,615	4,893	4,604	$133,516	22.0	$233	-	$41,365
Reedsburg Dam-Dolph Road	69.0	22.8	11,360	4,620	4,455	$129,195	14.6	$1,872	$5,666	$129,195
Dolph Road-Temple	248.2	49.8	512	504	504	$14,616	2.1	$59	$293	$14,616
Temple- Rogers Dam	1,052.0	64.8	31,790	7,348	7,033	$203,957	30.2	$194	$3,147	-
Temple- Evart	186.0	24.1	-	-	-	-	-	-	-	$7,073
Evart-Rogers Imp	255.0	33.1	-	-	-	-	-	-	-	$4,172,109
Rogers Impoundment	610.0	7.6	-	-	-	-	-	-	-	$957,947
Hardy Impoundment	3,971.0	22.1	97,100	23,111	20,337	$589,773	24.5	$149	-	$2,785,608
Croton Impoundment	1,380.0	6.7	50,494	13,133	12,815	$371,635	36.6	$269	-	$844,506
Croton Dam-Newaygo	142.5	15.0	265,121	67,233	65,196	$1,890,684	1,860.5	$13,268	$126,046	$1,890,684
Newaygo-Muskegon Lake	288.3	33.5	74,354	28,750	23,632	$685,328	257.9	$2,377	$20,458	$685,328
Muskegon Lake	4,232.0	-	180,064	45,819	45,819	$1,328,751	42.5	$314	-	$1,328,751
Total	43,267.5	286.8	1,473,420	454,715	428,317	$12,421,193	-	-	-	$19,930,919

Appendix 1. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 1985 for shore and boat fishing, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0004	-	-	102	83	-	-	0	22	167	44	-	418
	(0.0057)	-	-	(153)	(81)	-	-	(0)	(31)	(296)	(65)	-	(626)
Chinook salmon	0.0172	-	-	7	0	-	-	24	2,758	14,674	36	-	17,499
	(0.0396)	-	-	(13)	(0)	-	-	(36)	(885)	(3,350)	(41)	-	(4,325)
Northern Pike	0.0001	-	-	0	0	-	-	0	29	0	29	-	58
	(0.0011)	-	-	(0)	(0)	-	-	(0)	(59)	(0)	(59)	-	(118)
Rainbow trout	0.0087	-	-	4,824	341	-	-	17	521	2,737	403	-	8,843
	(0.0393)	-	-	(1,218)	(204)	-	-	(35)	(615)	(1,973)	(245)	-	(4,290)
Yellow perch	0.0012	-	-	224	0	-	-	26	14	0	961	-	1,225
	(0.0114)	-	-	(320)	(0)	-	-	(39)	(27)	(0)	(857)	-	(1,243)
Total	0.0276	-	-	5,157	424	-	-	67	3,344	17,578	1,473	-	28,043
	(0.0972)	-	-	(1,704)	(285)	-	-	(110)	(1,617)	(5,619)	(1,267)	-	(10,602)
Angler hours		-	-	44,660	3,458	-	-	1,654	38,738	109,828	4,628	-	202,966
		-	-	(4,181)	(962)	-	-	(644)	(4,395)	(10,547)	(1,091)	-	(21,820)
Angler trips		-	-	7,755	698	-	-	585	8,817	20,572	1,127	-	39,554
		-	-	(823)	(205)	-	-	(307)	(1,132)	(2,111)	(303)	-	(4,881)
Angler Days		-	-	7,755	698	-	-	585	8,817	20,572	1,127	-	39,554
		-	-	(823)	(205)	-	-	(307)	(1,132)	(2,111)	(303)	-	(4,881)

Appendix 2. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 1986 for shore and boat fishing, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0087	-	-	0	7	-	-	-	-	503	19	-	529
	(0.1089)	-	-	(0)	(15)	-	-	-	-	(785)	(38)	-	(838)
Chinook salmon	0.1094	-	-	27	0	-	-	-	-	6,512	123	-	6,662
	(0.4013)	-	-	(54)	(0)	-	-	-	-	(2,924)	(111)	-	(3,089)
Coho salmon	0.0000	-	-	0	0	-	-	-	-	0	3	-	3
	(0.0008)	-	-	(0)	(0)	-	-	-	-	(0)	(6)	-	(6)
Northern Pike	0.0006	-	-	0	0	-	-	-	-	36	0	-	36
	(0.0095)	-	-	(0)	(0)	-	-	-	-	(73)	(0)	-	(73)
Rainbow trout	0.0484	-	-	2,053	297	-	-	-	-	453	143	-	2,946
	(0.2439)	-	-	(665)	(347)	-	-	-	-	(773)	(92)	-	(1,877)
Walleye	0.0012	-	-	0	0	-	-	-	-	73	0	-	73
	(0.0190)	-	-	(0)	(0)	-	-	-	-	(146)	(0)	-	(146)
Yellow perch	0.0619	-	-	578	2,784	-	-	-	-	0	405	-	3,767
	(0.5761)	-	-	(894)	(2,930)	-	-	-	-	(0)	(610)	-	(4,434)
Total	0.2302	-	-	2,658	3,088	-	-	-	-	7,577	693	-	14,016
	(1.3594)	-	-	(1,613)	(3,292)	-	-	-	-	(4,701)	(857)	-	(10,463)
Angler hours		-	-	24,979	6,912	-	-	-	-	25,278	3,730	-	60,899
		-	-	(2,857)	(1,478)	-	-	-	-	(2,421)	(941)	-	(7,697)
Angler trips		-	-	4,021	1,177	-	-	-	-	5,163	636	-	10,997
		-	-	(520)	(309)	-	-	-	-	(853)	(171)	-	(1,853)
Angler Days		-	-	3,662	1,177	-	-	-	-	5,163	636	-	10,638
		-	-	(499)	(309)	-	-	-	-	(853)	(171)	-	(1,832)

Appendix 3. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 1987 for shore and boat fishing, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Chinook salmon	0.0395	-	0	0	-	-	-	-	360	2,507	-	-	2,867
	(0.3014)	-	(0)	(0)	-	-	-	-	(721)	(3,106)	-	-	(3,827)
Rainbow trout	0.0066	-	55	425	-	-	-	-	0	0	-	-	480
	(0.0447)	-	(83)	(485)	-	-	-	-	(0)	(0)	-	-	(568)
Yellow perch	0.0041	-	0	299	-	-	-	-	0	0	-	-	299
	(0.0473)	-	(0)	(600)	-	-	-	-	(0)	(0)	-	-	(600)
Total	0.0503	-	55	724	-	-	-	-	360	2,507	-	-	3,646
	(0.3934)	-	(83)	(1,085)	-	-	-	-	(721)	(3,106)	-	-	(4,995)
Angler hours		-	7,252	20,194	-	-	-	-	10,884	34,180	-	-	72,510
		-	(692)	(2,367)	-	-	-	-	(717)	(8,921)	-	-	(12,697)
Angler trips		-	2,317	5,552	-	-	-	-	2,518	7,932	-	-	18,319
		-	(744)	(1,396)	-	-	-	-	(714)	(2,279)	-	-	(5,133)
Angler Days		-	2,257	5,552	-	-	-	-	2,518	7,932	-	-	18,259
		-	(748)	(1,396)	-	-	-	-	(714)	(2,279)	-	-	(5,137)

Appendix 4. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 1988 for shore and boat fishing, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Chinook salmon	0.0185	-	0	0	-	-	-	-	126	706	48	-	880
	(0.1285)	-	(0)	(0)	-	-	-	-	(252)	(833)	(66)	-	(1,151)
Coho salmon	0.0016	-	0	0	-	-	-	-	0	77	0	-	77
	(0.0183)	-	(0)	(0)	-	-	-	-	(0)	(164)	(0)	-	(164)
Rainbow trout	0.0175	-	104	715	-	-	-	-	0	0	12	-	831
	(0.0749)	-	(85)	(563)	-	-	-	-	(0)	(0)	(23)	-	(671)
Smallmouth bass	0.0011	-	0	0	-	-	-	-	52	0	0	-	52
	(0.0082)	-	(0)	(0)	-	-	-	-	(73)	(0)	(0)	-	(73)
Walleye	0.0005	-	0	0	-	-	-	-	26	0	0	-	26
	(0.0042)	-	(0)	(0)	-	-	-	-	(38)	(0)	(0)	-	(38)
Yellow perch	0.1661	-	0	0	-	-	-	-	7,883	0	0	-	7,883
	(1.7613)	-	(0)	(0)	-	-	-	-	(15,771)	(0)	(0)	-	(15,771)
Total	0.2055	-	104	715	-	-	-	-	8,087	783	60	-	9,749
	(1.9955)	-	(85)	(563)	-	-	-	-	(16,134)	(997)	(89)	-	(17,868)
Angler hours		-	5,514	12,176	-	-	-	-	5,960	21,428	2,370	-	47,448
		-	(826)	(1,742)	-	-	-	-	(486)	(5,476)	(424)	-	(8,954)
Angler trips		-	1,619	2,421	-	-	-	-	1,607	4,318	454	-	10,419
		-	(332)	(544)	-	-	-	-	(436)	(1,901)	(108)	-	(3,321)
Angler days		-	1,390	1,971	-	-	-	-	1,607	4,318	454	-	9,740
		-	(294)	(503)	-	-	-	-	(436)	(1,901)	(108)	-	(3,242)

