

**Au Sable River, Mio Dam to Alcona Pond**  
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**Environment**

The Mio Dam to Alcona Pond backwaters reach of the Au Sable River is located in the west half of Oscoda County and the southeast corner of Alcona County between the towns of Mio and Glennie (Figure 1). This 23.9-mile reach flows through glacial moraines creating a scenic river valley with forested banks of second growth mixed hardwoods and conifers with impressive stands of white and red pine. Most land along this stretch of river is public access land composed of ownership by National Forest, State of Michigan and Consumers Energy lending a very "wild", undeveloped character. Private ownership is limited to less than 1.5 miles of this river reach, with most riverside structures used only seasonally. The entire reach is designated as a State Natural River and as a Federal Wild and Scenic River. Both of the designations impose various restrictions on riparian development to protect the environment and its aesthetic quality.

This stretch of river drains a 1,361 square mile watershed catchment. Mean annual discharge at the Mio Dam is 988 cubic feet per second (cfs) (Blumer et al, 2006). Other attributes of this reach include an average width of 164.7 feet (Lawler, Matusky and Skelly, 1991), 90% of the river depths less than 3 feet with a maximum depth of 14 feet (Affiliated Researchers, 2005), a total surface area of 477.1 acres (MDNR unpublished data) and an average gradient of 4.7 feet per mile (Zorn and Sendek, 2001). There are twelve tributaries that enter the river within this reach including Wolf Creek\*, Cherry Creek, Loud Creek\*, Perry Creek\*, Cauchy Creek\*, Comins Creek \*, Glennie Creek\*, Nine Mile Creek\*, O'Brien Lake outlet, Blockhouse Creek\*, Penoyer Creek\*, and Lost Creek ("\*" denotes a state designated trout stream). These tributaries in addition to ground water inputs contribute an additional 120 cfs (annual mean discharge) before exiting Alcona Dam.

The geology of this region is of glacial origin with major deposits of outwash sand and gravel, fine textured end moraine and coarse textured end moraine. These soils along with the "hilly" nature of the area provide an excellent source of ground water. This ground water provides the river a very stable flow regime when it is not influenced by dams. Upstream of Mio Pond at Parmalee Bridge, the 10 percent exceedence flow (high flow) of 1200 cfs is only 2.1 times higher than the 90 percent exceedence flow (base flow) of 554cfs (USGS data). These geological formations and the fact that Mio Dam interrupts the sediment transport of the stream results in a stream bed consisting largely of cobble and gravel. Sand and clay deposits are also present due to the glacial geology of the region.

This segment of the Au Sable River is located between Mio and Alcona Dams, which are owned and operated by Consumers Energy Company. Mio Dam was constructed in 1917 and produces a maximum pond head of 29 feet and a surface area of 860 acres. The location and structural design of Mio Dam and Alcona Dam significantly alter the riverine environment through fragmentation of habitats. Dams prevent migration between important habitat types, such as spawning sites, thermal refuges and wintering areas. These dams also affect water quality, temperature regimes, natural flow patterns, sediment transport, and woody debris transport. The impoundments provide habitats for

organisms that might not otherwise be present in the system (Zorn and Sendek, 2001). Past peaking operations at Mio Dam (prior to 1966) caused extreme daily flood and drought conditions with daily flows ranging from 400 cfs to 1,500 cfs (MDNR unpublished data). At night when the demand for electrical power was low, water flow through the dam was greatly reduced to store water in Mio Pond for electrical generation. Large volumes of water were then released in the morning when electrical demand was higher. This peaking mode of operation caused environmental damage downstream including accelerated stream bed scour, dewatering of riffles and bank erosion. These flow fluctuations had adverse effects on biotic communities including plants, larval and juvenile fishes, and invertebrates.

In 1966 the Michigan Department of Conservation (Michigan Department of Natural Resources) and Consumers Power made a verbal agreement to change the operation of Mio Dam from peaking mode to run-of-river mode. Run-of-river mode means that instantaneous inflow of water into Mio impoundment is equal to instantaneous outflow of water. This mode of operation is intended to mimic the natural flow regime of the river. The agreement was followed for the most part but periods of unnatural flows were still observed (MDNR, unpublished data). Run of river was formally established in 1994 as part of the Federal Energy Regulatory Commission licensing of the Consumer Power Company Au Sable River hydroelectric projects through a settlement agreement between Consumers Power Company (Consumers Energy), Michigan Department of Natural Resources, Michigan State Historic Preservation Officer, United States Department of Interior - Fish and Wildlife Service, United States Department of Interior - National Parks Service, and United States Department of Agriculture - Forest Service.

The Au Sable River is a cold water stream but Mio Dam significantly alters the water temperature regime of the river below the dam. The structural design of the dam only allows water from the upper 2/3 of the water column (above the thermocline) to be discharged downstream. Mean monthly water temperatures are about 2 degrees Celsius warmer downstream of the dam compared to riverine temperatures several miles upstream of the impoundment near Red Oak (Table 1a). In addition water downstream of the dam cools down only about 1.2 degrees C at night whereas unimpounded water upstream of the dam cools down an average of 2.2 degrees C. Unimpounded streams in Michigan typically cool down substantially during summer nights, thereby reducing thermal stress on coldwater species such as trout. The dam also delays spring warm-up and fall cool-down. Elliot (1994) reported an upper thermal limit for brown trout growth at about 67.1 degrees F with an upper incipient lethal temperature, i.e. the temperature beyond which death occurs, of 76.5 degrees F (24.7 degrees C). Affiliated Researchers (2005) found that 89.3% of the river reach between Mio Dam and 4001 bridge from June through September had water temperatures at or above 70 degrees F (21.1 degrees C), which are stressful temperatures for brown trout and rainbow trout. Maximum daily water temperatures below the Mio dam reach or exceed 24 degrees C in many years and during very hot periods even minimum daily water temperatures are higher than 24 degrees C (Figure 3). The highest maximum daily water temperatures observed below Mio between 1997 and 2006 have ranged from 22.5 degrees C in 2000 up to 26 degrees C in 2001. Further downstream at McKinley maximum daily water temperatures as high 26 degrees C also occur but nighttime cooling is substantially greater (Figure 4). Abundance of trout in Michigan streams is generally quite low when average July water temperatures exceed 20 degrees C (68 degrees F) (Figure 2). Mean monthly July temperatures downstream of the Mio Dam exceeded 20 degrees C in 8 of 10 years from 1997 to 2006 (Table 1b). Mean August

temperatures also often exceed this level so the time that trout must endure stressfully high temperatures can be quite long in some years (Figures 3 and 4).

Abdella (2001) found that total number of young-of-year rainbow and brown trout in this reach of the Au Sable River decreased significantly from June through August. High water temperatures are a plausible explanation for the high mortality rates for young trout. Woldt and Rutherford (2002) reported that only 1.7% of young-of-year steelhead present in early July in the Manistee River below Tippy Dam survived to late July due to stressful high temperatures (mean = 20.3 degrees C). The warmer water temperatures downstream of Mio Dam also create an environment suitable to other species such as walleye and smallmouth bass that prey on brown and rainbow trout (DePhilip 2001). Walleye inhabit both the impoundment backwaters and the river, and are known to feed on stocked trout. McRae and Diana (2005) hypothesized that low levels of emergent vegetation, high water temperatures, and decreased daily fluctuation in water temperature limited densities of young-of-year trout in the Au Sable River downstream of the Mio dam.

The river corridor between Mio Dam and Alcona Dam is a very popular destination for many forms of recreational use including fishing, canoeing, kayaking, hunting, trapping, horseback riding, hiking and bird watching. At times the river can be very congested, with summer watercraft use on this reach estimated at 11,503, with a mean of 114 watercraft per day (Johnson and Nelson 1996). Three canoe liveries operate primarily on the reach with several other liveries having incidental use. Developed access to the river is provided through four sites, two of which are operated by the State of Michigan (M-33 and Comins Flats) and two by the U.S. Forest Service (McKinley and U.S. Forest Service Road 4001) (Figure 1). Walk in access is available throughout the entire reach. The Michigan Shore to Shore Hiking and Horseback Riding Trail parallels the entire reach with various access points. The U.S. Forest Service maintains several primitive campsites along this reach.

In 1995, during a routine monitoring of the groundwater flowing beneath the Hoskins Manufacturing Plant northeast of Mio, investigators found ground water contamination in the form of tetrachloroethylene (PCE), chromium and nickel. Hoskins manufactured thermoelectric nickel and chromium alloys in the form of wire, strip and ribbon. Further investigations have found this groundwater contamination plume has traveled over ½ mile to the east and is upwelling into Perry Creek. Hoskins Manufacturing went out of business in 2002, deferring all clean up to the Federal Government and the State of Michigan. On site clean-up is presently occurring with removal of contaminated sediments and building materials. The extent of the ground water contaminations is not fully delineated at this time. It is unknown what the potential impact will be to Perry Creek or the Au Sable River, but studies are planned to evaluate this potential threat.

### **History**

Early fisheries management within this river reach began in 1938 with the stocking of 27,400 fall fingerling brown trout into Comins Creek, Glennie Creek, Perry Creek and Wolf Creek (Table 2). Through 2006, a total of 1,132,987 brown trout, 1,119,183 rainbow trout, 53,827 arctic grayling and 1,850 brook trout have been stocked in the Au Sable River between Mio Dam and Alcona Pond and its tributaries (Table 2). This stocking program has been successful in establishing and maintaining a very popular fishery for brown trout and rainbow trout. Stocking of fingerling walleye in adjacent Mio and Alcona Ponds has augmented a small population of walleye in the river.

The first fisheries survey of the Au Sable River watershed was conducted in 1924 by Dr. Carl L. Hubbs and Professor Thomas Langlois both from the University of Michigan. This survey was part of a statewide effort to identify and document the fish communities throughout the state and to recommend fisheries management actions to improve these fisheries. This survey was conducted shortly after the construction of the six hydroelectric dams on the mainstream Au Sable River which blocked the seasonal migration of fish from Lake Huron into the upper reaches of the river. Two of the sample sites in this survey were located within the Mio to Alcona reach, the first below Mio Dam and the second at Comins Landing. Fish were collected by the use of various seines ranging in size from 4-foot common minnow seines to 50-foot bag seines. Seventeen species of fish were captured and identified (Table 3) with the fish species comprised mostly of cool and warm water types. Virtually no game fish were captured. Game species collected were rainbow trout (1 fish), northern pike (2 fish), and rock bass (2 fish). Common shiner, longnose dace, mottled sculpin, white sucker, and hog sucker were the most common species found.

A survey of returns of tagged brown trout to the angler creel was conducted during 1948. Approximately 5,000 jaw-tagged brown trout ranging from 7.0 to 12.8 inches were stocked in the reach between Mio Dam and McKinley Bridge. A creel census clerk checked for tags in angler-harvested fish on one weekend day throughout the 1948 trout season and voluntary reports of tagged fish were reported verbally and by mail. Recoveries of a total of 2.6% of tagged brown trout were reported by this survey (Shetter 1962). About 70% of reported tag recoveries were made during 1948 but a few tagged fish were recovered four years later.

The next formal survey of this reach was conducted in September 1962 by Buddy L. Jacob, Michigan Department of Conservation. This survey was conducted during a scheduled repair of Mio Dam when the river flow downstream was greatly reduced. These low water levels in the river allowed wading crews to conduct mark and recapture population estimates at 13 stations. At 11 of these sites the sampling was conducted with the use of tow-barge DC electrofishing gear, and at the other two sites the fish were marked after capture with electrofishing gear and recaptured by a rotenone treatment. Each sampling site was approximately 1,100 feet long. Over-all, 27 species of fish were captured and identified (Table 3). At the 11 electrofishing sample sites, the average number of brown trout over 7 inches in length was estimated at 198 per mile. At two additional stations estimates of all species of fish were made by collecting for marking with electrofishing gear and recapture with rotenone. Twenty six species were identified with an average 2,352 fish per acre and an average of 38.37 lbs per acre (Table 4). Brown trout standing crop was 2.17 lbs per acre at the Davis Landing site and 6.38 lbs per acre at the Cherry Creek site. Rainbow trout were 2.01 lbs per ac at Davis Landing site and 0.51 lbs per ac at the Cherry Creek site. The most abundant species at the Cherry Creek site based on biomass was round whitefish (10.7 lbs per ac) and suckers (10.5 lbs per ac of white sucker and hog sucker combined)(Table 4).

During the summer of 1962, prior to the electrofishing survey, 4,950 legal-sized rainbow trout and 1,200 legal-sized brown trout were marked by fin-clipping and stocked in the 10 miles of river immediately below Mio Dam. Two hundred-fifty nine brown trout were captured during the shocking effort of which 13 (5%) retained recognizable marks. Eleven rainbow trout were also captured with 5 (45%) having fin clips. Thus in 1962 the trout population was supported principally by natural

recruitment of yearlings from tributary streams and hatchery stockings appeared to contribute little to the trout population. There was little natural reproduction in the mainstream study area.

In 1972, J.Scott Richards conducted a follow-up survey to the 1924 effort conducted by Hubbs and Langlois. This study was part of a watershed wide investigation into the effects of human use and development on the biology of the Au Sable River (Coopes et al. 1974). The goal of this survey was to determine the overall effect on the distribution of fish species resulting from the increased use and development in the watershed since the 1920's; i.e. do changes in fish distribution and abundance indicate substantial habitat change and in particular, have conditions for trout changed, and if so, in what way?

To validate comparisons, an attempt was made to duplicate as closely as possible the 1924 collection efforts of Hubbs and Langlois, with collections conducted with similar seines and during the same time period. Richards collected 23 species of fish as compared to 17 species of fish collected by Hubbs and Langlois at the same sites (Table 3). Most fish species were representative of cool or warm water fish communities. As in the 1924 survey few game fish were captured. Gamefish in the collection included brook trout (2), brown trout (3), rock bass (1), bluegill (1) and smallmouth bass (2). The most common species included common shiner, mimic shiner, white sucker, blacknose dace and blackside darter. Richards reported that species diversity was slightly higher immediately below Mio dam in 1972 compared to 1924. At Comins Landing species diversity was slightly lower in 1972 compared to 1924.

Michigan DNR personnel used a 17 foot outboard power boom shocker using pulsed DC current to collect fish during electro-fishing surveys in 1987, 1988 and, 1989. The surveys conducted in November 1987 and June 1988 were made to determine if any yearling Arctic grayling (*Thymallus arcticus*) stocked in 1987 and 1988 had survived. The August 1989 survey was conducted to gather fisheries data in response to reports of poor angler catches and to collect fish community information in preparation of the Federal Energy Regulatory Commission process to re-license the six Consumers Power Company hydro-electric projects located on the Au Sable River. Boom shocking was conducting during November 1987 and June 1988 by making one pass in a downstream direction throughout the entire reach of the Au Sable River between the Mio Dam and McKinley Bridge. Electrofishers attempted to capture all fish observed. During August 1989 sampling extended from Mio Dam to Alcona Pond and took place over 3 days of shocking. Only one Arctic grayling was captured during the November 1987 survey. Most Arctic grayling stocked disappeared within 6 months, with downstream migration from stocking sites, competition from other fish species, and predation listed as possible causes of the failure of the Arctic grayling reintroduction (Nuhfer 1991).

Suckers and redhorse were the most common fishes collected from the Au Sable River during the electrofishing surveys made each year from 1987-89 (Table 5). The three most common sucker species were white sucker, northern hog sucker and greater redhorse. Greater redhorse had not been noted in any significant numbers in previous surveys. The brown trout catch per hour was much higher in November 1987 (38.7/hour) compared to the June 1988 survey (8.4/hour) and the August 1989 survey (11.7/hour). Brown trout ranging from 4.3 inches to 25.6 inches long were captured. The catch per hour for rainbow trout was very low ranging from 0.5 to 2.9 fish per hour with the size ranging from 5.8 inches to 20.5 inches. Brown trout were 2.0 inches larger than the state average mean length at age. Rainbow trout were over 3 inches longer than the state average mean length at age. Walleye were

also captured in significant numbers (9.2 to 11.6 fish per hour) and were much more common than in previous surveys. These fish most likely originated from fingerling walleye plantings in the Mio impoundment upstream and Alcona Pond located downstream. Round whitefish abundance appeared low compared to Jacob's 1962 survey but direct comparisons were not possible between his population estimates and boom shocking CPE data.

Consumers Power Company conducted a fisheries survey in 1990 (Lawler, Matusky and Skelly Engineers 1991) with the specific objective to collect fish in selected riverine areas both upstream and downstream of the projects including species composition and relative abundance, to provide population estimates of fisheries resources in each area, and to document the presence of any threatened or endangered fish species. Two stream stretches were sampled, the first approximately 4.5 miles below Mio Dam at Meadow springs, and the other approximately ½ mile upstream of U.S.F.S. road 4001 bridge at Gabions (Figure 1). Fish population estimates were obtained through three pass depletion electrofishing from two boom shocker boats. Supplemental sampling was also conducted to better estimate species composition and abundance.

At the upstream site near Meadow Springs, 23 fish species were captured during the survey (Table 3). Total fish biomass for this site was 183 lbs per acre (Table 4). Game fish captured included black crappie, brook trout, brown trout, largemouth bass, rainbow trout, rock bass, smallmouth bass, and walleye. These game fish represented slightly more than 4% of the total catch by number and slightly more than 1% of the total biomass. The mean population estimate for brown trout was 6.8 per acre or 119 per mile, with a biomass estimate of 1.77 lbs per acre (Table 4). The most abundant species by number were hog sucker, white sucker, common shiner, blackside darter, and creek chub. The most abundant species by weight were white sucker, hog sucker and greater redhorse. These three species comprised 97% of total biomass at this site.

At Gabions, the downstream site, 19 fish species were captured (Table 3). Total fish biomass for this site was nearly 30 lbs per acre (Table 4). Low numbers of game fish were captured, including brown trout, largemouth bass, rock bass, and smallmouth bass. These game fish represented less than 0.3% of the total number and less than 3% of the total biomass. The mean population estimate for brown trout was less than 0.7 fish per acre or 12 fish per mile, with a biomass of 0.78 lbs per acre. The most common species by number in descending order of abundance were creek chub, log perch, blacknose dace, longnose dace, and blackside darter. The most abundant species by weight were hog sucker, creek chub, and white sucker. These three species comprised 72% of total biomass at this site.

#### Summary of historic surveys (1924-1990)

All fisheries community surveys conducted in the Mio to Alcona reach of the Au Sable River between 1924 and 1990 revealed a diverse fish community comprised of from 17 to 23 species (Table 3). Catostomidae species were the predominant species based on biomass. This river reach is too cold to support significant populations of warmwater gamefish species (Centrarchidae). Numbers of coolwater gamefish species such as northern pike and walleye captured in surveys were generally quite low. Walleye over winter in Alcona Pond before moving upstream into the river in the spring and some remain there throughout the summer where they occupy habitats similar to those used by brown

trout (DePhilip 2001). The overlap in habitats used by trout and walleye during spring and summer poses a potentially high risk of mortality for stocked trout (Abdella 2001; DePhilip 2001).

Brown trout and rainbow trout standing crops estimated in 1962 and 1990 surveys were very low with the highest total biomass occurring near Cherry Creek (6.9 lbs per acre) (Table 4). All historic surveys indicate that few young-of-year trout in the mainstem Au Sable River below Mio survive from hatching to late summer. However, this river reach has consistently produced trophy-sized trout and a popular angling fishery. If trout were not stocked here there would be no significant angling fishery for other gamefish species.

MDNR has never surveyed fish populations in coldwater tributaries to the mainstem between Mio and Alcona with electrofishing gear to determine if they provide refuge from warm water temperatures in the mainstem or have potential to provide significant recruitment to the mainstem. However, their small size and discharge indicates low habitat suitability for large trout (Table 6). A June 26, 2007 survey to estimate the discharge of the 12 named tributaries to the Au Sable between Mio and Alcona Dams revealed that 8 of the 12 were either not flowing or were discharging less than 1 cfs. With the possible exception of Perry Creek (flow 6.5 cfs) none of these tributaries were large enough to provide thermal refugia for large fish. Total discharge of the 12 named tributaries was less than 15 cfs on June 26, 2007. This is only about 1.5% of the flow of the mainstem Au Sable River so it is obvious that these tributaries do not have the potential to provide significant cooling to the mainstem even though July and August water temperatures measured in six of the "larger" tributaries were colder than the mainstem Au Sable River (Table 6). A radio telemetry study of large brown trout in this reach conducted in 1996 and 1997 did not detect movement into tributaries during hot periods of the summer (DePhillip 2001). It is likely that some young-of-year trout emigrate from tributaries into the mainstem but the extremely low numbers of young-of-year trout captured in late summer or fall surveys suggests that few of them survive. Abdella (2001) reported that young of year abundance in the river declined steadily each month over the summer as river temperatures increased.

#### History of angling quality and regulations

Angler perceptions of angling quality for trophy-sized trout have varied over time. This river reach has always produced some large trophy-sized trout catches but the fact that regulations were modified seven times between 1965 and 1979 indicates that anglers were not always satisfied with the quality of the fishery. Prior to 1965, general statewide trout regulations were applied to this reach. These regulations allowed use of bait, minimum size limits were low, and creel limits were relatively high. After the 1962 fisheries survey (Table 4) fisheries unit manager Buddy Jacob recommended higher minimum size limits, a reduced creel limit, and no bait angling. At this time some anglers believed that this river reach provided the best trophy trout fishing in the eastern U.S. It was hypothesized that restrictive regulations would produce even more trophy-sized trout because growth rates were high compared to many other streams. Gary Schnicke, who succeeded Buddy Jacob, recommended even more restrictive regulations because he believed that angler harvest was responsible for declines in the number and average of size of trout. A summary of trout regulations applied to the reach from the power line downstream of M33 and McKinley Bridge is shown in Table 7.

The desires of anglers who wished to fish with bait and harvest smaller fish were accommodated by applying general statewide stream angling regulations to the remainder of the reach between Mio Dam and 4001 bridge near the upstream end of Alcona Pond. Thus, a 0.3-mile river reach from Mio Dam to the power line and a 7.5-mile reach from McKinley Bridge to 4001 Bridge was regulated under general trout angling rules until 2000.

In 2000, MDNR Fisheries Division revised the statewide trout regulations in an attempt to match the biological potential of this stream to one of seven angling regulation types. The general regulation sections from Mio to the power line and McKinley Bridge to 4001 Bridge were converted to Type 2 regulations, which increased the minimum size limit for brown trout and rainbow trout from 8 inches to 12 inches. The creel limit was reduced from 10 to 5 fish per day with no more than 3 larger than 15 inches. Bait angling was permitted.

The river reach from the power line to McKinley, had regulations different from any of the seven classification types. Proposals to place this section into any one of the seven classification types received strong public reaction as there were diverse opinions on what regulations should be placed on this section. It was decided that the best method to address this issue was to maintain the present regulation until additional biological and social information could be collected to better guide the decision-making process as to the most appropriate regulation classification.

#### Recent stocking history

During the mid 1990s anglers perceived a decline in the trout population and its associated fishery. Hypotheses for reduced survival of the stocked trout included possible increases in stream temperatures, low fitness of hatchery trout strains, and increased predation from walleye. A walleye fingerling stocking program was initiated in 1985 in Mio Pond and in 1988 in Alcona Pond. MDNR is subject to a circuit court agreement to stock walleye in the ponds to provide additional angling opportunities. The amount of trout mortality attributable to walleye predation is unknown but believed to be relatively low. A large amount of electrofishing effort was required to locate the large walleye implanted with radio transmitters for the DePhilip (2001) study.

Trout stocking rates in the river were increased dramatically beginning in 1995 in an attempt to improve the trout fishery. Past experiences with increasing the stocking rate on the Muskegon River below Croton Dam to 200 yearlings per acre per year significantly improved total trout numbers in the stream. A new stocking proposal was prescribed which increased the stocking rate of brown trout and rainbow trout to 66 yearlings per acre per species in 1995-96 and then to 100 yearlings per acre per species beginning in 1998 (Table 2). An average of 49,000 yearling brown trout and 51,000 yearling rainbow trout were stocked per year between 1998 and 2006.

#### **Current Status**

The Au Sable River between Mio Dam and Alcona Pond is commonly referred to as the "Mio Trophy Waters" due to its reputation of holding a significant population of large brown trout. Anglers fish the river from shore, wading, from float tubes, and from canoes and boats. Fishing is presently regulated under three categories of angling regulations. Type 2 trout angling regulations are presently in place



from Mio Dam downstream to the power line at (T26N, R2W, Sec.4) and from McKinley Bridge downstream to U.S. Forest Service Road 4001 Bridge (Figure 1). In Type 2 waters anglers may fish from the last Saturday in April through September 30 of each year with bait, artificial lures and flies. Minimum size limits are 12 inches for brown trout and rainbow trout and 10 inches for brook trout. Daily possession limit is 5 trout in combination with no more the 3 fish 15 inches or larger. Prior to 2000, these two reaches were managed under general statewide trout stream regulations (8-inch minimum size limit on all trout species, bait permitted, and creel limit of 10 trout with no more than 3 over 16 inches long). The second regulation category is from the power line at (T26N, R2W, Sec. 4) to McKinley Bridge and is classified as the "Au Sable River Research Area". The regulations include an open season from the last Saturday in April through September 30; artificial lures or flies only, a minimum size limit 15 inches for brown trout, and 12 inches for all other trout, and a possession limit of 2 trout (Table 7). The third category is the reach between 4001 bridge and Alcona Pond which is not classified as a designated trout stream. Thus, this reach is open to fishing all year with an 8-inch minimum size limit and a 5 fish possession limit, no more than three of which may be 15 inches or longer.

The reach of river from Mio Dam to Alcona Pond is very popular with anglers using artificial flies, artificial lures and bait. A creel survey was conducted in 1999 and 2000 between M-33 Bridge and U.S.F.S. Bridge 4001 during the trout fishing season (Table 8). The census work shifts covered the period from 6:00 am to midnight. The total fishing pressure over the entire reach was estimated at 30,595 angler hours and 9,656 angler trips in 1999 and 34,734 angler hours over 9,127 trips in 2000. Rainbow trout were caught more frequently than brown trout. In 1999 anglers harvested 2,400 rainbow trout and released nearly 17,000. Anglers harvested 463 brown trout in 1999 and released an additional 7,300. In 2000, anglers harvested 955 brown trout and 335 rainbow trout. The large decline in rainbow trout harvest was primarily due to the higher minimum size limit applied to rainbow trout when regulations changed to Type 2 in the reaches from M-33 to the power line and downstream from McKinley Bridge. Other species in the catch were walleye, smallmouth bass, rock bass, brook trout, largemouth bass, northern pike and suckers. Detailed information on monthly harvest and release of all fish species is provided in the appendices to this report. Total harvest of brown trout averaged over 1999-2000 represents only about 1.5% of the average number of brown trout stocked annually into the Mio to Alcona reach. For rainbow trout the analogous percentage was 5%. However, after the minimum size limit on rainbow trout increased to 12 inches in the upstream and downstream zones in 2000 the total of 335 fish harvested represented only 0.7% of the average annual number of rainbow trout stocked.

Angling pressure was highest in the 0.3-mile stretch between M-33 and the power line based on effort per mile (26,829 angler hours per mile) (Table 9). About 41% of angling effort occurred in the two zones with more liberal regulations. Angling pressure per mile was over 10 times lower in all three reaches downstream of the power line (Table 9). Anglers fishing the quality regulation water (designated as "Au Sable River Mainstream, Research Area" in 2000) harvested 101 brown trout (6.9 per mile) in 1999 and in 2000 they harvested 841 brown trout (57 per mile). Rainbow trout in the quality regulation water were harvested at a rate of 31 per mile in 1999 and 10 per mile in 2000. Catch and release rates in the quality regulations water were 148 brown trout per mile and 769 rainbow trout per mile in 1999. Numbers of brown trout and rainbow trout released per mile in 2000 were 259 and 572, respectively. Anglers generally released about 90% or more of the trout they caught in all zones (Table 10). The ration of the cost of stocking trout in this reach compared to estimated value of the

fishery generated is very favorable. MDNR Fisheries Division estimates the cost of stocking the 100,000 yearling brown and rainbow trout at \$73,000 (\$0.73 each) per year. Average expenditures by Michigan anglers per trip, not including expenditures for equipment and other expenses, has been estimated at \$27 per trip (USFWS and USCB 2002). Thus, the annual trip expenditures alone of anglers fishing the Au Sable River below Mio exceed \$250,000 (Average of 9,391 angler days x \$27) so the total economic value generated by the fishery is certainly substantially higher.

A series of 5 trout population estimates were conducted in early November of 1999, 2000, 2001, 2002 and 2005 to evaluate the results of the increased trout stocking rates. A 4.75-mile stretch of river from the M33 access site to Meadow Springs (Figure 1) with an estimated area of 95 acres was sampled each year by electrofishing. Sampling was done with the use of two jet drive electrofishing boats, with one chase boat to assist in processing fish captured. Sampling was conducted over two days with the first day the marking run and the second day the recapture run. Brown trout, rainbow trout and brook trout populations were estimated by the Chapman-Peterson formula and fish ages were obtained through scale analysis. Due to the limitations of the survey equipment and the size, depth and current velocity of the Au Sable River below Mio Dam, the trout population was most likely under-sampled. However, the data obtained in this survey are still very useful and provide a basis for management decisions.

Total trout biomass in this 4.75-mile stretch averaged 23.7 lbs/acre with 16.2 lbs/acre of brown trout and 7.5 lbs/acre of rainbow trout. Brown trout comprised the largest portion of the trout population with a 5 year average population estimate of 2,992 for an average of 630 brown trout per mile. Brown trout total length ranged from 3 inches to 25 inches. All age classes up to age 7 were present in the population with age 1 fish being the most numerous (Table 11). The length-frequency histogram shown in Figure 5 shows that brown trout less than 12 inches long predominate in the population. The histogram does not include fish less than 8 inches long because there were very few trout less than 8 inches long by November.

Brown trout total annual survival rate estimates computed from the survey data and scale samples collected from 1999 to 2002 were determined to be biased due to several factors. The average estimated annual survival of age-1 brown trout to age 2 was 72% (Table 12). Information collected from many other Michigan rivers indicates that this estimate is greatly inflated, probably due primarily by upstream emigration of age-2 brown trout into the sampling reach. The median annual survival rate of age-1 brown trout at Michigan's fixed Stream Status and Trends Program (SSTP) sites (35 sites) is only about 30% (T. C. Wills, MI Department of Natural Resources, personal communication). The SSTP sampling sites are located on Michigan's better trout streams throughout the state so it is not credible that survival of brown trout in the thermally-stressful waters of the Au Sable could be surviving nearly 2.5 times better. Moreover, past studies conducted in MI and elsewhere have clearly demonstrated that stocked hatchery brown trout stocked into streams and rivers do not survive as well as their wild counterparts (Berg and Jørgensen 1991; Weiss and Schmutz 1999; Avery et al. 2001) particularly during the first year after stocking (Alexander and Peterson 1983). Brown trout survival from age 2 to age 3 (November to November) averaged 23%, which is about half the median survival rate observed at SSTP sites. The most plausible reasons for lower-than-median survival rate estimates for age-2 fish include thermal stress as well as aging error due to formation of false annuli during hot periods when growth ceases. Most of these fish were too small to be legally harvested by anglers so presumably mortality was due to predation and other factors. Average survival from age 3 to age 4

was high in 1999 and 2000, 54% compared to a median of 30% at SSTP sites. The fact that most of these fish were larger than the 15-inch size limit over an entire fishing season indicates that angling mortality was low. This conclusion is supported by angler census data collected in 1999 and 2000 (Table 8). Age-3-and-older brown trout in the Au Sable River below Mio are larger than the preferred prey size for most predators so it is not surprising that their survival rates are relatively high. Age 4 and age 5 brown trout also survived well from 1999 and 2000 to the subsequent year. Survival of trout that were 3 years old or older was substantially lower in 2001, possibly because summer water temperatures were substantially higher in both 2001 and 2002 compared to 1999 and 2000 (See Figure 3 and Figure 4).

Brown trout in the Au Sable below Mio are larger at a given age than the average size of trout in Michigan streams where the fishery is supported primarily by natural reproduction (Table 13). Part of this size difference is due to the larger size of yearling trout reared in the hatchery compared to those hatched and reared in the wild. However, annual growth increments (inches a trout grows per year) for brown trout were also generally well above the state average (Table 14) (Schneider 2000). Brown trout growing at a state average rate grow about 3 inches per year in streams. Data in Table 14 shows growth rates for each stocked cohort from 1999 to 2001. From 1999 to 2001 age-1 brown trout annual growth increments ranged from 1.7 to 4.0 inches; age-2 brown trout growth increments ranged from 3.6 to 5.5 inches; and age-3 brown trout grew 4.8 inches. Formation of false annuli during thermally stressful periods may again have caused some errors in age determination that could have contributed to this large variation in apparent growth rates. The yearlings stocked in 1999 and 2000 generally grew much faster than an average of 3 inches per year for several years after planting (Table 14). Slow growth of the cohort stocked in 2001 was a notable exception to the overall pattern. These fish grew 1.3 inches less than a state-average increment. The extremely warm water conditions that prevailed from late June 2002 through the first 3 weeks of August 2002 may account for the slow growth rate (Figures 3 and 4). Our data support the hypothesis that warm summer water temperatures below Mio Dam have a limiting and negative effect on both growth rates and survival (See discussion of survival above).