Appendix 5. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 1989 for shore and boat fishing, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0132	-	0	0	-	-	-	-	470	0	0	-	470
	(0.0274)	-	(0)	(0)	-	-	-	-	(406)	(0)	(0)	-	(406)
Chinook salmon	0.0438	-	0	0	-	-	-	-	0	1,443	120	-	1,563
	(0.1231)	-	(0)	(0)	-	-	-	-	(0)	(1,633)	(192)	-	(1,825)
Rainbow trout	0.0739	-	30	23	-	-	-	-	2,352	190	45	-	2,640
	(0.1779)	-	(63)	(46)	-	-	-	-	(2,030)	(407)	(92)	-	(2,638)
Yellow perch	0.0259	-	0	0	-	-	-	-	927	0	0	-	927
	(0.1295)	-	(0)	(0)	-	-	-	-	(1,921)	(0)	(0)	-	(1,921)
Total	0.1568	-	30	23	-	-	-	-	3,749	1,633	165	-	5,600
	(0.4579)	-	(63)	(46)	-	-	-	-	(4,357)	(2,040)	(284)	-	(6,790)
Angler hours		-	1,580	9,100	-	-	-	-	7,022	16,163	1,860	-	35,725
		-	(689)	(1,245)	-	-	-	-	(4,249)	(6,951)	(1,695)	-	(14,829)
Angler trips		-	469	2,528	-	-	-	-	1,842	3,516	580	-	8,935
		-	(277)	(758)	-	-	-	-	(1,084)	(1,580)	(555)	-	(4,254)
Angler Days		-	444	2,528	-	-	-	-	1,842	3,516	580	-	8,910
		-	(274)	(758)	-	-	-	-	(1,084)	(1,580)	(555)	-	(4,251)

Appendix 6. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 1999, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0301	-	0	369	3,600	3,224	1,247	262	259	0	53	0	9,013
	(0.0761)	-	(0)	(511)	(2,162)	(2,313)	(1,171)	(333)	(310)	(0)	(73)	(0)	(6,873)
Chinook salmon	0.0226	-	0	0	0	0	0	0	344	6,345	72	0	6,761
	(0.0447)	-	(0)	(0)	(0)	(0)	(0)	(0)	(562)	(3,326)	(145)	(0)	(4,033)
Pumpkinseed	0.0009	-	0	0	0	0	0	0	267	0	0	0	267
	(0.0060)	-	(0)	(0)	(0)	(0)	(0)	(0)	(546)	(0)	(0)	(0)	(546)
Rainbow trout	0.1677	-	1,342	3,652	8,011	13,299	12,560	2,525	6,641	653	1,269	287	50,239
	(0.3870)	-	(1,006)	(2,308)	(4,877)	(8,888)	(7,248)	(2,369)	(4,993)	(962)	(1,974)	(319)	(34,944)
Rock bass	0.0003	-	0	0	0	0	87	0	0	0	0	0	87
	(0.0019)	-	(0)	(0)	(0)	(0)	(167)	(0)	(0)	(0)	(0)	(0)	(167)
Smallmouth bass	0.0007	-	0	0	0	0	86	56	59	0	0	0	201
	(0.0035)	-	(0)	(0)	(0)	(0)	(120)	(115)	(85)	(0)	(0)	(0)	(320)
Walleye	0.0011	-	0	53	0	0	137	46	106	0	0	0	342
	(0.0076)	-	(0)	(92)	(0)	(0)	(297)	(92)	(204)	(0)	(0)	(0)	(685)
Yellow perch	0.0002	-	0	0	0	0	43	0	30	0	0	0	73
	(0.0015)	-	(0)	(0)	(0)	(0)	(79)	(0)	(58)	(0)	(0)	(0)	(137)
Total	0.2236	-	1,342	4,074	11,612	16,523	14,159	2,888	7,705	6,997	1,395	287	66,982
	(0.5283)	-	(1,006)	(2,912)	(7,040)	(11,200)	(9,081)	(2,909)	(6,759)	(4,288)	(2,191)	(319)	(47,704)
Angler hours		-	17,843	55,134	31,116	40,049	33,425	21,332	20,753	56,259	20,620	2,981	299,513
		-	(7,990)	(15,293)	(7,528)	(17,787)	(10,522)	(6,543)	(4,807)	(11,360)	(7,051)	(1,420)	(90,300)
Angler trips		-	4,703	11,995	7,994	9,977	10,445	6,370	5,716	11,941	5,439	775	75,353
		-	(2,161)	(3,846)	(2,411)	(4,637)	(3,814)	(2,210)	(1,725)	(2,633)	(2,188)	(468)	(26,094)
Angler days		-	4,548	11,604	7,384	9,410	10,378	6,271	5,716	11,941	5,439	775	73,465
		-	(2,137)	(3,755)	(2,325)	(4,403)	(3,802)	(2,202)	(1,725)	(2,633)	(2,188)	(468)	(25,639)

Appendix 7. The estimated number of fish released, release rates, and total catch in the Muskegon River during 1999, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0800	-	62	188	10,851	7,684	1,477	1,898	1,528	236	23	23	23,970
	(0.2104)	-	(128)	(226)	(7,357)	(4,632)	(1,363)	(2,075)	(1,161)	(277)	(46)	(39)	(17,305)
Chinook salmon	0.0373	-	0	0	337	0	0	46	30	10,572	191	0	11,176
	(0.0712)	-	(0)	(0)	(683)	(0)	(0)	(89)	(58)	(4,997)	(354)	(0)	(6,181)
Largemouth bass	0.0005	-	29	0	0	0	0	113	0	0	0	0	142
	(0.0027)	-	(58)	(0)	(0)	(0)	(0)	(166)	(0)	(0)	(0)	(0)	(225)
Rainbow trout	0.3810	-	714	6,742	34,971	38,839	11,395	11,594	8,100	878	588	287	114,110
	(0.8221)	-	(687)	(4,758)	(18,111)	(22,087)	(8,467)	(7,793)	(4,403)	(965)	(833)	(419)	(68,522)
Smallmouth bass	0.0028	-	0	0	73	316	129	234	80	0	0	0	832
	(0.0161)	-	(0)	(0)	(139)	(538)	(201)	(317)	(119)	(0)	(0)	(0)	(1,315)
Walleye	0.0046	-	222	1,106	0	0	43	0	0	0	0	0	1,372
	(0.0188)	-	(242)	(1,210)	(0)	(0)	(85)	(0)	(0)	(0)	(0)	(0)	(1,537)
Total release	0.5062	-	1,028	8,037	46,232	46,838	13,045	13,885	9,738	11,686	802	311	151,601
	(1.1413)	-	(1,116)	(6,194)	(26,289)	(27,257)	(10,116)	(10,440)	(5,743)	(6,239)	(1,233)	(457)	(95,084)
Total harvest	0.2236	-	1,342	4,074	11,612	16,523	14,159	2,888	7,705	6,997	1,395	287	66,982
	(0.5283)	-	(1,006)	(2,912)	(7,040)	(11,200)	(9,081)	(2,909)	(6,759)	(4,288)	(2,191)	(319)	(47,704)
Total catch	0.7298	-	2,370	12,110	57,844	63,361	27,204	16,773	17,443	18,684	2,197	598	218,584
	(1.2457)	-	(1,665)	(7,106)	(27,291)	(29,922)	(14,002)	(11,126)	(10,176)	(7,944)	(2,685)	(565)	(112,483)