However, the present stocking rates combined with relatively high survival rates for older brown trout and higher-than-average mean length at age generates more trophy-sized brown trout per mile than are found in upstream reaches of the mainstem Au Sable River that are more thermally suitable for trout. Panel A of Figure 6 illustrates that substantially more brown trout 15 inches or longer per mile were present below Mio on the Au Sable than at Stephan Bridge during four years when population estimates were available at both sites for the same years. However, on a per acre basis density of brown trout over 15 inches long are very similar (Figure 6 Panel B).

The rainbow trout population in the Mio to Meadow Springs reach averaged 1,379 individuals and 290 rainbow trout per mile (Table 15). Rainbow trout sizes ranged from 4 inches to 24 inches with the majority of the fish in the 9 to 12 inch range (Figure 7). Most of the population was composed of age-1 with a moderate number of age-2 and very few age-3 fish present (Table 15). Only about 2% of rainbow trout survive to the fall at age-3 (Table 12). It is most likely that this poor survival is mostly attributed to natural mortality or emigration. The highest estimate of angler harvest (2,400 in 1999 before regulation changes) represents only 5% of the annual number of rainbow trout planted in this reach (See Tables 2 and 8). In 2000, estimated rainbow trout harvest was only 0.7% of average annual plantings.

Rainbow trout total annual survival rate estimates computed from the survey data and scale samples collected from 1999 to 2002 were determined to be biased for the same reasons discussed above for brown trout. Computed estimates of annual survival of rainbow trout from age 1 to age 2 were very high in 2000 and 2001, averaging 75% (Table 12). It is certain that these high survival estimates reflect immigration of age 2 fish into the sampling reach as well as aging error due to formation of false annuli formed when fish are stressed by warm water. For example, annual survival of age-1 rainbow trout in the mainstem Au Sable at Stephan Bridge managed under a no-kill flies-only regulation has averaged only about 25% over the past decade. Estimated survival from age 2 to 3 in the Au Sable River below Mio averaged only about 2%. We could not compute a valid estimate of average survival from age 3 to 4 because only one age-4 rainbow trout was captured during the four annual surveys used to estimate survival. The paucity of rainbow trout longer than 12 inches clearly demonstrates that overall survival of rainbow trout is very low.

Rainbow trout growth rates (annual increments) were much lower than those for brown trout even though the mean growth index in November 2005 was +2.7 inches above state mean length at age (Table 13). Hatchery-reared yearling rainbow trout planted in the spring are about 2.5 - 4 inches longer than their wild counterparts (depending upon the year) and hence they remain larger than the state average, which is based on naturally reproduced fish, even if they grow relatively slowly. Rainbow trout in streams growing at a Michigan state-average rate grow about 3 inches a year. Rainbow trout stocked in 1999 grew from 1.4 to 2.2 inches a year over their lifetime (Table 14). However, age-2 rainbow trout captured in November 2001 were an average of 0.1 inches shorter than age-1 rainbow trout captured in November 2000. This clearly indicates that false annuli laid down during stressfully warm water periods resulted in aging errors and hence errors in estimates of mean length at age. Mortality due to angler harvest was negligible (0.7 % of the numbers of rainbow trout planted annually) after new regulations were adopted in 2000 (Table 8) so angler cropping of fish over the minimum size limit of 12.0 inches can not account for the slow growth estimate. High summer temperatures during the summers of 2001 and 2002 again appear to be the most likely cause of the "apparent" lack of growth of fish stocked in 2000 and 2001. A negative association between high summer temperatures and abundance of rainbow trout over 12 inches long has also been observed in the Manistee River downstream of the Hodenpyl impoundment (Tonello and Nuhfer 2004).

Other management actions undertaken in the Au Sable River between Mio Dam and Alcona Pond have included the placement of large woody debris (LWD) under U.S. Forest Service administration and, stabilization of eroding banks and other actions to reduce erosion into the tributaries at poorly designed road/stream crossings. The Au Sable River Watershed Restoration Committee was formed in 1987 to oversee those activities. Huron Pines RC&D administers the Partnership Agreement, which to date has been signed by 27 private, public and governmental organizations (Brad Jensen, Huron Pines RC & D, personal communication). Under this direction, a strategy to inventory erosion sites within this reach was initiated in 1987 with the identification of 71 erosion sites. Classification of these sites includes 2 severe, 28 moderate and 41 minor. In addition several road/ stream crossings have been upgraded through efforts of the U.S. Forest Service and Oscoda and Alcona County Road Commissions.

Beginning in 1998 a medium lift helicopter was used to transport and place whole trees (large woody debris, LWD) into the river channel to restore structure and function to this riparian ecosystem. Historically, the Au Sable River channel was complex, with a variety of depths, velocities, and

substrates, and abundant cover provided by large wood in the river. Large woody debris in the river channel has been identified as lacking as a result of historic logging practices and Mio Dam which halts downstream movement of LWD (Zorn and Sendek 2001). The first helicopter lift demonstration project was conducted in 1998 where approximately 100 whole trees were placed in 6 miles of river downstream from Mio Dam at a cost of \$30,000. This project was a partnership between Huron Pines (RC&D council), Michigan Department of Natural Resources, and the U.S. Forest Service. All trees lifted into the river remained in place two years later and blended in with the natural surroundings of the river. GIS-based photo-monitoring was done to evaluate the success of this restoration (Jennings et al. 2005). Approximately 80% of the trees have remained in place. Tree complexes were less likely to be moved downstream than individual trees. However, it's important to note that those trees that have moved from their original locations remain in the system. Thus, helicopter placement of whole trees remains a viable approach to restoring aquatic habitat within forested ecosystems in the upper Midwest. It was determined to be cost effective (comparable to traditional techniques), mimics natural disturbance processes, and introduces an efficiency of operation whereby large-scale restoration can be done across the landscape (river system) (Robert Stuber, USFS Fisheries Biologist, personal communication).

This large-scale landscape level project is felt to be integral to aquatic ecosystem restoration in Northern Michigan (Stuber et al., 2004). It is consistent with Michigan DNR management direction for riparian zones and trout streams (Tonello et. al., 2004) and with the management options listed in Zorn and Sendek's (2001) Au Sable River Watershed Assessment ("Improve channel diversity by adding woody debris ...in reaches where channel diversity is low, or in reaches where natural contributions of LWD have been reduced.") and Sendek's (2004) Au Sable River Watershed Management Plan. Even though site-specific fish population response to the treatment is inconclusive (Klungle and Hayes, 2004), there is a plethora of information regarding the importance of large wood in riverine ecosystems (Gregory et. al., 2000). From 1998 through 2006, a total of 948 whole trees were placed in 12.5 miles of river between the power line and McKinley (Table 16). Funding has been provided by Consumers Energy licensing settlement funds and the U.S. Forest Service. Additional placements of LWD are planned.

This reach of river has exceptional water quality with regard to high volumes of clean-clear water, but the stream is thermally challenging for cold water species management due to the operation of Mio Dam. These water temperatures push the thermal tolerance limits for cold water species and are the major factor limiting trout survival and growth. Stream temperature monitoring has shown that during June, July and August, Mio Dam is in violation of its licensing operation agreement as the waters released downstream of the dam during those months are warmer than allowed. Fisheries data have shown that very slight changes in water temperature near the lethal upper limit for salmonids can have dramatic effects on species composition and biomass.

Investigations into the potential to pass cold water into the tailwater from Mio Pond are ongoing. Data are being collected during the summer of 2007, including air and water temperatures. This information will be used in a model to predict the potential cooling effects on downstream water temperatures by passing cold water from the upstream pond. Model results should be available in 2009. As part of the 1994 FERC/Consumers Energy Settlement Agreement, Consumers Energy has agreed to maintain certain water quality standards including water temperatures. One million-seven hundred thousand dollars (in 1994 dollars) has been set aside to address water quality violations of the agreement for all

ten of Consumer's Energy projects on the Au Sable, Manistee and Muskegon Rivers. Modifications to the discharge configurations of the projects may be incorporated if the action results in a significant water temperature improvement and the modification fits into the budget constraints in the agreement.

### **Analysis and Discussion**

The Mio Dam to Alcona Pond section of the Au Sable River is a very unique and rare resource in the state in that it is a large river with some of the most seasonally stable stream flows in the nation, with high volumes of water and nearly all riparian lands in public ownership. Historic logging practices inflicted severe environmental degradation, but for the most part have healed or are in the process of healing. The presence of hydro electrical generating dams both above and below this river reach fragments the biological communities from other communities upstream and downstream; provides environmental conditions that allow other aquatic species to exist and in some situations, thrive where they would not have under normal conditions; alters natural stream temperature patterns; and interferes with the natural transport of sediment, nutrients and large woody debris.

The fish community has remained relatively stable through time with some changes in species composition and biomass that are most likely results of subtle changes in stream temperatures and fish stocking practices. This stream reach is relatively productive with moderate species diversity. If trout species were not stocked here the fish community would consist primarily of cool and warm water fish species. Numerically, a majority of fish are small-bodied members of the families Cyprinidae, Percidae, and Cottidae species (Table 3). Catostomidae species compose most of the biomass of fishes in this reach. Fish collections made after 1962 suggest that round whitefish abundance has declined, perhaps indicating that contemporary water temperatures are warmer (See Tables 4 and 5). High summer water temperatures are also the probable reason that few naturally reproduced trout, which are fairly abundant in late spring and early summer; survive to the fall.

Brown trout and rainbow trout populations have varied through time both in size structure and density. Prior to 1997, trout stocking rates were low ranging from 8 to 15 yearlings per acre for brown trout and 2 to 40 per acre for rainbow trout. In 1962 naturally reproduced trout were common in fish collections although density in terms of both numbers and biomass were low (Table 4). Average brown trout biomass was estimated at approximately 5 lbs per acre out of a total average biomass of 38 lbs per acre. Fish collections made in the late 1980's captured few naturally reproduced trout and electrofishing CPE's indicated that trout densities were quite low (Table 5). In 1998, trout stocking densities were increased to 200 yearlings per acre in an attempt to increase trout populations and improve fishing. Trout population surveys conducted in 1999, 2000, 2001, 2002 and 2005 estimated that average trout biomass was substantially higher than found in previous population surveys (Table 4).

There were no historic estimates of survival but recent estimates indicate that brown trout survival is reasonably high while rainbow trout survival is very low. A few age-7 and age-8 brown trout were sampled in the population resulting in some brown trout in the population exceeding 25 inches in length. Poor survival of rainbow trout results in a population composed primarily of age-1 fish that range up to 13 inches long (Figure 7).

Brown trout growth rates are faster than state average growth rates for older fish. Trout growing at an average Michigan rate grow approximately 3 inches per year. The average of growth increment for yearling brown trout from 1999 to 2001 was 2.7 inches (Table 14). Annual growth increments were very large for age 2 brown trout (4.5 inches) and age-3 brown trout (4.8 inches) (Table 14). Yearling brown trout typically are planted at a larger size than wild fish of the same age. This size advantage coupled with fast growth of age 2 and older fish results in older brown trout being considerably larger than Michigan state average lengths at age (Table 13). Most brown trout grow to a size where they may be legally harvested in type-2 regulation waters (12 inches) when they are 3 years old or about 2 years after they are stocked. In the quality regulation water brown trout grow to legal harvest size (15 inches) when they are 4 years old or about 3 years after they are stocked.

Rainbow trout appear to grow rapidly during the year they are stocked (based on length frequency data shown in Figure 7). This growth presumably occurs primarily during the spring when the waters remain cool and again in the fall when they cool down again. False annuli laid down when growth stops during hot water periods precludes accurate estimates of mean length at age or annual growth increments for older fish. Warm summer water temperatures downstream of Mio Dam may also cause high mortality of larger rainbow trout or induces them to emigrate. A similar paucity of larger rainbow trout has been observed in the Manistee River downstream of Hodenpyl Dam where angling pressure is extremely light (Tonello and Nuhfer 2004). During warmer summers, rainbow trout larger than 12 inches are rarely caught by either anglers or survey gear downstream of Hodenpyl Dam but during cooler summers the angling fishery for large rainbows is often very productive.

This fish community in the Au Sable River between Mio Dam and Alcona Pond provides a very popular sport fishery that has received nation-wide acclaim for trophy size brown trout and high catch rates of rainbow trout even though the brown trout and rainbow trout populations are dependent on stocking. Little game fishing opportunity would exist in this river reach if it was not stocked with trout. Angler access is found throughout this reach with formal and informal access sites managed by the U.S. Forest Service, State of Michigan and Consumers Energy. The large size and character of the river allows for anglers to fish from shore, wade riffles and shallows, float-tube, canoe or boat. Diverse but restrictive angling regulations allow for protection of this unique trophy brown trout population while affording limited harvest of trout and non trout species. Catch rates are good for most of the angling season but do drop during mid summer, most likely due to high mid-summer stream temperatures (Appendix 1). In mid summer the high use of recreational watercraft causes conflicts with anglers. Water temperatures decline in fall and catch rates increase dramatically (see Appendices) but the fishing season ends on September 30. Because spawning success is low, the closed season serves no biological need and thus unnecessarily reduces the recreational potential of this fishery.

Recent habitat management has focused on placement of whole trees into the river channel to restore river channel diversity and provide cover for fish. Mio Dam disrupts natural sediment transport by trapping sediment in the impoundment. This increases the erosive power of the river downstream of the dam resulting in increased scour of the stream bed and banks. Past peaking flows magnified this erosion. The Mio impoundment also collects the large woody debris from upstream reaches, causing a lack of large woody debris in the Mio to Alcona reach. Run-of-river flows have reduced the erosion, and bank stabilization projects at several erosion sites has reduced new sediment inputs into the

channel. Efforts to transport and place whole trees into the river channel are restoring instream channel diversity.

### **Management Direction**

Michigan Department of Natural Resources is committed to the conservation, protection, management, use and enjoyment of the state's natural resources for current and future generations. Managing the state's resources is based on the principles of ecosystem management where ecosystem management is a process that integrates biological, social and economic factors into a comprehensive strategy aimed at protecting and enhancing sustainability, diversity and productivity of natural resources. The Mio to Alcona reach of the Au Sable River is a pristine, unique and exceptional riverine resource. The key value of the Mio to Alcona reach of the Au Sable River lies the quality trout fishing opportunities that the river provides, particularly for trophy-sized brown trout, high catch rates of rainbow trout, and a pristine environment with large tracts in public ownership. This section of river is nationally renowned for its trout fishing and is ideal for all types of anglers including shore, wading and boating anglers. Management actions should be directed at maintaining or improving these key values while providing diverse fishing opportunities for the angling public.

#### Limiting factors

A combination of high mean summer water temperatures coupled with little cooling at night is the most likely factor limiting survival, standing stocks, and natural reproduction of brown trout. High summer water temperatures are also the most likely factor limiting both survival and growth rates of rainbow trout during mid summer. Eaton et al. (1995) developed estimates of maximum temperature tolerances for 30 freshwater fish species based on a national dataset of temperature and fish presence. They defined maximum tolerance as the 95th percentile of the maximum weekly mean temperature where each species was found. This analysis yielded a maximum weekly temperature tolerance of 24.1 degrees C for brown trout and 24.0 degrees C for rainbow trout. These temperatures were exceeded in August 2001 below Mio on the Au Sable and weekly mean temperatures approaching these limits are common. Wehrly et al. (2007) estimated the 7-d upper tolerance level for maximum daily mean temperature for brown trout presence at 23.3 degrees C. Thus, the thermal potential of the Mio to Alcona reach of the Au Sable River to consistently support high densities and biomass is limited (See Figure 2). Mean daily summer water temperatures below Mio Dam reached or exceeded 22.0 degrees C (71.6 degrees F) for 30 or more summer days during hot years since USGS began collecting temperature data (Table 1c). Our analysis of flow contributed to the mainstem Au Sable River by small tributaries in this reach conclusively demonstrated that they do not offer any potential for significant cooling.

Due to extreme downstream water temperatures created by the operation of Mio Dam, the Au Sable River between Mio Dam and Alcona Pond will need to be stocked annually with yearling brown trout and rainbow trout to maintain the trout fishery. Thus, trout reproduction is not currently a key value of this system and the closed fishing season of the present regulations is unnecessarily reducing the recreational potential of the Mio tailwater.

Studies are presently underway to determine the potential to pass cold water that is present in the upstream impoundment to the tailwater. All efforts should be taken to comply with the license



requirements for discharged water temperatures. Until a remedy to excessive tailwater temperatures is prescribed, natural reproduction will not be high enough to support a quality trout fishery. Stocking rates should continue at 100 yearlings per acre each for brown trout and rainbow trout. Size at stocking is critical with a 6.5-inch minimum average length at stocking in order to assure adequate survival to successive year classes. Strains of trout should be selected that perform best (survival and growth) in riverine environments that are thermally challenged.

Angler values have been changing over the past two decades (Sendek 2004). A growing segment of anglers are willing to reduce or even give up the ability to harvest fish in order to improve the number and size of fish they catch. Fisheries Division has been receiving an increasing number of requests from these anglers to provide more quality angling opportunities. Fisheries managers should seek opportunities that can accommodate these new angling interests while still understanding that the majority of the angling public does harvest fish. In addition it is also recommended that habitat restoration efforts be continued, including bank stabilization where appropriate, and restoration of instream channel diversity through addition of large woody debris.

## Regulations

We recommend retaining Type 2 trout regulations from Mio Dam to the power line and from McKinley Bridge to 4001 Bridge. Regulations for the reach from the power line to McKinley Bridge could be converted to one of the standard gear-restricted regulations, i.e. Types 5, 6, or 7.

The primary purpose of regulations that restrict terminal tackle to artificial lures or flies is to reduce mortality of angler-caught fish that are released. Both lures and flies have been permitted on this reach of the Au Sable River for both biological and social reasons. The average mortality of trout released after capture with artificial lures or artificial flies is essentially identical. Allowing both lures and flies to be fished provides additional angling opportunities. Wydoski (1977) reviewed many hooking mortality studies of inland trout and reported that the mortality of trout released after capture on barbed artificial flies (average from 17 studies) was 4.02% as compared to 6.1% for trout caught on barbed artificial lures (average from 24 studies). Hooking mortality tends to be greater at higher water temperatures (Klein 1965; Hunsaker et al. 1970; Dotson 1982; Plumb et al. 1988). Hence, high water temperatures downstream from Mio dam probably increase hooking mortality to rates higher than the averages reported by Wydoski (1977).

Michigan fisheries managers use a formal process to evaluate streams for inclusion in gear-restricted stream regulation Types 5, 6, and 7 (MDNR, Fisheries Division 2003). Biological and physical factors as well as social considerations are all incorporated into this process. The flowchart shown in Figure 8 describes how biological criteria are incorporated into the stream selection process. The following narrative will describe how we followed the flow chart to make the decision that the reach of the Au Sable from the power line to McKinley Bridge is a good candidate for a gear-restricted regulation type.

First the angler fishery is dominated by trout so we proceed down to the next box. The mean length of age-2 brown trout and rainbow trout are both above the Michigan state average, which leads down the flow chart to the natural mortality rate box. Natural mortality rates for brown trout are not high (Table 12) so the flowchart was followed to the fishing mortality decision box for brown trout. Mortality

rates for age-1 rainbow trout are high (Figure 7) such that few fish grow larger than 12 inches. However, social factors such as the popularity of the current fishery again led us to the fishing mortality decision box. Angler census data indicate that fishing mortality of both brown trout and rainbow trout is low but again, social and political factors point toward the stream segment being a good candidate for further consideration for a gear-restricted type regulation.

Physical considerations incorporated into the decision process are shown in Figure 9. The stream reach is 14.7 miles long and there is excellent assured public access. Thus, this reach is clearly a very good candidate for gear-restrictive regulations.

The next stage of the process is to select which of the gear-restricted type regulations, 5, 6, or 7 should be applied. The following pages of this report list different potential regulation options and their implications for the brown trout and rainbow trout fisheries of the mainstem Au Sable River from the power line to McKinley Bridge.

We used a population simulation model to make predictions about the probable effects of applying different regulation types on this reach of the Au Sable. Model inputs included hooking mortality, natural mortality, growth rates, size limits, fishing effort, recruitment, and rates of voluntary release of legal-sized trout. We based the natural mortality and growth rates used in the model on fishery survey data. Effects of different regulation types were modeled at four rates of voluntary release of legal-sized trout, no release, 50% release, 75% release, and 100% release (no-kill). Angling effort inputs to the model were adjusted so that simulated total catches (harvest + catch and release) approximated the catch estimates from the creel census conducted in 1999 and 2000.

Other assumptions of the model include the following:

- The size distribution of fish within an age group follows a normal distribution.
- An annual time step is reasonable to depict population dynamics (including growth).
- Instantaneous rates are additive.
- No density dependent changes in growth or mortality occur.
- Recruitment is constant (~50,000 yearling brown trout and 50,000 yearling rainbow trout stocked each year).
- Hooking mortality is equal for all sizes of fish.
- The mean size is representative of the time when the bulk of the fishing occurs.

All these assumptions are reasonable based on our knowledge of fisheries dynamics in Michigan rivers including the Au Sable.

Option: Type 6 regulations

Implications:

- Open to angling all year
- Possession limit of 2 trout/day and possession season (Last Saturday in April through September 30) remain the same for brown trout (BNT) but rainbow trout (RBT) can be harvested all year.

- Artificial lures and flies are the only permissible terminal tackle, i.e. no change from present gear restrictions.
- Minimum size limit for BNT would be reduced from 15 inches to 12 inches.
- Harvest of brown trout would probably increase
- Catches of brown trout over 12 inches long are predicted to decrease from 4 to 13% depending upon the rate of voluntary release of legal-sized fish (Figure 10).
- We believe that the voluntary release rate for legal-sized brown trout is substantially higher than zero. Hence, catches of 12-inch-or-longer brown trout are expected to be very similar under either Type 6 or Type 5 regulations (Figure 10).
- Catches of brown trout larger than 15 inches might decline from 7 to 23% depending upon the rate of voluntary release of legal-sized fish (Figure 11).
- Again, we believe that the voluntary release rate is substantially higher than zero so the difference in total annual catches of brown trout over 15 inches under Type 6 or Type 5 regulations may be very similar.
- Minimum size limit for RBT remains the same (12 inches).
- Size limit for RBT in NON-gear restricted waters located upstream and downstream are also 12 inches so Type 6 regulations simplify enforcement of size limits.
- Limited angler harvest of stocked RBT could still occur. Estimated angler harvest in the gear-restricted reach was 459 RBT in 1999 and 146 in 2000 (Table 8).
- The difference in catches of 12-inch-or-longer rainbow trout (catch + release) under Type 6 regulations are predicted to be very similar to catches under Type 5 or Type 7 regulations because high natural mortality rates rather than angling mortality have the most influence on the population (Figure 12).
- Catches of 15-inch-or-longer rainbow trout under Type 6 regulations is predicted to be lower than under Type 5 regulations if there was no voluntary release of legal-sized fish, but note that the numbers of fish caught of this size is very small so the difference between the regulations would likely be undetectable (Figure 13). Moreover, if 50% or more of anglers voluntarily release legal-sized fish then the predicted difference in total annual catches of 15 inch or longer rainbow trout under Type 6 versus Type 5 regulations is less than 10 fish (Figure 13).

#### Option: Type 5 regulations

##### Implications:

- Open to angling all year
- Possession limit of 2 trout/day and possession season (Last Saturday in April through September 30) remain the same as the present regulation for brown trout (BNT) but rainbow trout (RBT) may be harvested all year.
- Artificial flies are the only permissible terminal tackle.
- An opportunity to fish for trophy trout with artificial lures would be lost.
- Recreational use of the reach by anglers may decline due to the loss of the opportunity to fish with artificial lures and reduced opportunities to harvest a few RBT.
- Minimum size limit for BNT would remain at 15 inches.
- Harvest of brown trout would probably remain the same.
- Angler catches of brown trout over 15 inches would probably not change.

- If voluntary release of legal-sized fish is 50% then predicted angler catches of brown trout over 15 inches long (harvest + catch and release) would be 13% higher than under Type 6 regulations (Figure 11).
- The minimum size limit for RBT would increase from 12 inches to 15 inches.
- A 15 inch minimum size limit on RBT would eliminate most harvest of RBT because high natural mortality rates preclude most fish from growing this large.
- Predicted angler catches (harvest + catch and release) of 12 inch and longer RBT would increase slightly from 4% to 13% depending upon what percentage of legal-sized fish are voluntarily released (Figure 12).
- Predicted angler catches of 15 inch and longer RBT would increase from 9% to 31% depending upon voluntary release rates but numerical differences in catch would be very small (Figure 13).

Option: Type 7 (No Kill) regulations

Implications:

- Open to angling all year
- No harvest of any trout species
- Artificial flies are the only permissible terminal tackle.
- An opportunity to fish for trophy trout with artificial lures would be lost.
- Recreational use of the reach by anglers may decline due to the loss of the opportunity to fish with artificial lures and lost opportunities to harvest a few trout.
- The abundance and size structure of RBT populations would not change significantly because high natural mortality rates result in few RBT surviving long enough to grow to a large size.
- Predicted angler catches of RBT 12-inches or longer would be very similar to catches under either Type 5 or Type 6 regulations (See Figures 12 and 13).
- Predicted angler catches of BNT over 15 inches long would increase about 25% compared to catches under Type 6 regulations and by about 15% compared to catches under Type 5 regulations if half of legal-sized BNT are presently being voluntarily released (Figure 11).
- Predicted angler catches of BNT over 15 inches long would increase about 14% compared to catches under Type 6 regulations and by about 8% compared to catches under Type 5 regulations if 75% of legal-sized BNT are voluntarily released (Figure 11).

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Month/yr	Monthly means		Monthly maximum		Monthly minimum		Mean range	
	Up	Down	Up	Down	Up	Down	Up	Down
June 05	19.0	20.2	23.0	24.0	13.5	15.0	2.3	1.4
June 06	17.3	19.5	22.3	21.5	13.2	16.5	2.3	1.2
July 05	19.5	21.6	22.5	24.5	15.0	19.0	2.2	1.0
July 06	17.3	19.5	22.6	24.7	15.7	19.0	2.2	1.3
Aug 05	18.0	20.1	22.5	23.5	14.0	16.5	1.9	1.2
Aug 06	17.7	19.4	24.7	24.1	13.9	16.2	2.0	1.0

Table 1b. – Mean monthly summer water temperatures in the Au Sable River downstream of the Mio Dam and near McKinley Bridge 1997-2006. Data from USGS web site.

Year	June		July		August	
	Mio Dam	McKinley	Mio Dam	McKinley	Mio Dam	McKinley
1997	19.0	18.6	20.4	19.9	17.5	17.2
1998	17.7	17.7	21.0	20.4	19.8	19.3
1999	19.8	19.6	21.5	21.4	19.5	18.8
2000	18.5	18.1	19.5	19.2	19.2	18.7
2001	18.8	18.6	21.1	20.6	21.0	20.3
2002	18.2	18.3	22.1	22.4	20.5	20.3
2003	17.9	17.6	20.2	20.0	21.1	20.3
2004	17.8	17.7	19.8	19.6	18.4	18.0
2005	20.2	20.2	21.6	21.4	20.1	19.8
2006	19.5	19.2	21.3	21.1	19.4	19.6

Table 1c. – Number of summer days (June, July and August) that mean daily water temperature exceeded 20 °C, 22 °C and 24 °C in the Au Sable River downstream of the Mio Dam and near McKinley Bridge 1997-2006. Data from USGS web site.

Year	Days 20.0+ °C (68 °F)		Days 22.0+ °C (71.6 °F)		Days 24.0+ °C (75.2 °F)	
	Mio Dam	McKinley	Mio Dam	McKinley	Mio Dam	McKinley
1997	29	25	10	11	0	0
1998	56	42	13	10	0	0
1999	51	50	29	16	0	0
2000	33	16	0	0	0	0
2001	67	59	26	20	6	2
2002	59	57	32	33	1	4
2003	60	48	13	6	0	0
2004	30	20	1	1	0	0
2005	65	62	36	29	0	0
2006	50	42	12	11	0	0

Table 2. – Trout plantings into the Au Sable River and tributaries between Mio dam and Alcona Pond 1938-2006.

Year	Species	Location	Number	Size (age)	Strain
<i>1938</i>	Brown trout	Comins Creek	4,940	Fall fingerlings	
	Brown trout	Glennie Creek	4,940	Fall fingerlings	
	Brown trout	Perry Creek	9,880	Fall fingerlings	
	Brown trout	Wolf Creek	7,640	Fall fingerlings	
<i>1939</i>	Brook trout	Perry Creek	4,000	Fall fingerlings	
	Brown trout	Cherry Creek	13,600	Fall fingerlings	
	Brown trout	Comins Creek	3,600	Fall fingerlings	
	Brown trout	Glennie Creek	3,600	Fall fingerlings	
	Brown trout	Perry Creek	13,600	Fall fingerlings	
<i>1940</i>	Brown trout	Au Sable River	1,000	Adult	
	Brown trout	Cherry Creek	13,500	Fall fingerlings	
	Brown trout	Comins Creek	5,196	Fall fingerlings	
	Brown trout	Glennie Creek	3,107	Fall fingerlings	
	Brown trout	Wolf Creek	15,000	Fall fingerlings	
	Brown trout	Perry Creek	20,196	Fall fingerlings	
	Rainbow trout	Au Sable River	100	Adult	
	Rainbow trout	Cherry Creek	4,500	Fall fingerlings	
	Rainbow trout	Perry Creek	4,500	Fall fingerlings	
<i>1941</i>	Brown trout	Au Sable River	6,000	Yearling	
	Brown trout	Au Sable River	400	Adult	
	Brown trout	Cherry Creek	2,500		
	Brown trout	Comins Creek	2,500		
	Brown trout	Glennie Creek	15,000	Spring fingerlings	
	Brown trout	Perry Creek	35,000	Spring fingerlings	
	Rainbow trout	Au Sable River	600	Adult	
	Rainbow trout	Cherry Creek	2,500	Fall fingerlings	
	Rainbow trout	Comins Creek	2,500	Fall fingerlings	
	Rainbow trout	Glennie Creek	2,500	Fall fingerlings	
	Rainbow trout	Perry Creek	2,500	Fall fingerlings	
<i>1942</i>	Brown trout	Cherry Creek	7,500	fingerlings	
	Brown trout	Comins Creek	7,500	fingerlings	
	Brown trout	Perry Creek	30,000	fingerlings	
	Rainbow trout	Cherry Creek	5,000	fingerlings	
	Rainbow trout	Comins Creek	7,000	fingerlings	
	Rainbow trout	Perry Creek	12,000	fingerlings	
<i>1943</i>	Brown trout	Au Sable River	500	Adult	
	Brown trout	Cherry Creek	10,000	fingerlings	
	Brown trout	Comins Creek	5,000	fingerlings	
	Brown trout	Glennie Creek	5,000	fingerlings	
	Brown trout	Perry Creek	30,000	fingerlings	
	Rainbow trout	Au Sable River	500	Adult	
	Rainbow trout	Cherry Creek	5,000	fingerlings	
	Rainbow trout	Comins Creek	5,000	fingerlings	
	Rainbow trout	Glennie Creek	5,000	fingerlings	
Rainbow trout	Perry Creek	10,000	fingerlings		

Table 2. – Trout plantings into the Au Sable River and tributaries between Mio dam and Alcona Pond 1938-2006 (Continued).