Appendix 8. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 1999, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0019	-	0	0	0	137	0	0	0	30	0	8	176
	(0.0045)	-	(0)	(0)	(0)	(99)	(0)	(0)	(0)	(55)	(0)	(16)	(170)
Chinook salmon	0.0093	-	0	0	0	0	0	0	671	175	0	0	845
	(0.0232)	-	(0)	(0)	(0)	(0)	(0)	(0)	(626)	(250)	(0)	(0)	(875)
Largemouth bass	0.0003	-	0	0	0	0	0	0	0	30	0	0	30
	(0.0016)	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(59)	(0)	(0)	(59)
Northern Pike	0.0019	-	23	0	0	0	91	58	0	0	0	0	172
	(0.0089)	-	(46)	(0)	(0)	(0)	(197)	(94)	(0)	(0)	(0)	(0)	(338)
Pumpkinseed	0.0156	-	0	0	0	185	454	0	776	0	0	0	1,415
	(0.0617)	-	(0)	(0)	(0)	(323)	(792)	(0)	(1,216)	(0)	(0)	(0)	(2,331)
Rainbow trout	0.0531	-	116	456	85	137	0	0	0	1,708	1,617	691	4,810
	(0.0764)	-	(144)	(584)	(165)	(224)	(0)	(0)	(0)	(916)	(455)	(395)	(2,883)
Smallmouth bass	0.0020	-	0	0	0	0	0	58	0	120	0	0	178
	(0.0095)	-	(0)	(0)	(0)	(0)	(0)	(121)	(0)	(236)	(0)	(0)	(357)
Walleye	0.0027	-	0	0	0	37	91	117	0	0	0	0	244
	(0.0135)	-	(0)	(0)	(0)	(78)	(197)	(235)	(0)	(0)	(0)	(0)	(510)
Total	0.0869	-	139	456	85	497	636	233	1,446	2,063	1,617	700	7,872
	(0.1993)	-	(190)	(584)	(165)	(724)	(1,187)	(450)	(1,841)	(1,516)	(455)	(411)	(7,523)
Angler hours		-	8,379	7,755	8,502	6,125	11,355	10,177	11,249	12,662	9,219	5,161	90,583
		-	(4,137)	(3,669)	(3,372)	(3,290)	(4,528)	(3,778)	(4,942)	(4,583)	(3,158)	(2,299)	(37,755)
Angler trips		-	2,066	2,712	2,592	2,205	4,550	3,425	3,151	3,184	2,388	1,272	27,545
		-	(1,279)	(994)	(1,352)	(875)	(1,540)	(1,855)	(1,709)	(1,254)	(455)	(544)	(11,857)
Angler Days		-	2,066	2,605	2,592	2,205	4,270	3,125	3,151	3,184	2,388	1,272	26,858
		-	(1,279)	(988)	(1,352)	(875)	(1,553)	(1,855)	(1,709)	(1,254)	(455)	(544)	(11,862)

Appendix 9. The estimated number of fish released, release rates, and total catch in the Muskegon River during 1999, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0073	-	0	0	0	641	0	0	0	0	21	0	662
	(0.0155)	-	(0)	(0)	(0)	(458)	(0)	(0)	(0)	(0)	(42)	(0)	(500)
Chinook salmon	0.0023	-	0	0	0	0	0	0	0	204	0	0	204
	(0.0101)	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(328)	(0)	(0)	(328)
Largemouth bass	0.0000	-	0	0	0	0	0	0	0	0	0	0	0
	(0.0000)	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Northern Pike	0.0000	-	0	0	0	0	0	0	0	0	0	0	0
	(0.0000)	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Pumpkinseed	0.0000	-	0	0	0	0	0	0	0	0	0	0	0
	(0.0000)	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Rainbow trout	0.0215	-	0	0	0	504	0	0	0	1,006	201	233	1,945
	(0.0646)	-	(0)	(0)	(0)	(770)	(0)	(0)	(0)	(914)	(175)	(226)	(2,085)
Smallmouth bass	0.0093	-	0	0	0	171	464	58	150	0	0	0	844
	(0.0478)	-	(0)	(0)	(0)	(193)	(897)	(121)	(334)	(0)	(0)	(0)	(1,545)
Walleye	0.0006	-	0	0	0	0	0	58	0	0	0	0	58
	(0.0038)	-	(0)	(0)	(0)	(0)	(0)	(124)	(0)	(0)	(0)	(0)	(124)
Total release	0.0410	-	0	0	0	1,317	464	117	150	1,211	221	233	3,713
	(0.1419)	-	(0)	(0)	(0)	(1,422)	(897)	(245)	(334)	(1,242)	(217)	(226)	(4,582)
Total harvest	0.0869	-	139	456	85	497	636	233	1,446	2,063	1,617	700	7,872
	(0.1993)	-	(190)	(584)	(165)	(724)	(1,187)	(450)	(1,841)	(1,516)	(455)	(411)	(7,523)
Total catch	0.1279	-	139	456	85	1,814	1,100	350	1,596	3,274	1,838	933	11,585
	(0.2851)	-	(190)	(584)	(165)	(1,865)	(2,084)	(531)	(2,175)	(2,170)	(530)	(471)	(10,764)

Appendix 10. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2000, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0056	0	45	0	128	527	133	121	245	716	74	0	1,989
	(0.0215)	(0)	(90)	(0)	(146)	(540)	(180)	(218)	(445)	(1,430)	(156)	(0)	(3,206)
Chinook salmon	0.0280	0	0	0	0	0	0	0	406	9,487	0	0	9,893
	(0.0426)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(618)	(5,731)	(0)	(0)	(6,348)
Largemouth bass	0.0001	0	0	0	0	22	0	0	0	0	0	0	22
	(0.0003)	(0)	(0)	(0)	(0)	(45)	(0)	(0)	(0)	(0)	(0)	(0)	(45)
Pumpkinseed	0.0103	0	0	0	0	44	0	208	3,400	0	0	0	3,652
	(0.0498)	(0)	(0)	(0)	(0)	(88)	(0)	(424)	(6,911)	(0)	(0)	(0)	(7,424)
Rainbow trout	0.0619	228	6,281	2,283	988	2,242	2,211	1,152	2,778	1,803	1,924	9	21,899
	(0.1362)	(462)	(3,517)	(1,679)	(1,131)	(2,215)	(2,431)	(992)	(3,607)	(2,357)	(1,893)	(17)	(20,300)
Smallmouth bass	0.0000	0	0	0	0	0	0	0	0	0	0	0	0
	(0.0000)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Walleye	0.0018	80	100	0	77	0	172	67	136	0	0	0	632
	(0.0073)	(162)	(159)	(0)	(112)	(0)	(270)	(142)	(247)	(0)	(0)	(0)	(1,092)
Yellow perch	0.0104	0	0	0	0	0	0	0	3,672	0	0	0	3,672
	(0.0492)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(7,335)	(0)	(0)	(0)	(7,335)
Total	0.1181	308	6,426	2,283	1,194	2,835	2,515	1,548	10,637	12,006	1,998	9	41,758
	(0.3069)	(624)	(3,766)	(1,679)	(1,390)	(2,888)	(2,881)	(1,777)	(19,163)	(9,518)	(2,049)	(17)	(45,750)
Angler hours		10,540	53,320	39,568	16,534	31,273	33,118	15,554	31,825	93,541	24,465	3,822	353,560
		(8,337)	(18,617)	(17,303)	(9,948)	(12,710)	(22,595)	(4,391)	(18,452)	(22,017)	(10,269)	(4,448)	(149,086)
Angler trips		2,751	12,444	9,347	5,112	7,497	10,201	4,908	8,539	23,090	6,552	1,011	91,452
		(2,649)	(4,411)	(4,577)	(3,176)	(3,197)	(7,376)	(1,702)	(4,983)	(7,160)	(3,001)	(1,128)	(43,359)
Angler Days		2,669	12,400	9,347	5,112	7,497	10,201	4,469	8,539	23,090	6,552	1,011	90,887
		(2,608)	(4,405)	(4,577)	(3,176)	(3,197)	(7,376)	(1,571)	(4,983)	(7,160)	(3,001)	(1,128)	(43,181)

Appendix 11. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2000, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0231	274	149	316	396	2,578	1,510	368	1,320	793	0	465	8,169
	(0.0741)	(381)	(200)	(405)	(422)	(2,133)	(1,828)	(517)	(1,996)	(1,548)	(0)	(523)	(9,955)
Chinook salmon	0.0633	0	0	0	0	0	0	0	1,510	20,884	0	0	22,394
	(0.1413)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1,541)	(17,445)	(0)	(0)	(18,986)
Rainbow trout	0.1568	523	10,607	4,193	1,982	8,717	5,768	2,070	4,314	12,772	3,222	1,281	55,449
	(0.3885)	(949)	(6,411)	(2,819)	(1,519)	(6,170)	(5,708)	(1,800)	(5,430)	(16,542)	(2,726)	(2,124)	(52,199)
Smallmouth bass	0.0004	0	0	0	0	0	114	0	38	0	0	0	153
	(0.0022)	(0)	(0)	(0)	(0)	(0)	(225)	(0)	(74)	(0)	(0)	(0)	(299)
Total release	0.2437	797	10,756	4,509	2,378	11,295	7,393	2,438	7,182	34,448	3,222	1,746	86,165
	(0.6061)	(1,330)	(6,611)	(3,224)	(1,941)	(8,304)	(7,761)	(2,318)	(9,042)	(35,535)	(2,726)	(2,648)	(81,440)
Total harvest	0.1181	308	6,426	2,283	1,194	2,835	2,515	1,548	10,637	12,006	1,998	9	41,758
	(0.3069)	(624)	(3,766)	(1,679)	(1,390)	(2,888)	(2,881)	(1,777)	(19,163)	(9,518)	(2,049)	(17)	(45,750)
Total catch	0.3618	1,105	17,181	6,793	3,572	14,130	9,908	3,986	17,820	46,454	5,220	1,755	127,923
	(0.7047)	(1,637)	(7,691)	(3,687)	(2,498)	(8,958)	(8,557)	(3,184)	(24,810)	(37,896)	(3,490)	(2,648)	(105,056)