Year	Species	Location	Number	Size (age or length)	Strain
<i>1944</i>	Brown trout	Au Sable River	1,900	7.8	
<i>1945</i>	Brown trout	Au Sable River	4,700	8.3-9	
	Rainbow trout	Au Sable River	900	10	
<i>1946</i>	Brown trout	Au Sable River	4,225	8.6-9.2	
	Rainbow trout	Au Sable River	1,350	9.3	
<i>1947</i>	Brown trout	Au Sable River	3,700	9.3-9.6	
	Rainbow trout	Au Sable River	4,000	9.1-9.3	
<i>1948</i>	Brown trout	Au Sable River	10,500	8.5-9.7	
	Brown trout	Au Sable River	393	16.3	
<i>1949</i>	Brown trout	Au Sable River	3,600	7.5-9.7	
	Brown trout	Au Sable River	190	18.7	
	Rainbow trout	Au Sable River	11,600	7.2-9.4	
<i>1950</i>	Brown trout	Au Sable River	3,000	8.1	
	Brown trout	Au Sable River	180	18.3	
	Rainbow trout	Au Sable River	8,000	7.1	
<i>1951</i>	Brown trout	Au Sable River	5,950	7.2-7.5	
	Brown trout	Au Sable River	180	19.2	
	Brown trout	Au Sable River	6,100	7.2-7.5	
	Brown trout	Au Sable River	180	19.2	
	Rainbow trout	Au Sable River	6,000	7.5	
	Rainbow trout	Au Sable River	95	16	
	Rainbow trout	Au Sable River	6,000	7.5	
	Rainbow trout	Au Sable River	90	16	
	Brook trout	Au Sable River	900	7.7	
<i>1952</i>	Brown trout	Au Sable River	9,600	7.5-7.8	
	Brown trout	Au Sable River	66	21	
	Rainbow trout	Au Sable River	6,250	7.2-8.6	
	Rainbow trout	Au Sable River	80	19.5-23	
<i>1953</i>	Brown trout	Au Sable River	13,500	7.2-7.8	
	Brown trout	Au Sable River	160	20-24	
	Rainbow trout	Au Sable River	3,500	7.4-7.8	
<i>1954</i>	Brown trout	Au Sable River	7,845	7.4-8.1	
	Brown trout	Au Sable River	125	14.8-17.6	
	Rainbow trout	Au Sable River	5,000	7.8	

Table 2. – Trout plantings into the Au Sable River and tributaries between Mio dam and Alcona Pond 1938-2006 (Continued).

Year	Species	Location	Number	Size (age or length)	Strain
<b>1955</b>	Brown trout	Au Sable River	15,000	Legal	
	Rainbow trout	Au Sable River	25,200	Legal	
	Brook trout	Guster Creek (Perry)	300	Legal	
<b>1956</b>	Brown trout	Au Sable River	4,500	Legal	
	Rainbow trout	Au Sable River	43,500	Legal	
<b>1957</b>	Brown trout	Au Sable River	3,000	Legal	
	Rainbow trout	Au Sable River	43,300	Legal	
<b>1958</b>	Brown trout	Au Sable River	5,700	Legal	
	Rainbow trout	Au Sable River	20,550	Legal	
<b>1959</b>	Brown trout	Au Sable River	4,500	Legal	
	Rainbow trout	Au Sable River	20,850	Legal	
<b>1960</b>	Brown trout	Au Sable River	3,500	Legal	
	Rainbow trout	Au Sable River	17,000	Legal	
<b>1961</b>	Brown trout	Au Sable River	650	Legal	
	Rainbow trout	Au Sable River	12,900	Legal	
	Brook trout	Au Sable River	650	Legal	
<b>1962</b>	Brown trout	Au Sable River	3,400	Legal	
	Rainbow trout	Au Sable River	13,500	Legal	
<b>1963</b>	Brown trout	Au Sable River	3,600	Legal	
	Rainbow trout	Au Sable River	12,000	Legal	
<b>1964</b>	Brown trout	Au Sable River	3,900	Legal	
	Rainbow trout	Au Sable River	13,000	Legal	
<b>1965</b>	Brown trout	Au Sable River	3,900	Legal	
	Rainbow trout	Au Sable River	12,000	Legal	
<b>1966</b>	Brown trout	Au Sable River	3,000	Legal	
<b>1967</b>	No plantings				
<b>1968</b>	Brown trout	Au Sable River	3,790	Yearling	
	Rainbow trout	Au Sable River	1,070	Yearling	
<b>1969</b>	Rainbow trout	Au Sable River	10,500	Yearling	
<b>1970</b>	Brown trout	Au Sable River	5,000	Yearling	
	Rainbow trout	Au Sable River	13,000	Yearling	

Table 2. – Trout plantings into the Au Sable River and tributaries between Mio dam and Alcona Pond 1938-2006 (Continued).

Year	Species	Location	Number	Size (age or length)	Strain
1971	Brown trout	Au Sable River	2,000	Yearling	
	Brown trout	Au Sable River	1,120	Adult	
	Rainbow trout	Au Sable River	13,000	Yearling	
1972	Brown trout	Au Sable River	8,000	Yearling	
	Rainbow trout	Au Sable River	10,002	Yearling	
1973	Brown trout	Au Sable River	8,000	Yearling	
	Rainbow trout	Au Sable River	8,500	Yearling	
1974	Brown trout	Au Sable River	10,000	Yearling	
	Rainbow trout	Au Sable River	16,500	Yearling	
1975	Brown trout	Au Sable River	8,005	Yearling	
	Rainbow trout	Au Sable River	4,100	Yearling	
1976	Brown trout	Au Sable River	10,866	Yearling	
	Rainbow trout	Au Sable River	10,160	Yearling	
1977	Brown trout	Au Sable River	8,005	Yearling	
	Rainbow trout	Au Sable River	11,486	Yearling	
1978	Brown trout	Au Sable River	8,005	Yearling	
	Rainbow trout	Au Sable River	8,300	Yearling	
1979	Brown trout	Au Sable River	900	Yearling	
	Rainbow trout	Au Sable River	6,500	Yearling	
1980	Brown trout	Au Sable River	1,140	Yearling	
	Rainbow trout	Au Sable River	6,500	Yearling	
1981	Brown trout	Au Sable River	1,200	Yearling	
	Rainbow trout	Au Sable River	6,500	Yearling	
1982	Brown trout	Au Sable River	1,200	Yearling	
	Rainbow trout	Au Sable River	6,500	Yearling	
1983	Brown trout	Au Sable River	800	6.2	Harrietta
	Brown trout	Au Sable River	4,700	6.9	Harrietta
1985	Brown trout	Au Sable River	4,620	7.1	
	Rainbow trout	Au Sable River	6,500	7.4	Shasta
1986	Brown trout	Au Sable River	5,440	5.4	Plymouth Rock
	Rainbow trout	Au Sable River	6,750	7.6	Shasta
1987	Brown trout	Au Sable River	5,880	7.6	Plymouth Rock
	Rainbow trout	Au Sable River	5,750	7.4	Shasta
	Arctic Grayling	Au Sable River	40,032	7.4	Tricolor-Lacu

Table 2. – Trout plantings into the Au Sable River and tributaries between Mio dam and Alcona Pond 1938-2006 (Continued).

Year	Species	Location	Number	Size (length in inches)	Strain
1988	Brown trout	Au Sable River	3,350	6.6	Plymouth Rock
	Brown trout	Au Sable River	20,000	3.3	
	Rainbow trout	Au Sable River	17,900	4.1	Shasta
	Rainbow trout	Au Sable River	7,250	7.3	Shasta
	Rainbow trout	Au Sable River	12,078	4.8	Wyoming
	Arctic Grayling	Au Sable River	13,795	7.9	Signifer-Fluv
1989	Brown trout	Au Sable River	12,000	3.8	Plymouth Rock
	Rainbow trout	Au Sable River	12,000	4.3	Arlee
1990	Brown trout	Au Sable River	5,225		Plymouth Rock
	Rainbow trout	Au Sable River	7,250	6.3	Shasta
1991	Brown trout	Au Sable River	7,555	6.2	Plymouth Rock
	Rainbow trout	Au Sable River	6,510		Arlee
1992	Brown trout	Au Sable River	7,090	6.6	Plymouth Rock
	Rainbow trout	Au Sable River	7,250	7.0	Shasta
1993	Brown trout	Au Sable River	7,230	8.1	Wild Rose
	Rainbow trout	Au Sable River	6,354	6.4	Shasta
1994	Brown trout	Au Sable River	8,000	6.9	Wild Rose
	Rainbow trout	Au Sable River	8,000	5.6	Harrison Lake
1995	Brown trout	Au Sable River	3,700	6	Soda Lake
	Brown trout	Au Sable River	7,398	6.7	Wild Rose
	Rainbow trout	Au Sable River	17,470	5.3	Harrison Lake
	Rainbow trout	Au Sable River	10,527	6.5	Shasta
1996	Brown trout	Au Sable River	15,393	6.7	Wild Rose
	Rainbow trout	Au Sable River	8,000	7.4	Shasta
	Rainbow trout	Au Sable River	7,591	6.4	Eagle Lake
1997	Brown trout	Au Sable River	7,760	6.7	Wild Rose
	Brown trout	Au Sable River	12,000	7.3	Seeforellen
	Rainbow trout	Au Sable River	24,000	6.7	Eagle Lake
1998	Brown trout	Au Sable River	31,885	5.9	Seeforellen
	Brown trout	Au Sable River	11,600	6.3	Wild Rose
	Rainbow trout	Au Sable River	18,700	7.6	Shasta
	Rainbow trout	Au Sable River	27,750	7.2	Eagle Lake
1999	Brown trout	Au Sable River	48,000	3.9	Gilchrist Creek
	Rainbow trout	Au Sable River	46,400	8	Eagle Lake



Table 2. – Trout plantings into the Au Sable River and tributaries between Mio dam and Alcona Pond 1938-2006 (Continued).

Year	Species	Location	Number	Size (length in inches)	Strain
2000	Brown trout	Au Sable River	48,000	4.6	Gilchrist Creek
	Rainbow trout	Au Sable River	44,000	7.3	Eagle Lake
2001	Brown trout	Au Sable River	48,000	4.9	Gilchrist Creek
	Brown trout	Au Sable River	43,554	3.3	Gilchrist Creek
	Brown trout	Au Sable River	21,938	2.8	Seeforellen
	Rainbow trout	Au Sable River	34,200	6.2	Eagle Lake
	Rainbow trout	Au Sable River	11,980	6.2	Shasta
2002	Brown trout	Au Sable River	67,566	5.2	Gilchrist Creek
	Rainbow trout	Au Sable River	48,600	7	Eagle Lake
2003	Brown trout	Au Sable River	48,000	5	Gilchrist Creek
	Rainbow trout	Au Sable River	48,000	6.5	Eagle Lake
2004	Brown trout	Au Sable River	48,000	5.1	Gilchrist Creek
	Rainbow trout	Au Sable River	60,000	6.2	Eagle Lake
2005	Brown trout	Au Sable River	24,000	6.7	Gilchrist Creek
	Brown trout	Au Sable River	18,000	7.1	Wild Rose
	Rainbow trout	Au Sable River	65,394	6	Eagle Lake
2006	Brown trout	Au Sable River	48,022	6.8	Wild Rose
	Rainbow trout	Au Sable River	54,496	6.7	Eagle Lake

Table 3. – Fish species captured on four fish community surveys. See text for survey methods.

Species	1924	1962	1972	1990
<b>Carp and Minnows</b>				
Spotfin Shiner			X	
Common Shiner	X	X	X	X
Pearl Dace			X	
River Chub	X			X
Golden Shiner			X	
Emerald Shiner			X	
Blackchin Shiner	X	X		
Blacknose Shiner			X	
Spottail Shiner			X	
Mimic Shiner			X	
Bluntnose Minnow	X	X	X	X
Fathead Minnow			X	
Blacknose Dace	X	X	X	X
Longnose Dace	X	X		X
Creek Chub		X	X	X
<b>Suckers</b>				
White Sucker	X	X	X	X
Northern Hog Sucker	X	X	X	X
Greater Redhorse				X
<b>Bullhead Catfishes</b>				
Black Bullhead		X		
Stonecat		X		X
<b>Pikes</b>				
Northern Pike	X	X		
<b>Trouts</b>				
Rainbow Trout	X	X		X
Round Whitefish		X		
Brown Trout		X	X	X
Brook Trout		X	X	X
<b>Sticklebacks</b>				
Brook Stickleback	X			X
<b>Sculpins</b>				
Mottled Sculpin	X			X
Slimy Sculpin	X	X		
<b>Sunfishes</b>				
Rock Bass	X	X	X	X
Bluegill		X	X	
Smallmouth Bass		X	X	X
Largemouth Bass		X		X
Black Crappie		X		X
<b>Perches</b>				
Rainbow Darter	X	X	X	X
Johnny Darter	X	X	X	
Yellow Perch		X		
Logperch		X	X	X
Blackside Darter	X	X	X	X
Walleye		X		X
Total Species captured	17	27	23	23

Table 4. - Summary of fish population estimates in the Mio to Alcona reach of the Au Sable River, September 1962 and October 1990.

Species	1962				1990			
	Cherry Creek		Davis Landing		Meadow Springs		-Gabions	
	Number per acre	Pounds per acre	Number per acre	Pounds per acre	Number per acre	Pounds per acre	Number per acre	Pounds per acre
Brown Trout	10	6.38	6	2.17	27	1.77	2	0.78
Rainbow Trout	1	0.51	4	2.01	1	0.15		
Brook Trout			4	0.92	1	0.02		
Round Whitefish	8	10.67	6	3.82				
Smallmouth Bass	7	0.13		0.01	32	0.07	2	0.01
Largemouth Bass	1	0.02			1	-	3	0.02
Walleye	1	0.09			5	0.64		
Northern Pike	2	1.50						
Rock Bass	28	0.90			12	0.09	4	0.01
Yellow Perch	17	0.17	4	0.04				
Bluegill	5	0.01	1	-				
Black Crappie	1	-			1	-		
Logperch	156	3.11	512	6.59	25	0.11	925	2.82
Blackside Darter	162	1.57	105	0.62	211	0.49	123	0.17
Rainbow Darter	5	0.03	769	3.35	71	0.05	29	0.03
Johnny Darter			243	0.78				
Northern Hog Sucker	133	7.82	794	7.08	542	59.90	60	8.45
White Sucker	43	2.66	158	2.26	309	79.01	19	5.37
Blacknose Dace	31	0.23	754	2.58	29	0.04	365	0.40
Longnose Dace	104	1.51	247	2.09	69	0.10	223	0.79
Common Shiner	238	0.71	34	0.03	98	0.12	83	0.07
Bluntnose Minnow	10	0.06	3	0.02			22	0.06
Creek Chub	16	0.15	5	0.11	179	1.10	1,434	7.71
Blackchin Shiner	7	0.01						
Stonecat	24	3.07	2	0.01	8	0.08	5	0.24
Black Bullhead		-						
Slimy Sculpin	4	0.04	39	0.83				
Greater Redhorse					31	39.15	3	1.53
Mottled Sculpin					1	-	42	0.14
River Chub					5	0.01		
Stickleback					1	-	2	-
Tessellated Darter					82	0.08	91	0.11
<b>Total</b>	<b>1,014</b>	<b>41.38</b>	<b>3,690</b>	<b>35.36</b>	<b>1741</b>	<b>183.17</b>	<b>3,437</b>	<b>29.80</b>

Table 5. – Fish species caught by boom shocker electrofishing between Mio Dam and McKinley Bridge.

Species	Year	Catch per hour	Length (inches)	
			Minimum	Maximum
Arctic grayling	1987	0.2	9.9	9.9
	1988	0.0	--	--
	1989	0.0	--	--
Brown trout	1987	38.7	4.3	23.5
	1988	8.4	6.1	25.6
	1989	11.7	6.4	23.3
Rainbow trout	1987	2.9	5.8	19.7
	1988	0.6	9.2	10.1
	1989	0.5	9.8	20.5
Brook trout	1987	0.2	6.7	6.7
	1988	0.2	5.0	5.0
	1989	0.2	8.3	8.3
Northern hog sucker	1987	36.0	3.1	18.3
	1988	30.2	4.1	22.7
	1989	62.4	4.8	18.3
White sucker	1987	16.0	4.7	18.8
	1988	87.1	6.0	19.9
	1989	67.5	5.8	19.2
Greater redhorse	1987	4.0	20.6	27.7
	1988	70.9	17.0	26.7
	1989	31.0	17.8	31.3
Hornyhead chub	1987	0.2	7.6	7.6
	1988	0.2	4.8	4.8
Creek chub	1987	1.0	4.6	8.3
Common shiner	1987	0.4	6.5	7.1
	1988	0.2	6.9	6.9
	1989	0.2	6.3	6.3
Longnose dace	1987	2.9	2.3	4.3
	1989	0.2	2.8	2.8
Logperch	1987	0.2	4.3	4.3
	1989	0.2	3.9	3.9
Blackside darter	1987	0.4	2.1	3.1
	1989	0.2	2.4	2.4
Rock bass	1987	0.2	6.2	6.2
	1989	2.7	4.6	9.5

Table 5. – Fish species caught by boom shocker electrofishing between Mio Dam and McKinley Bridge (Continued)

Species	Year	Catch per hour	Length	
			Minimum	Maximum
Northern pike	1987	0.4	24.0	24.1
	1989	0.2	18.4	18.4
Round whitefish	1987	2.9	6.6	17.3
	1988	0.4	13.9	14.9
	1989	1.7	11.5	16.2
Walleye	1987	9.2	5.7	15.0
	1988	3.2	7.7	27.5
	1989	11.6	9.7	30.2
Smallmouth bass	1988	0.4	13.5	27.5
	1989	1.6	6.4	14.5
Stonecat	1988	0.4	7.8	8.2
Yellow perch	1989	0.3	7.0	8.5

Table 6.– Stream discharge (cfs) near the mouth of tributaries to the mainstem Au Sable River between Mio Dam and Alcona Pond on June 26, 2007. Mean water July and August 2007 temperatures (<sup>0</sup>F) for six streams were summarized from hourly temperature recordings made with Onset electronic thermometers. Streams are arranged in the table from upstream (Wolf Creek) to downstream (Lost Creek). Discharge of the Au Sable River immediately downstream of Mio Dam was near the median level for this date, i.e. 863 cfs at noon.