Appendix 12. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2000, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Chinook salmon	0.0107	0	0	0	0	0	0	0	409	539	0	0	947
	(0.0209)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(335)	(489)	(0)	(0)	(824)
Northern Pike	0.0017	0	69	0	0	0	78	0	0	0	0	0	147
	(0.0075)	(0)	(140)	(0)	(0)	(0)	(156)	(0)	(0)	(0)	(0)	(0)	(296)
Rainbow trout	0.0370	143	413	674	0	0	0	0	0	945	1,067	20	3,261
	(0.0610)	(170)	(255)	(539)	(0)	(0)	(0)	(0)	(0)	(595)	(820)	(26)	(2,406)
Smallmouth bass	0.0000	0	0	0	0	0	0	0	0	0	0	0	0
	(0.0000)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Walleye	0.0066	0	0	0	0	0	439	141	0	0	0	0	580
	(0.0198)	(0)	(0)	(0)	(0)	(0)	(598)	(184)	(0)	(0)	(0)	(0)	(782)
Total	0.0559	143	482	674	0	0	517	141	409	1,484	1,067	20	4,935
	(0.1093)	(170)	(395)	(539)	(0)	(0)	(753)	(184)	(335)	(1,084)	(820)	(26)	(4,307)
Angler hours		2,037	11,842	7,260	2,232	5,153	10,290	8,897	13,145	14,850	11,732	780	88,217
		(1,632)	(3,132)	(3,347)	(1,182)	(2,843)	(5,734)	(4,356)	(7,377)	(4,176)	(5,483)	(153)	(39,416)
Angler trips		1,230	3,455	3,050	1,097	1,800	3,549	3,940	3,541	4,270	2,782	221	28,936
		(1,209)	(1,452)	(2,180)	(609)	(1,219)	(987)	(3,139)	(2,319)	(1,436)	(1,449)	(68)	(16,067)
Angler Days		1,230	3,455	3,050	1,097	1,800	3,549	3,940	3,541	4,270	2,782	221	28,936
		(1,209)	(1,452)	(2,180)	(609)	(1,219)	(987)	(3,139)	(2,319)	(1,436)	(1,449)	(68)	(16,067)

Appendix 13. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2000, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Chinook salmon	0.0072	0	0	0	0	0	0	0	137	498	0	0	635
	(0.0217)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(290)	(444)	(0)	(0)	(734)
Northern Pike	0.0008	0	69	0	0	0	0	0	0	0	0	0	69
	(0.0042)	(0)	(140)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(140)
Rainbow trout	0.0222	64	106	422	0	36	0	0	0	845	478	10	1,960
	(0.0640)	(85)	(164)	(396)	(0)	(59)	(0)	(0)	(0)	(848)	(589)	(22)	(2,163)
Smallmouth bass	0.0004	0	0	0	0	0	39	0	0	0	0	0	39
	(0.0025)	(0)	(0)	(0)	(0)	(0)	(83)	(0)	(0)	(0)	(0)	(0)	(83)
Walleye	0.0000	0	0	0	0	0	0	0	0	0	0	0	0
	(0.0000)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Total release	0.0306	64	175	422	0	36	39	0	137	1,343	478	10	2,703
	(0.0924)	(85)	(305)	(396)	(0)	(59)	(83)	(0)	(290)	(1,292)	(589)	(22)	(3,121)
Total harvest	0.0559	143	482	674	0	0	517	141	409	1,484	1,067	20	4,935
	(0.1093)	(170)	(395)	(539)	(0)	(0)	(753)	(184)	(335)	(1,084)	(820)	(26)	(4,307)
Total catch	0.0866	206	657	1,096	0	36	556	141	545	2,826	1,545	30	7,638
	(0.1443)	(190)	(502)	(669)	(0)	(59)	(836)	(184)	(443)	(1,727)	(1,042)	(34)	(5,686)

Appendix 14. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2001, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0082	-	0	376	421	795	235	0	355	0	139	0	2,320
	(0.0294)	-	(0)	(464)	(493)	(857)	(320)	(0)	(660)	(0)	(290)	(0)	(3,084)
Chinook salmon	0.0042	-	0	0	0	0	0	0	81	1,100	0	0	1,181
	(0.0109)	-	(0)	(0)	(0)	(0)	(0)	(0)	(157)	(984)	(0)	(0)	(1,142)
Pumpkinseed	0.0015	-	0	0	0	419	0	0	0	0	0	0	419
	(0.0066)	-	(0)	(0)	(0)	(696)	(0)	(0)	(0)	(0)	(0)	(0)	(696)
Rainbow trout	0.0425	-	1,268	2,537	836	2,083	1,506	509	1,442	1,107	483	278	12,049
	(0.1313)	-	(834)	(2,315)	(874)	(2,335)	(2,131)	(724)	(2,040)	(1,587)	(648)	(272)	(13,760)
Rock bass	0.0030	-	0	0	0	838	0	0	0	0	0	0	838
	(0.0133)	-	(0)	(0)	(0)	(1,392)	(0)	(0)	(0)	(0)	(0)	(0)	(1,392)
Smallmouth bass	0.0001	-	0	0	0	0	0	41	0	0	0	0	41
	(0.0007)	-	(0)	(0)	(0)	(0)	(0)	(75)	(0)	(0)	(0)	(0)	(75)
Walleye	0.0003	-	41	0	0	0	0	41	0	0	0	0	82
	(0.0015)	-	(86)	(0)	(0)	(0)	(0)	(75)	(0)	(0)	(0)	(0)	(160)
Yellow perch	0.0053	-	313	0	0	140	0	1,023	0	0	0	20	1,495
	(0.0355)	-	(621)	(0)	(0)	(232)	(0)	(2,833)	(0)	(0)	(0)	(41)	(3,726)
Total	0.0651	-	1,622	2,913	1,257	4,274	1,741	1,614	1,878	2,208	622	298	18,425
	(0.2293)	-	(1,540)	(2,779)	(1,367)	(5,513)	(2,451)	(3,707)	(2,857)	(2,571)	(938)	(312)	(24,035)
Angler hours		-	30,661	68,218	18,492	23,443	22,748	14,357	28,612	53,618	19,496	3,549	283,192
		-	(10,141)	(19,220)	(9,035)	(8,714)	(10,006)	(7,038)	(13,646)	(15,856)	(9,844)	(1,332)	(104,831)
Angler trips		-	7,702	13,657	5,136	6,848	7,082	7,304	8,536	14,183	4,804	974	76,225
		-	(2,749)	(4,454)	(2,963)	(2,426)	(3,507)	(4,063)	(4,183)	(4,950)	(2,616)	(330)	(32,241)
Angler Days		-	7,411	13,592	4,582	6,699	7,082	6,943	8,536	14,183	4,804	974	74,804
		-	(2,681)	(4,441)	(2,614)	(2,424)	(3,507)	(4,011)	(4,183)	(4,950)	(2,616)	(330)	(31,758)

Appendix 15. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2001, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0369	-	445	608	1,406	2,217	520	0	3,280	1,332	561	78	10,447
	(0.1412)	-	(661)	(647)	(1,294)	(3,114)	(624)	(0)	(4,239)	(1,837)	(659)	(143)	(13,220)
Chinook salmon	0.0077	-	0	0	0	0	0	0	294	1,877	0	0	2,171
	(0.0271)	-	(0)	(0)	(0)	(0)	(0)	(0)	(455)	(2,080)	(0)	(0)	(2,534)
Rainbow trout	0.1080	-	1,564	6,936	2,309	2,734	3,934	547	7,303	1,400	3,730	120	30,576
	(0.2955)	-	(1,219)	(3,368)	(2,046)	(3,529)	(4,187)	(846)	(6,806)	(1,817)	(3,704)	(151)	(27,674)
Smallmouth bass	0.0006	-	0	0	0	0	80	85	0	0	0	0	165
	(0.0036)	-	(0)	(0)	(0)	(0)	(159)	(182)	(0)	(0)	(0)	(0)	(340)
Walleye	0.0006	-	157	0	0	0	0	0	0	0	0	0	157
	(0.0033)	-	(307)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(307)
Total release	0.1537	-	2,166	7,544	3,715	4,951	4,534	632	10,877	4,609	4,291	198	43,516
	(0.4706)	-	(2,187)	(4,015)	(3,340)	(6,643)	(4,970)	(1,028)	(11,500)	(5,734)	(4,363)	(294)	(44,075)
Total harvest	0.0651	-	1,622	2,913	1,257	4,274	1,741	1,614	1,878	2,208	622	298	18,425
	(0.2293)	-	(1,540)	(2,779)	(1,367)	(5,513)	(2,451)	(3,707)	(2,857)	(2,571)	(938)	(312)	(24,035)
Total catch	0.2187	-	3,788	10,457	4,972	9,225	6,275	2,245	12,755	6,817	4,912	496	61,942
	(0.5476)	-	(3,132)	(4,999)	(3,626)	(10,015)	(6,381)	(4,328)	(13,066)	(6,891)	(4,513)	(495)	(57,406)

Appendix 16. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2001, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0014	-	102	0	0	NS	0	0	0	0	0	0	102
	(0.0075)	-	(198)	(0)	(0)	NS	(0)	(0)	(0)	(0)	(0)	(0)	(198)
Chinook salmon	0.0095	-	0	0	0	NS	0	0	713	0	0	0	713
	(0.0468)	-	(0)	(0)	(0)	NS	(0)	(0)	(1,233)	(0)	(0)	(0)	(1,233)
Rainbow trout	0.0486	-	660	424	0	NS	0	0	0	1,168	1,399	0	3,651
	(0.1340)	-	(1,049)	(712)	(0)	NS	(0)	(0)	(0)	(1,049)	(719)	(0)	(3,529)
Smallmouth bass	0.0012	-	0	0	0	NS	0	0	91	0	0	0	91
	(0.0064)	-	(0)	(0)	(0)	NS	(0)	(0)	(168)	(0)	(0)	(0)	(168)
Walleye	0.0138	-	143	0	0	NS	762	0	132	0	0	0	1,037
	(0.0459)	-	(231)	(0)	(0)	NS	(790)	(0)	(187)	(0)	(0)	(0)	(1,208)
Total	0.0745	-	904	424	0	NS	762	0	937	1,168	1,399	0	5,594
	(0.2405)	-	(1,478)	(712)	(0)	NS	(790)	(0)	(1,588)	(1,049)	(719)	(0)	(6,336)
Angler hours		-	11,494	9,006	4,701	NS	8,561	5,353	10,668	9,397	12,516	3,432	75,128
		-	(4,622)	(6,269)	(3,380)	NS	(360)	(363)	(4,266)	(4,279)	(2,801)	(0)	(26,339)
Angler trips		-	3,358	2,777	1,395	NS	3,092	2,665	2,045	2,774	2,732	902	21,740
		-	(1,794)	(1,107)	(837)	NS	(0)	(0)	(870)	(1,030)	(653)	(0)	(6,291)
Angler Days		-	3,358	2,777	1,276	NS	1,886	2,665	2,045	2,774	2,732	902	20,415
		-	(1,794)	(1,107)	(842)	NS	(0)	(0)	(870)	(1,030)	(653)	(0)	(6,296)

Appendix 17. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2001, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Rainbow trout	0.0162	-	0	0	0	-	0	0	0	1,067	148	0	1,215
	(0.0856)	-	(0)	(0)	(0)	-	(0)	(0)	(0)	(1,806)	(208)	(0)	(2,015)
Smallmouth bass	0.0019	-	0	0	139	-	0	0	0	0	0	0	139
	(0.0073)	-	(0)	(0)	(173)	-	(0)	(0)	(0)	(0)	(0)	(0)	(173)
Total release	0.0180	-	0	0	139	-	0	0	0	1,067	148	0	1,354
	(0.0929)	-	(0)	(0)	(173)	-	(0)	(0)	(0)	(1,806)	(208)	(0)	(2,187)
Total harvest	0.0745	-	904	424	0	-	762	0	937	1,168	1,399	0	5,594
	(0.2405)	-	(1,478)	(712)	(0)	-	(790)	(0)	(1,588)	(1,049)	(719)	(0)	(6,336)
Total	0.0925	-	904	424	139	-	762	0	937	2,235	1,547	0	6,949
	(0.2877)	-	(1,478)	(712)	(173)	-	(790)	(0)	(1,588)	(2,089)	(748)	(0)	(7,578)

Appendix 18. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2002, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0099	0	0	70	388	792	113	0	688	0	37	0	2,088
	(0.0395)	(0)	(0)	(102)	(601)	(995)	(183)	(0)	(1,121)	(0)	(68)	(0)	(3,070)
Chinook salmon	0.0138	0	0	0	0	0	0	0	141	2,770	0	0	2,911
	(0.0309)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(288)	(2,112)	(0)	(0)	(2,400)
Largemouth bass	0.0004	0	0	0	95	0	0	0	0	0	0	0	95
	(0.0019)	(0)	(0)	(0)	(149)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(149)
Northern Pike	0.0010	0	0	210	0	0	0	0	0	0	0	0	210
	(0.0054)	(0)	(0)	(420)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(420)
Rainbow trout	0.0447	0	139	2,816	129	2,177	849	0	423	1,145	1,661	114	9,453
	(0.1304)	(0)	(154)	(1,490)	(218)	(2,607)	(914)	(0)	(590)	(1,873)	(2,057)	(222)	(10,125)
Rock bass	0.0035	0	0	0	0	737	0	0	0	0	0	0	737
	(0.0188)	(0)	(0)	(0)	(0)	(1,461)	(0)	(0)	(0)	(0)	(0)	(0)	(1,461)
Walleye	0.0003	0	69	0	0	0	0	0	0	0	0	0	69
	(0.0014)	(0)	(108)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(108)
Yellow perch	0.0006	0	0	0	0	0	0	0	0	0	0	135	135
	(0.0027)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(208)	(208)
Total	0.0742	0	208	3,096	613	3,707	961	0	1,252	3,915	1,698	249	15,700
	(0.2311)	(0)	(262)	(2,012)	(968)	(5,064)	(1,098)	(0)	(1,999)	(3,985)	(2,125)	(430)	(17,942)
Angler hours		4,107	14,001	50,573	14,485	23,001	12,749	15,981	12,015	50,860	11,445	2,429	211,647
		(1,213)	(7,033)	(12,460)	(5,690)	(8,560)	(7,719)	(7,104)	(5,209)	(15,484)	(5,214)	(1,949)	(77,635)
Angler trips		1,945	3,703	9,670	2,263	6,288	3,904	5,525	4,562	11,021	2,699	691	52,271
		(1,014)	(1,995)	(2,909)	(1,173)	(2,730)	(2,331)	(2,829)	(2,193)	(3,456)	(1,415)	(592)	(22,638)
Angler Days		1,945	3,555	9,561	2,263	6,288	3,904	5,525	4,562	11,021	2,699	691	52,014
		(1,014)	(1,917)	(2,871)	(1,173)	(2,730)	(2,331)	(2,829)	(2,193)	(3,456)	(1,415)	(592)	(22,522)

Appendix 19. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2002, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0610	0	17	177	3,241	2,834	371	645	1,123	755	3,569	185	12,917
	(0.2080)	(0)	(34)	(274)	(2,647)	(3,160)	(554)	(704)	(2,170)	(965)	(3,848)	(302)	(14,659)
Chinook salmon	0.0494	0	0	0	0	0	0	0	0	10,430	26	0	10,457
	(0.0787)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(5,493)	(53)	(0)	(5,547)
Rainbow trout	0.2171	0	121	6,055	4,293	6,315	3,787	4,426	863	13,637	5,580	866	45,943
	(0.6270)	(0)	(111)	(3,507)	(3,695)	(6,646)	(4,901)	(4,281)	(1,105)	(13,333)	(5,439)	(1,169)	(44,188)
Smallmouth bass	0.0030	0	0	0	0	0	0	625	0	0	0	0	625
	(0.0178)	(0)	(0)	(0)	(0)	(0)	(0)	(1,251)	(0)	(0)	(0)	(0)	(1,251)
Total release	0.3305	0	139	6,232	7,533	9,148	4,159	5,697	1,985	24,822	9,175	1,052	69,942
	(0.9315)	(0)	(146)	(3,781)	(6,341)	(9,806)	(5,455)	(6,237)	(3,275)	(19,791)	(9,341)	(1,472)	(65,645)
Total harvest	0.0742	0	208	3,096	613	3,707	961	0	1,252	3,915	1,698	249	15,700
	(0.2311)	(0)	(262)	(2,012)	(968)	(5,064)	(1,098)	(0)	(1,999)	(3,985)	(2,125)	(430)	(17,942)
Total catch	0.4046	0	346	9,328	8,146	12,855	5,120	5,697	3,238	28,737	10,873	1,301	85,642
	(0.9280)	(0)	(332)	(4,553)	(6,954)	(12,455)	(5,622)	(6,237)	(4,212)	(20,377)	(9,797)	(1,711)	(72,042)