Tributary name	Discharge in cubic feet per second	Mean July Water Temperature	Mean August Water Temperature
Wolf Creek	0.02	—	—
Cherry Creek	3.17	59.8	59.4
Loud Creek	Channel dry at mouth	—	—
Perry Creek	6.56	61.4	61.3
Cauchy Creek	0.66	58.7	58.0
Comins Creek	Channel dry at mouth	—	—
Glennie Creek	0.02	—	—
Nine Mile Creek	1.86	51.9	52.4
O'Brien Lake outlet	1.85	63.0 <sup>A</sup>	66.1 <sup>A</sup>
Blockhouse Creek	0.37	54.0	54.6
Penoyer Creek	0.15	—	—
Lost Creek	Mouth of creek was not located	—	—
<b>Total discharge of all named tributaries</b>	<b>14.66</b>		

<sup>A</sup>It is possible that local springs resulted in colder temperature readings than those in mid stream. However, this was the only good hiding spot for the thermometer found within 400 feet of the mouth of the creek.

Stream discharge of the Au Sable River at noon on 6/26/07 was 863 cfs immediately below Mio Dam and 993 cfs immediately below Alcona Dam at noon. Thus, the 14.66 cfs of water contributed to this reach by named tributaries was 11% of the 130 cfs increase in discharge between the two dams. Discharge data from USGS real-time data for Michigan streamflow web page.

Table 7. -Quality Trout Angling Regulations- Power line (T26N, R2E, Sec. 4) to McKinley Bridge 1965-2007.

Year	Tackle	Size limits	Creel Limits	Season
1965 through 1967	Artificial lures or flies only	12" all trout	2 trout per day	Last Saturday in April to September 30
1968 through 1970	Artificial lures or flies only	15" all trout	2 trout per day	Last Saturday in April to October 10
1971 through 1972	Artificial lures or flies only	15" all trout	2 trout per day	Last Saturday in April to October 31
1973	Artificial flies only	18" all trout	2 trout per day	Last Saturday in April to October 31
1974 through 1975	Artificial flies only	18" brown and rainbow trout 12" brook trout	2 trout per day	Last Saturday in April to October 31
1976 through 1978	Artificial lures or flies only	15" brown and rainbow trout 12" brook trout	2 trout per day	Last Saturday in April to September 30
1979 through 2008	Artificial lures or flies only	15" brown 12" rainbow and brook trout	2 trout per day	Last Saturday in April to September 30

Table 8. – Angler catches of brown trout and rainbow trout and angler effort in the Au Sable River between M-33 and 4001 Bridge from the last Saturday in April through 30-September in 1999 and 2000. Two standard errors are given in parenthesis. Angler catches of other fish species are shown in appendices to this report.

	M33 – Power line (0.3 mi)		Power line – Comins Flats (7.05 mi)		Comins Flats – McKinley (7.65 mi)		McKinley – 4001 (7.5 mi)	
	1999 -8" all trout 2000 – 12" all trout		Quality regulations				1999 - 8" all trout 2000 – 12" all trout	
	Brown	Rainbow	Brown	Rainbow	Brown	Rainbow	Brown	Rainbow
	<b>Harvest</b>							
1999	146 (119)	906 (554)	77 (151)	178 (126)	24 (34)	281 (347)	216 (181)	1,035 (415)
2000	37 (65)	116 (131)	811 (999)	127 (122)	30 (50)	19 (23)	77 (73)	73 (60)
	<b>Catch and release</b>							
1999	4,610 (5,386)	3,559 (1,892)	1,811 (1,136)	6,703 (2,102)	371 (190)	4,597 (1,637)	512 (691)	2,093 (876)
2000	388 (278)	854 (760)	3,310 (1,156)	6,510 (1,558)	500 (295)	1,903 (823)	616 (340)	1,023 (433)
	<b>Total angler hours</b>							
1999	8,033 (1,990)		10,410 (1,705)		6,865 (1,591)		5,287 (1,104)	
2000	4,738 (1,471)		17,615 (3,233)		5,403 (1,299)		6,978 (1,633)	
	<b>Total angler trips</b>							
1999	2,295		3,427		1,887		2,047	
2000	1,354		4,022		1,186		2,565	



Table 9. – Angler catches of brown trout and rainbow trout and angler effort per mile in the Au Sable River from the last Saturday in April through 30-September in 1999 and 2000.

	M33 – Power line (0.3 mi)		Power line – Comins Flats (7.05 mi)		Comins Flats – McKinley (7.65 mi)		McKinley – 4001 (7.5 mi)	
	Brown	Rainbow	Brown	Rainbow	Brown	Rainbow	Brown	Rainbow
	1999 -8" all trout 2000 – 12" all trout		Quality regulations				1999 - 8" all trout 2000 – 12" all trout	
<b>Harvest per mile</b>								
1999	487	3,020	11	25	3.1	37	29	138
2000	123	387	115	18	4	2	10	10
<b>Catch and release per mile</b>								
1999	15,367	11,863	257	951	48	601	68	279
2000	1,293	2,847	470	923	65	249	82	136
<b>Angler hours per mile</b>								
1999	26,829		1,476		896		705	
2000	15,793		2,499		706		930	
Ave.	21,311		1,987		801		818	

Table 10. – Percentage of brown trout and rainbow trout released by anglers fishing in the Au Sable River from the last Saturday in April through 30-September in 1999 and 2000.

M33 – Power line (0.3 mi)		Power line – Comins Flats (7.05 mi)		Comins Flats – McKinley (7.65 mi)		McKinley – 4001 (7.5 mi)		
1999 -8” all trout 2000 – 12” all trout		Quality regulations				1999 - 8” all trout 2000 – 12” all trout		
Brown	Rainbow	Brown	Rainbow	Brown	Rainbow	Brown	Rainbow	
1999	96.9	79.7	95.9	97.4	93.9	94.2	70.3	66.9
2000	91.3	88.0	80.3	98.1	94.3	99.0	88.9	93.3

Table 11.—Brown trout population estimates by age in the Au Sable River between the Mio dam and Meadow Springs and weighted mean length at age. This 4.75-mile long reach has a surface area of 95 acres.

<b>Numbers per acre by age</b>									
Survey date	0	1	2	3	4	5	6	7	Total
11/8/1999	0.1	18.1	12.0	3.2	0.8	0.2	0.1	0.0	34.3
11/6/2000	1.9	20.0	12.5	3.3	1.7	0.4	0.1	0.01	39.9
11/8/2001	1.7	12.8	15.1	2.5	1.7	0.5	0.1	0.0	34.2
11/6/2002	0.2	13.3	9.1	3.0	0.7	0.3	0.1	0.0	26.7
11/08/2005	3.8	11.4	6.1	0.5	0.1	0.1	0.2	0.1	22.3

<b>Numbers per mile by age</b>									
	0	1	2	3	4	5	6	7	Total
11/8/1999	1.8	361.4	239.0	63.1	15.9	3.3	1.1	0.0	685.5
11/6/2000	37.9	400.0	249.6	66.0	34.6	8.8	1.7	0.1	798.6
11/8/2001	33.2	255.0	300.9	49.1	34.8	9.6	2.1	0.0	684.4
11/6/2002	3.9	266.6	181.7	59.7	13.6	6.9	1.1	0.0	533.3
11/08/2005	76.8	228.3	121.3	9.0	2.1	2.7	4.5	1.9	446.4

<b>Brown trout weighted mean length at age in inches</b>							
Year	Age						
	0	1	2	3	4	5	6
1999	4.9	8.8	11.4	16.1	18.4	21.5	24.4
2000	5.3	6.1	11.3	15.4	18.2	20.5	23.1
2001	4.7	8.9	10.2	14.9	18.9	21.5	20.1
2002	4.4	9.1	10.6	15.7	19.7	22.1	24.6
2005	5.3	7.6	10.5	13.5	19.3	22.0	23.7

Table 12. - Annual survival estimates (%) for brown trout and rainbow trout in a 4.75 mile reach of the Au Sable River between Mio dam and Meadow Springs. Survival estimates were calculated from consecutive annual population estimates conducted each November from 1999 through 2002.

<b>Brown trout annual percent survival by age</b>						
Year	1-2	2-3	3-4	4-5	5-6	6-7
1999	69 <sup>1</sup>	28	55	56	45	12
2000	75	20	53	28	21	0
2001	71	20	28	20	11	0
Average	72	22	45	34	29	4

<b>Rainbow trout annual percent survival by age</b>						
Year	1-2	2-3	3-4	4-5	5-6	6-7
1999	11	1	0	---	---	---
2000	79	4	0	---	---	---
2001	71	2	--- <sup>2</sup>	---	---	---
Average	54	2	0			

<sup>1</sup> Computed as the number of age-2 fish present in November 2000 divided by the number of age-1 fish present in November 1999 and so on. Note that these estimates are “*apparent*” survival rates since immigration into or emigration out of the study reach could occur between the times populations were estimated. Immigration of trout into this reach was suggested by Abdella (2001). In addition, bias was introduced by aging errors caused by false annuli laid down during periods when warm water stress halts growth.

<sup>2</sup> A valid estimate of survival could not be computed due to a small sample size. Only one four-year-old fish was captured in the 4.75 mile sampling reach during this survey.

Table 13. - Average total length (inches) at age, and size relative to the state average, for trout sampled from the Au Sable River below Mio Dam during November 2005.

Species	Age Group	Number of Fish	Length Range in Inches	Mean Length in Inches	State Average Length	Growth Index (by age group)	Mean Growth Index for Species
Brown trout	0	31	3.3-6.3	4.9	4.0	+0.9	+1.5
	I	68	4.2-10.9	8.7	6.9	+1.8	
	II	45	8.1-14.3	10.5	9.9	+0.6	
	III	16	10.8-19.5	13.7	12.9	+0.8	
	IV	6	18.3-20.7	19.4	15.9	+3.5	
	V	9	19.6-24.6	21.1	18.9	+3.2	
	VI	15	20.3-26.8	23.4	21.9	+1.5	
	VII	5	22.8-25.4	24.4	23.8	+0.6	
	VIII	1	25.3	25.3			
Rainbow trout	0	1	4.5	4.5	3.4	+1.1	+2.7
	I	68	4.2-12.4	10.0	6.5	+3.5	
	II	10	9.6-12.1	10.5	9.5	+1.0	
	III	1	17.1	17.1	12.4	+4.7	
	IV	1	24.2	24.2	15.4	+8.8	
Brook trout	I	6	5.2-7.3	6.0	5.3	+0.7	+0.7

Table 14. - Annual growth increments (inches) for cohorts of yearling brown trout and rainbow trout stocked from 1999 through 2001. Annual growth increments<sup>A</sup> are from November to November of the next year when populations were estimated.

**Brown trout Growth Increments (in) by planting year (yearlings)**

Year	Age		
	1 to 2	2 to 3	3 to 4
1999	2.5	3.6	4.8
2000	4.0	5.5	
2001	1.7		
Average	2.7	4.55	4.8

**Rainbow trout Growth Increments (in) by planting year (yearlings)**

Year	Age		
	1 to 2	2 to 3	3 to 4
1999	1.4	2.0	2.2
2000	-0.1	3.1	
2001	0.2		
Average	0.5	2.5	2.2

<sup>A</sup> A more detailed analysis of incremental growth data for specific planted cohorts revealed that these estimates were biased due to false annuli laid down during summer periods when water high water temperatures arrested growth. Annual incremental growth rates used in simulation modeling were estimated from length frequency histograms of trout captured during electrofishing surveys.

Table 15.—Rainbow trout population estimates by age in the Au Sable River between the Mio dam and Meadow Springs. Estimates were conducted during the first week of November each year. This 4.75-mile long reach has a surface area of 95 acres.

Survey Date	Number per acre by age								Total
	0	1	2	3	4	5	6	7	
11/08/1999	0.0	14.0	4.2	0.03	0.0	0.0	0.0	0.0	18.2
11/06/2000	0.4	5.1	1.5	0.04	0.0	0.0	0.0	0.0	7.0
11/08/2001	0.0	6.9	4.1	0.06	0.0	0.0	0.0	0.0	11.0
11/06/2002	0.0	10.4	4.9	0.07	0.01	0.0	0.0	0.0	15.4
11/08/2005	0.01	17.9	3.0	0.01	0.02	0.0	0.0	0.0	21.0

	Number per mile by age								Total
	0	1	2	3	4	5	6	7	
11/08/1999	0.0	279.9	84.3	0.6	0.0	0.0	0.0	0.0	364.8
11/06/2000	7.0	102.4	29.9	0.9	0.0	0.0	0.0	0.0	140.0
11/08/2001	0.0	137.3	81.4	1.2	0.0	0.0	0.0	0.0	219.8
11/06/2002	0.0	207.4	97.9	1.3	0.2	0.0	0.0	0.0	307.0
11/08/2005	0.2	358.5	59.8	0.2	0.42	0.0	0.0	0.0	419.2

Year	Rainbow trout weighted mean length at age in inches							6
	Age							
	0	1	2	3	4	5		
1999	4.5	11.9	12.4	19.2	---	---	---	
2000	6.6	12.0	13.3	17.7	---	---	---	
2001	---	11.4	11.9 <sup>1</sup>	15.3	---	---	---	
2002	---	11.0	11.7 <sup>1</sup>	15.1	17.5	---	24.5	
2005	4.5	10.0	10.5 <sup>1</sup>	17.5	24.5	---	---	

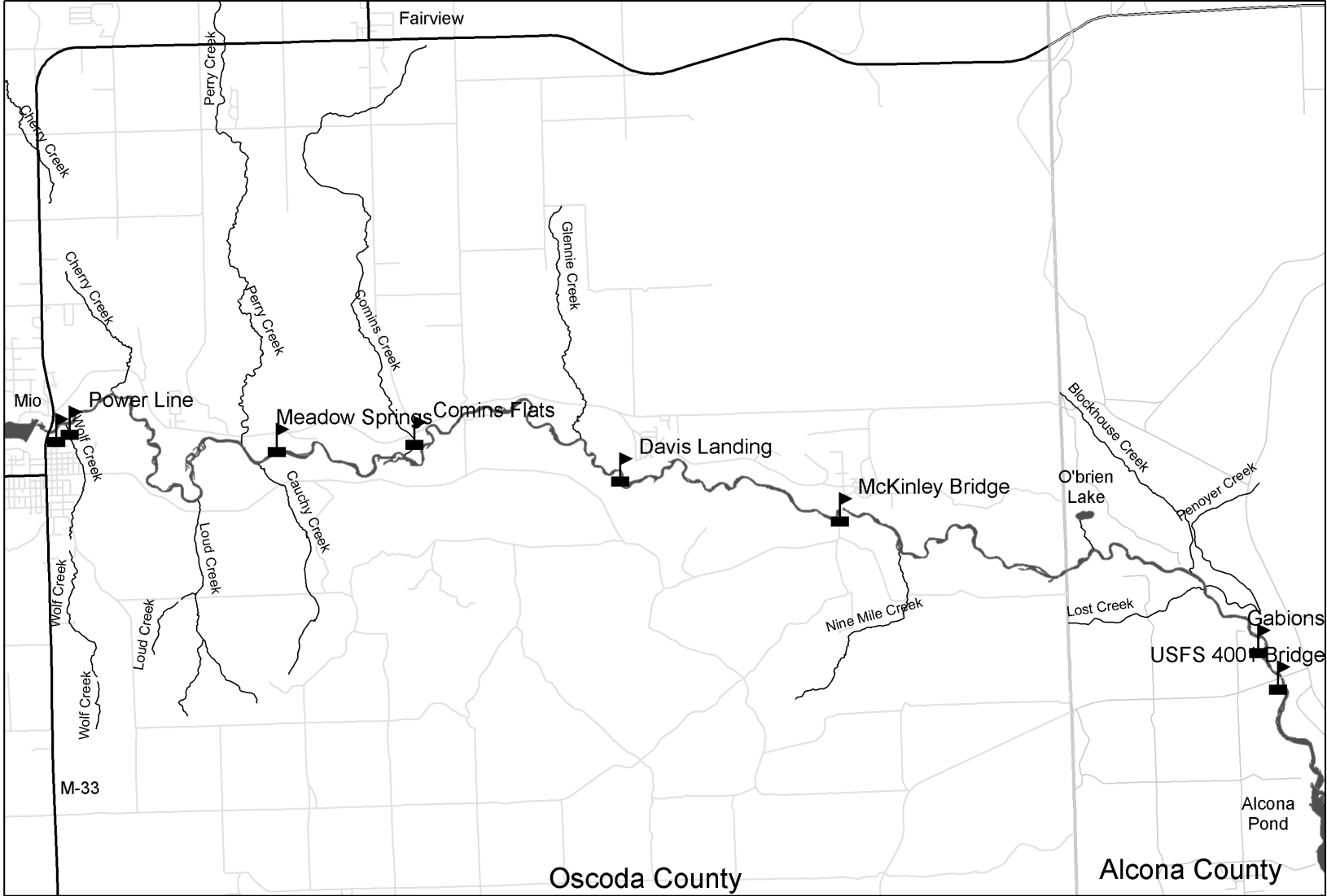
<sup>1</sup> Estimates of mean length at age are believed to be biased (low) due to aging error resulting from false annuli being laid down during stressfully warm water conditions. Mean lengths at age used in simulation modeling were estimated from examination of length frequency histograms of trout captured during electrofishing surveys.