Appendix 20. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2002, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Chinook salmon	0.0033	0	0	0	0	-	-	-	115	0	0	0	115
	(0.0065)	(0)	(0)	(0)	(0)	-	-	-	(137)	(0)	(0)	(0)	(137)
Rainbow trout	0.0924	47	367	441	0	-	-	-	0	0	2,364	0	3,219
	(0.0989)	(99)	(599)	(379)	(0)	-	-	-	(0)	(0)	(1,012)	(0)	(2,089)
Smallmouth bass	0.0016	0	0	0	0	-	-	-	57	0	0	0	57
	(0.0060)	(0)	(0)	(0)	(0)	-	-	-	(127)	(0)	(0)	(0)	(127)
Total	0.0973	47	367	441	0	-	-	-	172	0	2,364	0	3,391
	(0.1114)	(99)	(599)	(379)	(0)	-	-	-	(264)	(0)	(1,012)	(0)	(2,353)
Angler hours		1,134	4,450	5,751	740	-	-	-	3,856	6,355	11,023	1,538	34,847
		(506)	(2,670)	(2,988)	(1,017)	-	-	-	(2,282)	(3,780)	(6,614)	(1,265)	(21,121)
Angler trips		495	1,275	2,458	234	-	-	-	846	2,513	4,023	390	12,232
		(199)	(865)	(1,872)	(333)	-	-	-	(660)	(1,135)	(1,531)	(483)	(7,079)
Angler Days		495	1,275	2,458	234	-	-	-	846	2,513	4,023	390	12,232
		(199)	(865)	(1,872)	(333)	-	-	-	(660)	(1,135)	(1,531)	(483)	(7,079)

Appendix 21. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2002, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Northern Pike	0.0086	0	0	0	0	-	-	-	0	301	0	0	301
	(0.0512)	(0)	(0)	(0)	(0)	-	-	-	(0)	(678)	(0)	(0)	(678)
Rainbow trout	0.0363	0	19	30	0	-	-	-	0	725	491	0	1,265
	(0.0882)	(0)	(40)	(63)	(0)	-	-	-	(0)	(0)	(1,065)	(0)	(1,168)
Smallmouth bass	0.0059	0	0	91	114	-	-	-	0	0	0	0	205
	(0.0350)	(0)	(0)	(199)	(264)	-	-	-	(0)	(0)	(0)	(0)	(463)
Total release	0.0508	0	19	121	114	-	-	-	0	1,026	491	0	1,771
	(0.1744)	(0)	(40)	(262)	(264)	-	-	-	(0)	(678)	(1,065)	(0)	(2,309)
Total harvest	0.0973	47	367	441	0	-	-	-	172	0	2,364	0	3,391
	(0.1114)	(99)	(599)	(379)	(0)	-	-	-	(264)	(0)	(1,012)	(0)	(2,353)
Total catch	0.1481	47	387	562	114	-	-	-	172	1,026	2,855	0	5,161
	(0.1875)	(99)	(601)	(584)	(264)	-	-	-	(264)	(678)	(1,469)	(0)	(3,960)

Appendix 22. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2003, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0086	7	0	353	474	361	458	121	185	40	0	0	1,999
	(0.0299)	(14)	(0)	(483)	(513)	(438)	(721)	(187)	(222)	(81)	(0)	(0)	(2,660)
Chinook salmon	0.0206	0	0	0	0	0	0	0	32	4,629	132	0	4,793
	(0.0431)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(61)	(3,504)	(261)	(0)	(3,826)
Northern Pike	0.0000	0	8	0	0	0	0	0	0	0	0	0	8
	(0.0002)	(0)	(15)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(15)
Other	0.0024	0	547	0	0	0	0	0	0	0	0	0	547
	(0.0069)	(0)	(609)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(609)
Rainbow trout	0.0726	22	249	3,720	1,384	2,055	3,016	1,972	1,043	2,100	1,273	38	16,872
	(0.1888)	(40)	(278)	(2,636)	(1,174)	(2,665)	(3,063)	(2,008)	(1,393)	(2,322)	(1,132)	(60)	(16,771)
Rock bass	0.0015	0	0	0	0	0	0	0	0	0	344	0	344
	(0.0086)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(762)	(0)	(762)
Smallmouth bass	0.0014	0	0	0	153	0	151	28	0	0	0	0	331
	(0.0061)	(0)	(0)	(0)	(306)	(0)	(180)	(59)	(0)	(0)	(0)	(0)	(545)
Yellow perch	0.0010	0	0	0	0	0	0	0	0	238	0	0	238
	(0.0055)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(487)	(0)	(0)	(487)
Total	0.1082	28	803	4,073	2,011	2,416	3,625	2,121	1,259	7,007	1,748	38	25,130
	(0.2890)	(55)	(902)	(3,119)	(1,993)	(3,103)	(3,965)	(2,254)	(1,676)	(6,394)	(2,155)	(60)	(25,675)
Angler hours		1,459	13,497	56,096	21,090	18,054	20,101	11,229	13,442	54,210	19,676	3,426	232,279
		(1,373)	(5,794)	(19,543)	(11,040)	(5,607)	(12,310)	(4,146)	(3,696)	(16,327)	(7,030)	(1,976)	(88,843)
Angler trips		409	3,891	12,966	4,790	3,816	6,138	3,852	4,069	10,756	4,546	766	55,998
		(393)	(1,818)	(4,699)	(2,645)	(1,669)	(4,065)	(1,812)	(1,372)	(3,617)	(1,783)	(506)	(24,380)
Angler Days		353	3,276	11,438	4,293	3,509	5,852	3,712	4,069	10,756	4,546	766	52,571
		(337)	(1,568)	(4,297)	(2,420)	(1,571)	(3,788)	(1,794)	(1,372)	(3,617)	(1,783)	(506)	(23,052)

Appendix 23. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2003, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0153	35	155	314	322	293	949	268	437	258	507	18	3,557
	(0.0578)	(66)	(180)	(357)	(433)	(311)	(1,406)	(548)	(713)	(449)	(643)	(32)	(5,137)
Chinook salmon	0.0386	0	0	0	0	0	0	0	32	8,647	281	0	8,960
	(0.0836)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(70)	(6,795)	(558)	(0)	(7,423)
Rainbow trout	0.1237	78	1,363	5,285	2,688	3,159	3,084	1,321	1,623	6,235	3,097	799	28,732
	(0.3309)	(114)	(1,718)	(3,819)	(3,282)	(2,822)	(4,991)	(2,292)	(1,974)	(5,765)	(1,971)	(654)	(29,402)
Smallmouth bass	0.0018	0	0	0	0	289	38	47	0	0	41	0	414
	(0.0083)	(0)	(0)	(0)	(0)	(474)	(75)	(100)	(0)	(0)	(88)	(0)	(737)
Total release	0.1794	113	1,518	5,599	3,010	3,741	4,071	1,636	2,092	15,140	3,927	817	41,663
	(0.4806)	(179)	(1,899)	(4,176)	(3,715)	(3,607)	(6,473)	(2,939)	(2,756)	(13,009)	(3,259)	(686)	(42,700)
Total harvest	0.1082	28	803	4,073	2,011	2,416	3,625	2,121	1,259	7,007	1,748	38	25,130
	(0.2890)	(55)	(902)	(3,119)	(1,993)	(3,103)	(3,965)	(2,254)	(1,676)	(6,394)	(2,155)	(60)	(25,675)
Total catch	0.2876	141	2,321	9,672	5,021	6,157	7,696	3,757	3,350	22,147	5,675	855	66,793
	(0.5970)	(188)	(2,595)	(5,343)	(4,517)	(5,152)	(8,043)	(3,830)	(3,448)	(14,805)	(4,431)	(690)	(53,043)

Appendix 24. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2003, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Chinook salmon	0.0276	-	0	0	0	-	-	-	713	210	188	0	1,111
	(0.0602)	-	(0)	(0)	(0)	-	-	-	(568)	(295)	(366)	(0)	(1,229)
Northern Pike	0.0003	-	0	0	12	-	-	-	0	0	0	0	12
	(0.0014)	-	(0)	(0)	(28)	-	-	-	(0)	(0)	(0)	(0)	(28)
Other	0.0093	-	375	0	0	-	-	-	0	0	0	0	375
	(0.0338)	-	(689)	(0)	(0)	-	-	-	(0)	(0)	(0)	(0)	(689)
Rainbow trout	0.0563	-	75	154	264	-	-	-	0	400	1,036	337	2,266
	(0.1230)	-	(100)	(209)	(279)	-	-	-	(0)	(602)	(918)	(401)	(2,509)
Smallmouth bass	0.0005	-	0	0	0	-	-	-	0	20	0	0	20
	(0.0021)	-	(0)	(0)	(0)	-	-	-	(0)	(43)	(0)	(0)	(43)
Total	0.0940	-	451	154	276	-	-	-	713	630	1,223	337	3,785
	(0.2205)	-	(790)	(209)	(307)	-	-	-	(568)	(939)	(1,284)	(401)	(4,498)
Angler hours		-	1,866	12,144	1,486	-	-	-	4,286	9,914	7,913	2,669	40,277
		-	(1,911)	(6,758)	(746)	-	-	-	(2,033)	(3,598)	(3,826)	(1,526)	(20,398)
Angler trips		-	654	4,842	498	-	-	-	1,122	2,447	1,921	674	12,157
		-	(733)	(3,161)	(318)	-	-	-	(616)	(863)	(1,159)	(413)	(7,263)
Angler Days		-	654	4,719	498	-	-	-	1,122	2,447	1,921	674	12,034
		-	(733)	(3,122)	(318)	-	-	-	(616)	(863)	(1,159)	(413)	(7,224)