Table 16. - Numbers of trees placed in the Mio Dam to McKinley section of the Au Sable River from 1998 to 2006.

<b>Year</b>	<b>Numbers of trees</b>	<b>Location</b>	<b>River miles</b>
1998	90	Mio Power line to Comins Flats	6.5
2002	214	Loud rest stop to Perry Creek	2.5
2003	256	Mio power line to Loud Rest Stop (156) and River islands near Scenic Overlook (100)	2.5
2005	195	Comins Flats to Davis Landing	2.5
2006	193	Davis Landing to McKinley	3.5
<b>Total</b>	<b>948</b>		<b>12.5*</b>

\*Numbers are not additive because some areas overlapped year to year.

Figure 1: Au Sable River  
Mio Dam to Alcona Pond





**Total brook and brown trout numbers per acre versus mean July water temperature in 125 Michigan streams. Data set includes stocked streams.**

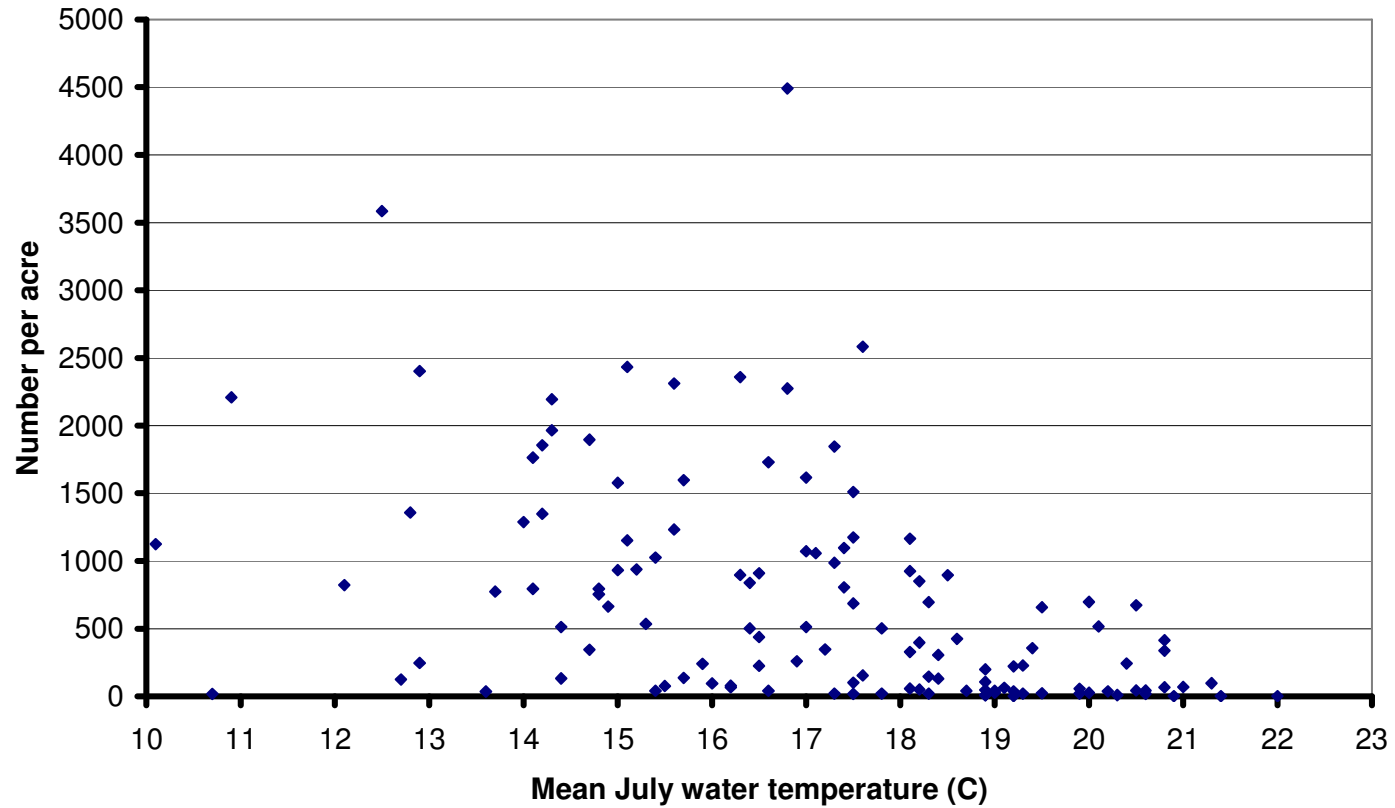


Figure 2. – Brook trout and brown trout density (numbers per acre) in 125 Michigan rivers. Data are from the Michigan Rivers Inventory (MRI) database. Sites where no trout were captured were omitted from the graphic.

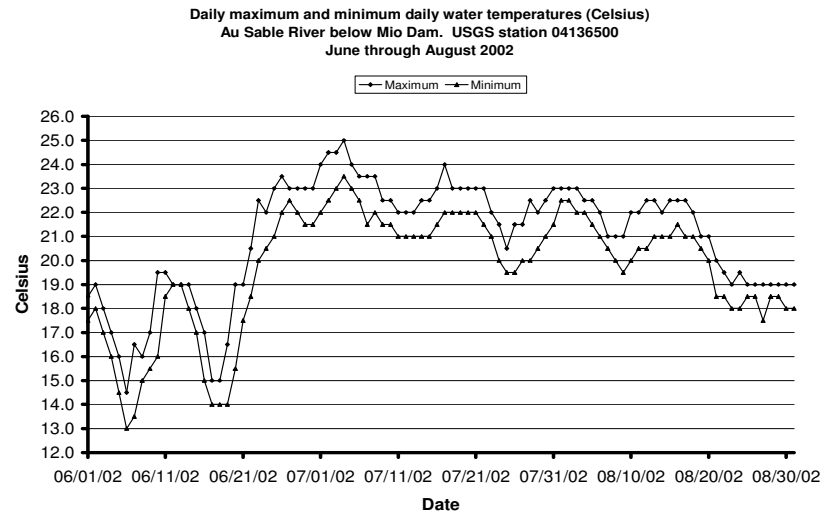
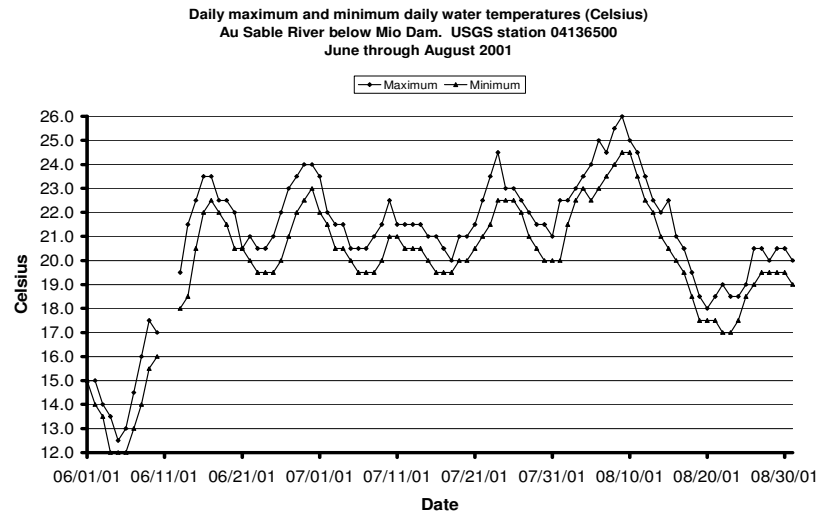
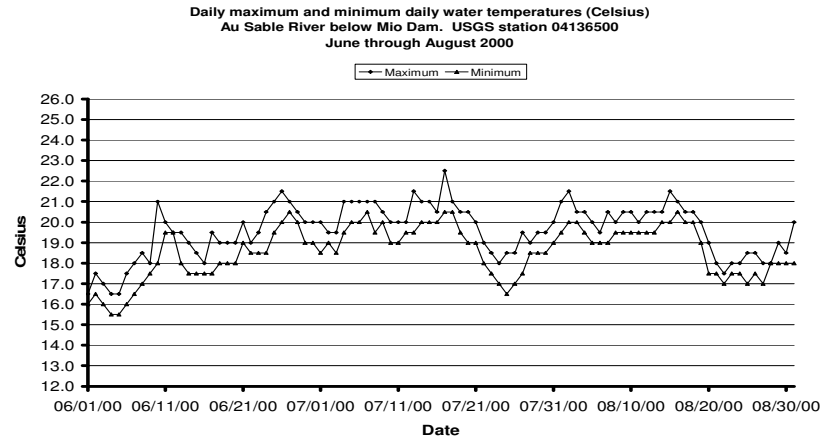
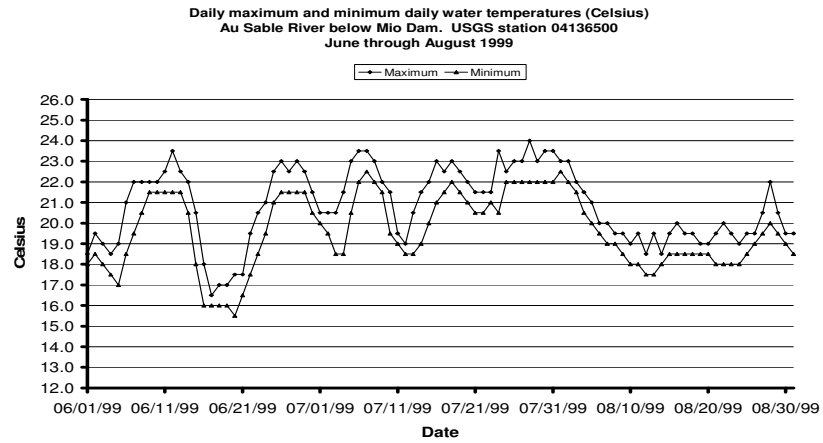


Figure 3. – Summer maximum and minimum daily water temperatures in the Au Sable River downstream of Mio dam 1999-2002. Data from USGS.

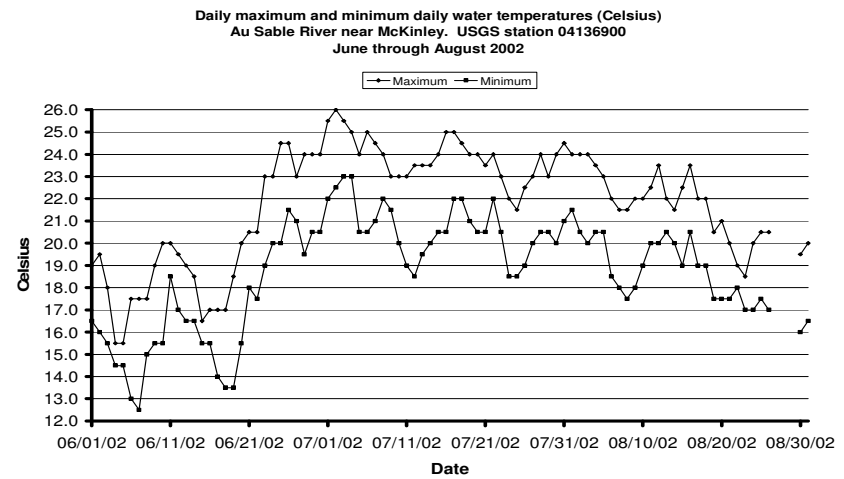
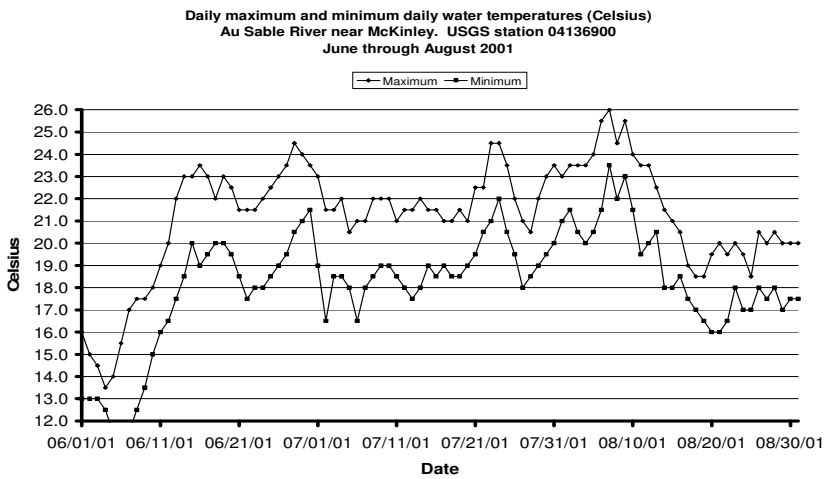
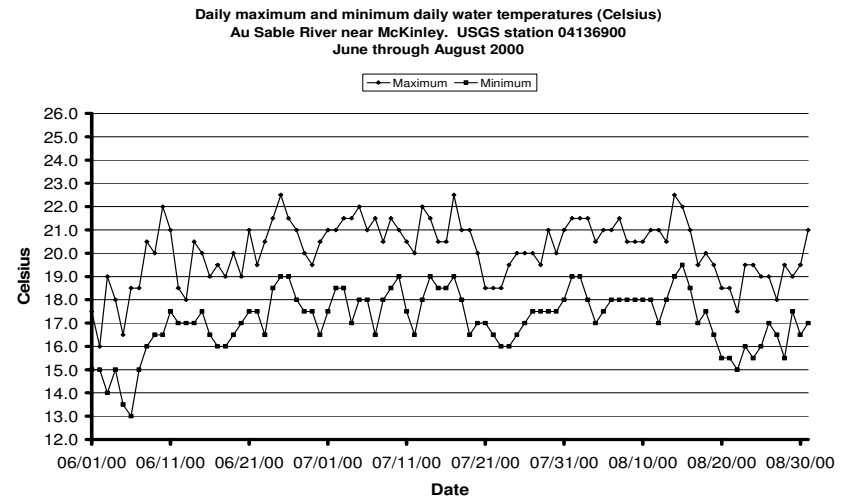
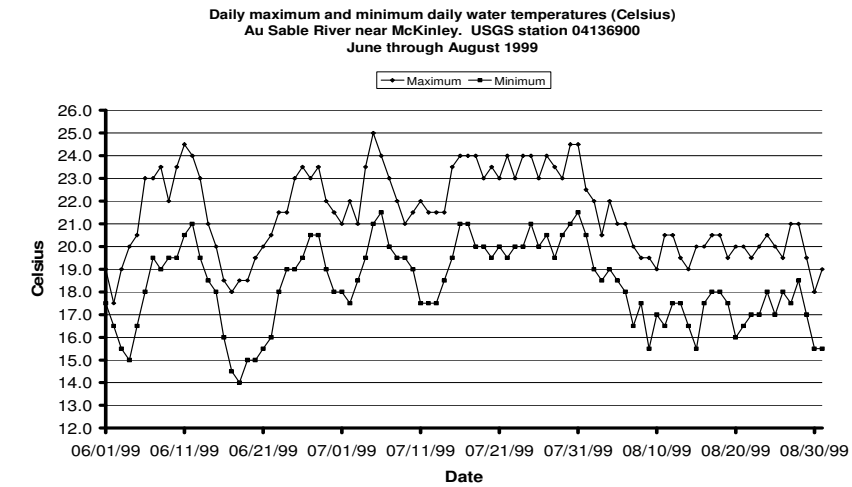


Figure 4. – Summer maximum and minimum daily water temperatures in the Au Sable River near McKinley Bridge 1999-2002. Data from USGS.