Appendix 25. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2003, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Chinook salmon	0.0268	-	0	0	0	-	-	-	0	1,048	31	0	1,080
	(0.0764)	-	(0)	(0)	(0)	-	-	-	(0)	(1,495)	(64)	(0)	(1,559)
Rainbow trout	0.0368	-	0	866	12	-	-	-	0	150	438	18	1,484
	(0.1491)	-	(0)	(2,087)	(19)	-	-	-	(0)	(339)	(557)	(39)	(3,042)
Smallmouth bass	0.0008	-	0	31	0	-	-	-	0	0	0	0	31
	(0.0031)	-	(0)	(64)	(0)	-	-	-	(0)	(0)	(0)	(0)	(64)
Total release	0.0644	-	0	897	12	-	-	-	0	1,198	469	18	2,594
	(0.2287)	-	(0)	(2,151)	(19)	-	-	-	(0)	(1,835)	(621)	(39)	(4,664)
Total harvest	0.0940	-	451	154	276	-	-	-	713	630	1,223	337	3,785
	(0.2205)	-	(790)	(209)	(307)	-	-	-	(568)	(939)	(1,284)	(401)	(4,498)
Total catch	0.1584	-	451	1,051	288	-	-	-	713	1,828	1,692	355	6,379
	(0.3889)	-	(790)	(2,161)	(308)	-	-	-	(568)	(2,258)	(1,445)	(402)	(7,932)

Appendix 26. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2004, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0093	0	0	423	408	733	332	245	42	0	0	0	2,183
	(0.0353)	(0)	(0)	(724)	(577)	(656)	(430)	(429)	(87)	(0)	(0)	(0)	(2,903)
Chinook salmon	0.0257	0	0	0	0	0	0	0	199	5,860	0	0	6,059
	(0.0415)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(212)	(3,197)	(0)	(0)	(3,410)
Other	0.0002	0	0	43	0	0	0	0	0	0	0	0	43
	(0.0011)	(0)	(0)	(87)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(87)
Rainbow trout	0.0508	389	902	4,154	585	2,693	1,247	561	495	407	269	281	11,982
	(0.1365)	(454)	(915)	(2,591)	(480)	(2,568)	(1,835)	(458)	(579)	(769)	(251)	(318)	(11,219)
Smallmouth bass	0.0016	0	0	0	0	134	122	116	0	0	0	0	373
	(0.0076)	(0)	(0)	(0)	(0)	(233)	(254)	(141)	(0)	(0)	(0)	(0)	(628)
Walleye	0.0004	0	0	0	0	0	0	58	0	0	26	0	84
	(0.0022)	(0)	(0)	(0)	(0)	(0)	(0)	(126)	(0)	(0)	(51)	(0)	(177)
Yellow perch	0.0014	0	0	0	0	329	0	0	0	0	0	0	329
	(0.0080)	(0)	(0)	(0)	(0)	(658)	(0)	(0)	(0)	(0)	(0)	(0)	(658)
Total	0.0893	389	902	4,620	993	3,890	1,702	980	736	6,266	294	281	21,053
	(0.2322)	(454)	(915)	(3,402)	(1,057)	(4,115)	(2,520)	(1,154)	(878)	(3,967)	(302)	(318)	(19,082)
Angler hours		5,594	16,699	58,969	10,849	19,694	21,899	13,337	17,415	50,129	17,814	3,339	235,738
		(3,449)	(9,023)	(15,157)	(7,069)	(6,238)	(7,569)	(6,371)	(6,421)	(13,431)	(5,433)	(2,031)	(82,191)
Angler trips		1,374	4,999	14,264	3,109	5,560	6,014	4,044	4,251	12,176	4,208	764	60,763
		(864)	(2,922)	(4,276)	(2,498)	(2,146)	(2,510)	(2,398)	(2,120)	(3,548)	(1,871)	(319)	(25,473)
Angler Days		1,274	4,563	12,618	2,764	5,052	5,412	3,841	4,251	12,176	4,208	764	56,922
		(795)	(2,768)	(4,058)	(2,251)	(2,051)	(2,309)	(2,328)	(2,120)	(3,548)	(1,871)	(319)	(24,419)

Appendix 27. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2004, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0216	150	288	1,405	205	949	177	331	687	246	549	113	5,101
	(0.0822)	(219)	(418)	(1,740)	(248)	(1,047)	(294)	(473)	(1,035)	(365)	(732)	(185)	(6,756)
Chinook salmon	0.0584	0	0	0	0	0	0	0	42	13,613	114	0	13,770
	(0.1051)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(83)	(8,394)	(157)	(0)	(8,635)
Northern Pike	0.0001	0	0	0	0	0	0	29	0	0	0	0	29
	(0.0008)	(0)	(0)	(0)	(0)	(0)	(0)	(63)	(0)	(0)	(0)	(0)	(63)
Rainbow trout	0.0906	848	539	7,183	1,135	4,043	1,742	1,091	474	1,516	2,276	514	21,360
	(0.2200)	(1,051)	(582)	(4,313)	(964)	(3,262)	(1,777)	(1,439)	(658)	(1,838)	(1,755)	(440)	(18,080)
Smallmouth bass	0.0029	0	0	0	0	47	172	467	0	0	0	0	685
	(0.0128)	(0)	(0)	(0)	(0)	(64)	(332)	(654)	(0)	(0)	(0)	(0)	(1,050)
Walleye	0.0061	0	0	1,383	0	0	0	58	0	0	0	0	1,441
	(0.0195)	(0)	(0)	(1,475)	(0)	(0)	(0)	(126)	(0)	(0)	(0)	(0)	(1,600)
Total release	0.1798	998	827	9,971	1,339	5,039	2,091	1,976	1,203	15,376	2,939	627	42,386
	(0.4402)	(1,270)	(1,000)	(7,528)	(1,212)	(4,373)	(2,403)	(2,754)	(1,776)	(10,597)	(2,645)	(626)	(36,184)
Total harvest	0.0893	389	902	4,620	993	3,890	1,702	980	736	6,266	294	281	21,053
	(0.2322)	(454)	(915)	(3,402)	(1,057)	(4,115)	(2,520)	(1,154)	(878)	(3,967)	(302)	(318)	(19,082)
Total catch	0.2691	1,387	1,729	14,592	2,332	8,928	3,792	2,956	1,939	21,642	3,234	908	63,439
	(0.5317)	(1,373)	(1,504)	(8,493)	(1,705)	(6,420)	(3,756)	(3,175)	(2,400)	(11,426)	(2,725)	(729)	(43,705)

Appendix 28. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2004, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Chinook salmon	0.0395	-	0	0	0	-	-	-	0	1,607	0	0	1,607
	(0.0500)	-	(0)	(0)	(0)	-	-	-	(0)	(1,092)	(0)	(0)	(1,092)
Rainbow trout	0.0537	-	109	219	0	-	-	-	0	0	1,523	331	2,182
	(0.0713)	-	(136)	(309)	(0)	-	-	-	(0)	(0)	(746)	(366)	(1,557)
Walleye	0.0049	-	118	0	83	-	-	-	0	0	0	0	201
	(0.0140)	-	(188)	(0)	(117)	-	-	-	(0)	(0)	(0)	(0)	(305)
Total	0.0982	-	227	219	83	-	-	-	0	1,607	1,523	331	3,990
	(0.1353)	-	(324)	(309)	(117)	-	-	-	(0)	(1,092)	(746)	(366)	(2,954)
Angler hours		-	7,680	6,528	747	-	-	-	4,188	9,713	9,930	1,843	40,629
		-	(5,498)	(3,547)	(465)	-	-	-	(1,685)	(6,158)	(3,054)	(1,427)	(21,835)
Angler trips		-	2,754	2,682	166	-	-	-	1,344	2,754	2,055	341	12,096
		-	(2,375)	(1,474)	(151)	-	-	-	(544)	(806)	(723)	(263)	(6,336)
Angler Days		-	2,754	2,682	166	-	-	-	1,344	2,754	2,055	341	12,096
		-	(2,375)	(1,474)	(151)	-	-	-	(544)	(806)	(723)	(263)	(6,336)

Appendix 29. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2004, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Rainbow trout	0.0192	-	0	110	0	-	-	-	0	185	469	15	778
	(0.0489)	-	(0)	(224)	(0)	-	-	-	(0)	(427)	(386)	(30)	(1,067)
Smallmouth bass	0.0064	-	0	219	41	-	-	-	0	0	0	0	261
	(0.0207)	-	(0)	(394)	(59)	-	-	-	(0)	(0)	(0)	(0)	(452)
Total release	0.0256	-	0	329	41	-	-	-	0	185	469	15	1,039
	(0.0696)	-	(0)	(618)	(59)	-	-	-	(0)	(427)	(386)	(30)	(1,519)
Total harvest	0.0982	-	227	219	83	-	-	-	0	1,607	1,523	331	3,990
	(0.1353)	-	(324)	(309)	(117)	-	-	-	(0)	(1,092)	(746)	(366)	(2,954)
Total catch	0.1238	-	227	548	124	-	-	-	0	1,791	1,992	346	5,029
	(0.1832)	-	(324)	(776)	(176)	-	-	-	(0)	(1,519)	(840)	(367)	(4,001)

Appendix 30. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2005, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0069	0	0	47	247	543	337	318	103	0	0	0	1,595
	(0.0296)	(0)	(0)	(95)	(290)	(971)	(404)	(583)	(217)	(0)	(0)	(0)	(2,560)
Chinook salmon	0.0140	0	0	0	0	0	0	0	215	3,018	0	0	3,233
	(0.0333)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(349)	(2,532)	(0)	(0)	(2,882)
Northern Pike	0.0002	44	0	0	0	0	0	0	0	0	0	0	44
	(0.0008)	(73)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(73)
Pumpkinseed	0.0007	0	0	0	0	0	0	167	0	0	0	0	167
	(0.0039)	(0)	(0)	(0)	(0)	(0)	(0)	(340)	(0)	(0)	(0)	(0)	(340)
Rainbow trout	0.0816	121	92	4,125	1,340	1,922	3,362	5,447	492	200	1,574	108	18,783
	(0.2889)	(120)	(88)	(2,830)	(1,408)	(2,006)	(3,098)	(12,504)	(700)	(200)	(1,910)	(167)	(25,029)
Rock bass	0.0005	0	0	0	0	0	106	0	0	0	0	0	106
	(0.0026)	(0)	(0)	(0)	(0)	(0)	(229)	(0)	(0)	(0)	(0)	(0)	(229)
Smallmouth bass	0.0007	0	0	0	0	0	159	0	0	0	0	0	159
	(0.0028)	(0)	(0)	(0)	(0)	(0)	(243)	(0)	(0)	(0)	(0)	(0)	(243)
Walleye	0.0001	27	0	0	0	0	0	0	0	0	0	0	27
	(0.0006)	(54)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(54)
Yellow perch	0.0024	80	0	0	0	0	0	0	464	0	0	0	543
	(0.0119)	(166)	(0)	(0)	(0)	(0)	(0)	(0)	(868)	(0)	(0)	(0)	(1,035)
Total	0.1072	271	92	4,173	1,587	2,465	3,963	5,932	1,274	3,218	1,574	108	24,656
	(0.3745)	(413)	(88)	(2,925)	(1,698)	(2,977)	(3,974)	(13,427)	(2,135)	(2,732)	(1,910)	(167)	(32,444)
Angler hours		2,841	9,347	58,082	22,039	18,044	21,138	15,235	12,196	48,598	19,259	3,323	230,100
		(1,544)	(4,101)	(20,096)	(8,871)	(8,040)	(9,425)	(5,350)	(4,018)	(14,971)	(8,022)	(2,201)	(86,639)
Angler trips		729	1,988	10,249	5,754	4,857	6,565	5,797	3,355	11,809	3,923	660	55,685
		(448)	(1,012)	(3,903)	(2,599)	(2,447)	(3,274)	(3,055)	(1,385)	(3,891)	(2,026)	(486)	(24,528)
Angler Days		729	1,960	9,818	5,608	4,267	5,692	5,098	3,355	11,809	3,923	660	52,918
		(448)	(1,003)	(3,760)	(2,570)	(2,261)	(2,920)	(2,813)	(1,385)	(3,891)	(2,026)	(486)	(23,563)

Appendix 31. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2005, from Croton Dam to the DNR Access Site in Newaygo (Site 151). Uncertainty values (two standard errors) are given in parentheses.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Brown trout	0.0742	26	66	955	2,798	3,813	3,373	1,132	1,629	1,296	1,851	125	17,063
	(0.1824)	(29)	(89)	(892)	(2,837)	(2,928)	(3,345)	(1,298)	(1,089)	(1,275)	(1,899)	(120)	(15,801)
Chinook salmon	0.0431	0	0	0	0	0	0	0	0	8,927	984	0	9,911
	(0.0895)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(6,602)	(1,152)	(0)	(7,754)
Largemouth bass	0.0005	0	0	0	0	125	0	0	0	0	0	0	125
	(0.0038)	(0)	(0)	(0)	(0)	(327)	(0)	(0)	(0)	(0)	(0)	(0)	(327)
Northern Pike	0.0002	44	0	0	0	0	0	0	0	0	0	0	44
	(0.0010)	(89)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(89)
Rainbow trout	0.7482	86	492	17,534	47,332	38,249	30,259	17,570	11,666	3,371	4,786	822	172,167
	(1.2160)	(73)	(391)	(7,843)	(28,981)	(24,929)	(19,359)	(9,572)	(8,194)	(2,512)	(2,709)	(788)	(105,352)
Smallmouth bass	0.0304	0	0	0	0	341	5,087	1,046	532	0	0	0	7,006
	(0.0854)	(0)	(0)	(0)	(0)	(540)	(4,954)	(1,350)	(552)	(0)	(0)	(0)	(7,397)
Walleye	0.0037	0	0	854	0	0	0	0	0	0	0	0	854
	(0.0172)	(0)	(0)	(1,488)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1,488)
Total release	0.9003	156	558	19,342	50,130	42,528	38,719	19,748	13,827	13,594	7,620	947	207,169
	(1.5952)	(191)	(480)	(10,223)	(31,818)	(28,724)	(27,659)	(12,220)	(9,834)	(10,388)	(5,760)	(908)	(138,207)
Total harvest	0.1072	271	92	4,173	1,587	2,465	3,963	5,932	1,274	3,218	1,574	108	24,656
	(0.3745)	(413)	(88)	(2,925)	(1,698)	(2,977)	(3,974)	(13,427)	(2,135)	(2,732)	(1,910)	(167)	(32,444)
Total catch	1.0075	427	650	23,515	51,717	44,993	42,682	25,680	15,101	16,812	9,195	1,054	231,825
	(1.7339)	(512)	(490)	(10,741)	(31,889)	(29,292)	(28,175)	(19,524)	(11,130)	(10,892)	(6,651)	(925)	(150,221)

Appendix 32. The estimated number of fish harvested, harvest rates, and angler effort in the Muskegon River during 2005, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Northern Pike	0.0085	-	105	-	-	-	-	-	-	-	0	0	105
	(0.0181)	-	(153)	-	-	-	-	-	-	-	(0)	(0)	(153)
Rainbow trout	0.0644	-	105	-	-	-	-	-	-	-	603	85	793
	(0.0970)	-	(145)	-	-	-	-	-	-	-	(675)	(0)	(820)
Walleye	0.0085	-	105	-	-	-	-	-	-	-	0	0	105
	(0.0181)	-	(153)	-	-	-	-	-	-	-	(0)	(0)	(153)
Total	0.0815	-	315	-	-	-	-	-	-	-	603	85	1,003
	(0.1332)	-	(451)	-	-	-	-	-	-	-	(675)	(0)	(1,126)
Angler hours		-	5,523	-	-	-	-	-	-	-	6,316	468	12,307
		-	(3,950)	-	-	-	-	-	-	-	(4,504)	(0)	(8,453)
Angler trips		-	2,348	-	-	-	-	-	-	-	1,160	85	3,592
		-	(553)	-	-	-	-	-	-	-	(897)	(0)	(1,450)
Angler Days		-	2,348	-	-	-	-	-	-	-	1,160	85	3,592
		-	(553)	-	-	-	-	-	-	-	(897)	(0)	(1,450)

Appendix 33. The estimated number of fish released, release rates, and total catch in the Muskegon River during 2005, from the DNR Access Site in Newaygo to Muskegon Lake (Site 152). Uncertainty values (two standard errors) are given in parentheses. A dash indicates no survey was conducted.

Species	Rate	February	March	April	May	June	July	August	September	October	November	December	Season
Northern Pike	0.0028	-	35	-	-	-	-	-	-	-	0	0	35
	(0.0086)	-	(73)	-	-	-	-	-	-	-	(0)	(0)	(73)
Rainbow trout	0.0587	-	70	-	-	-	-	-	-	-	653	0	723
	(0.1255)	-	(135)	-	-	-	-	-	-	-	(926)	(0)	(1,061)
Total release	0.0616	-	105	-	-	-	-	-	-	-	653	0	758
	(0.1341)	-	(208)	-	-	-	-	-	-	-	(926)	(0)	(1,134)
Total harvest	0.0815	-	315	-	-	-	-	-	-	-	603	85	1,003
	(0.1332)	-	(451)	-	-	-	-	-	-	-	(675)	(0)	(1,126)
Total catch	0.1430	-	420	-	-	-	-	-	-	-	1,255	85	1,760
	(0.1971)	-	(521)	-	-	-	-	-	-	-	(1,145)	(0)	(1,666)