**November brown trout average population density by inch group for fish 8-inches or longer (5-year average of 1999-2002, + 2005) in a 4.75 mile reach of the Au Sable River between Mio dam and Meadow Springs**

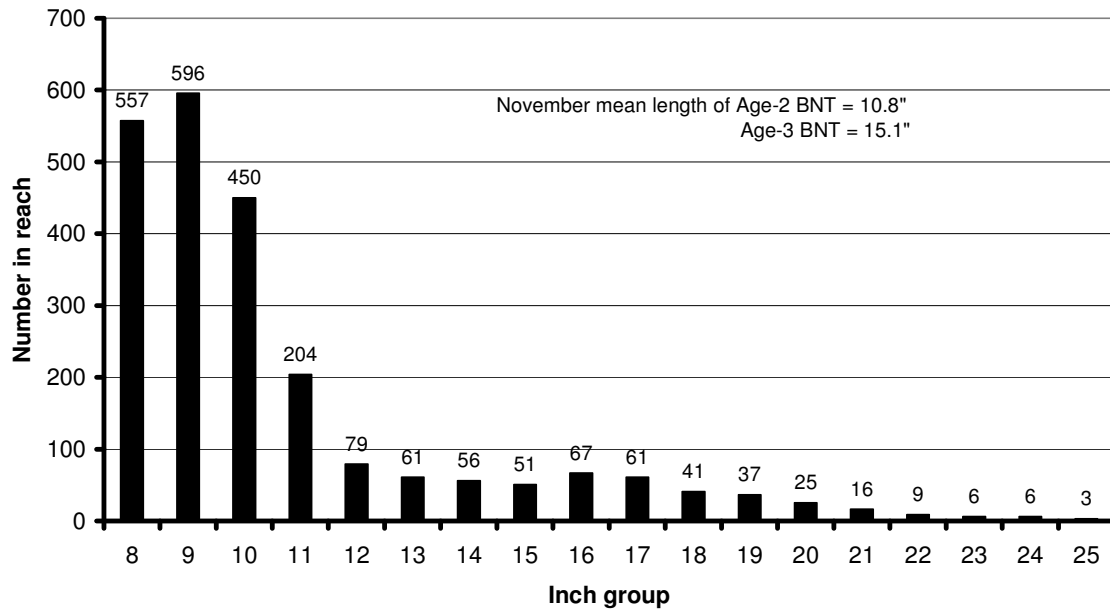
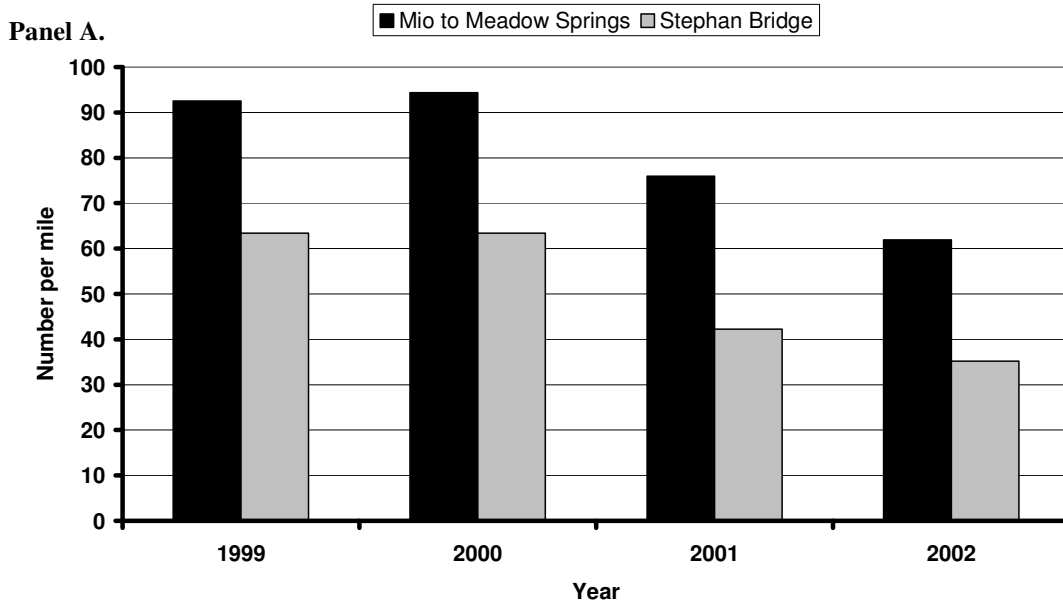


Figure 5. – November brown trout average population density by inch group for fish 8-inches or longer in a 4.75 mile reach of the Au Sable River between Mio Dam and Meadow Springs.

**Number of Brown Trout 15 inches or longer per mile:**  
 Au Sable River, Mio dam to Meadow Springs compared to Au Sable at Stephan Bridge:



**Number of Brown Trout 15 inches or longer per acre:**  
 Au Sable River, Mio dam to Meadow Springs compared to Au Sable at Stephan Bridge:

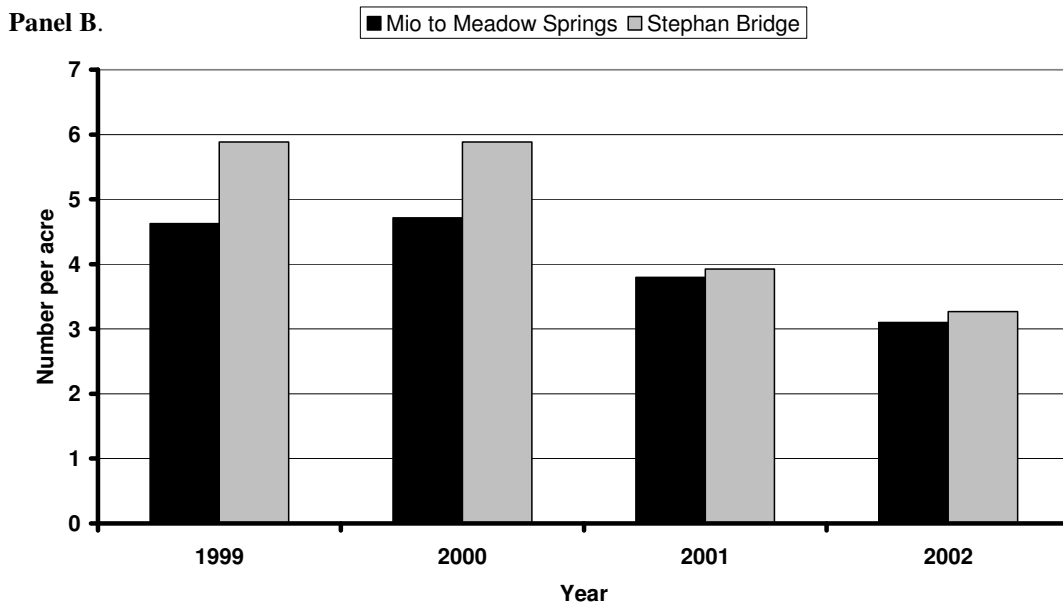


Figure 6. – Comparisons of brown trout density in the Au Sable River upstream and downstream of Mio Dam.

**November rainbow trout average population density by inch group for fish 8-inches or longer (5-year average of 1999-2002, + 2005) in a 4.75 mile reach of the Au Sable River between Mio dam and Meadow Springs**

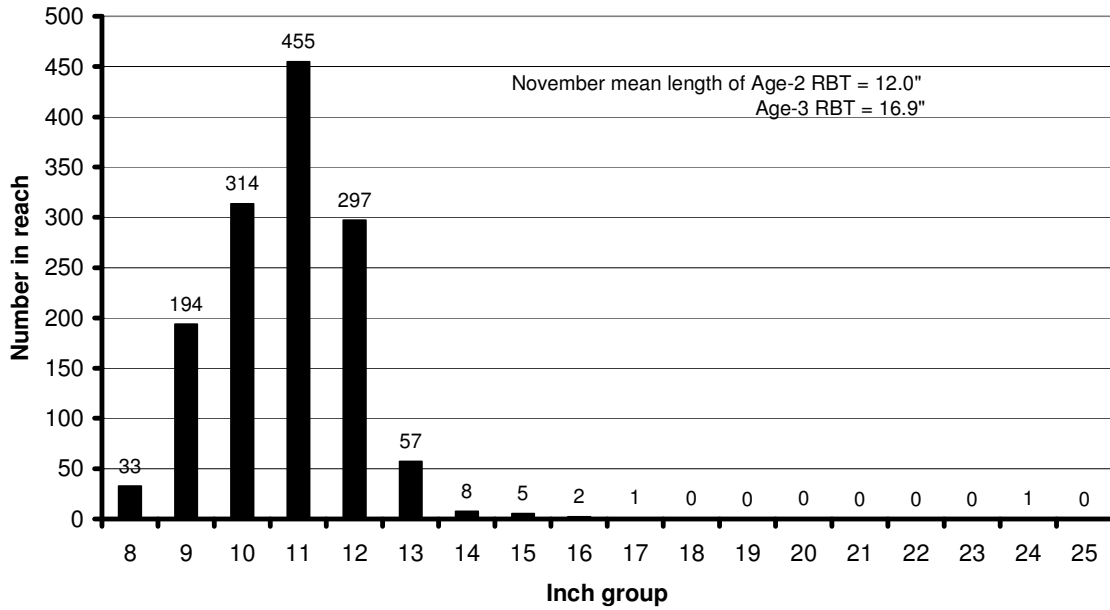


Figure 7. – November rainbow trout average population density by inch group for fish 8-inches or longer in a 4.75 mile reach of the Au Sable River between Mio Dam and Meadow Springs.

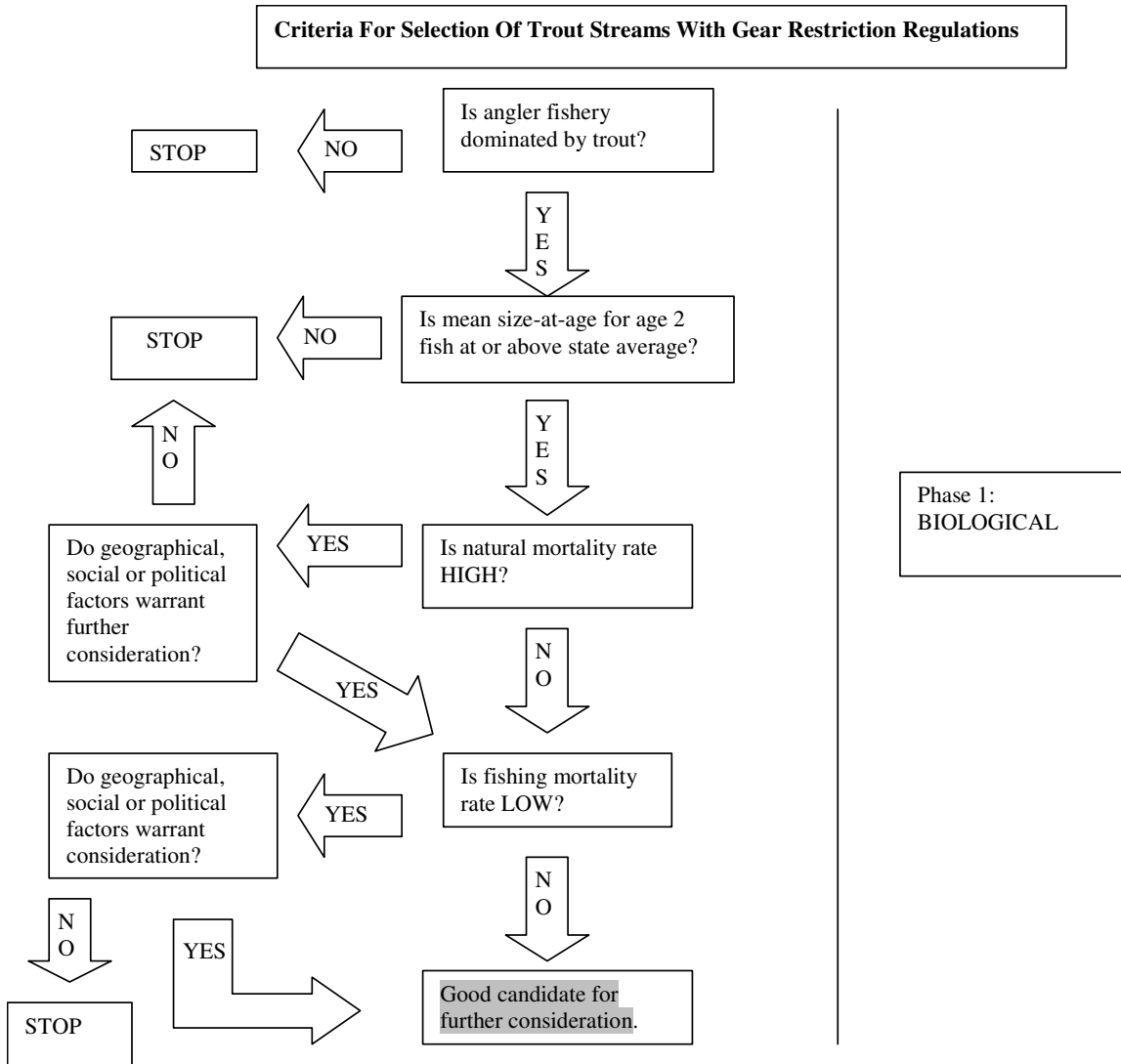


Figure 8. – Biological criteria for selection of trout streams with gear restriction regulations.

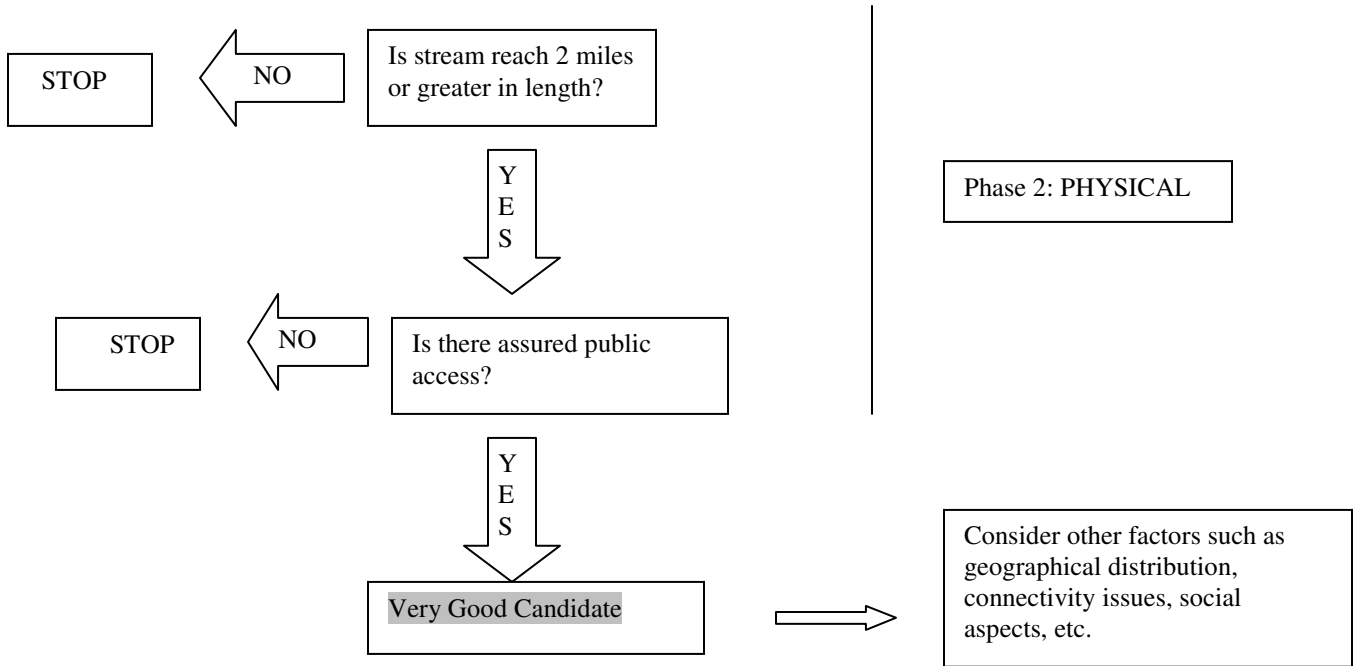


Figure 9. - Physical criteria for selection of trout streams with gear restriction regulations.



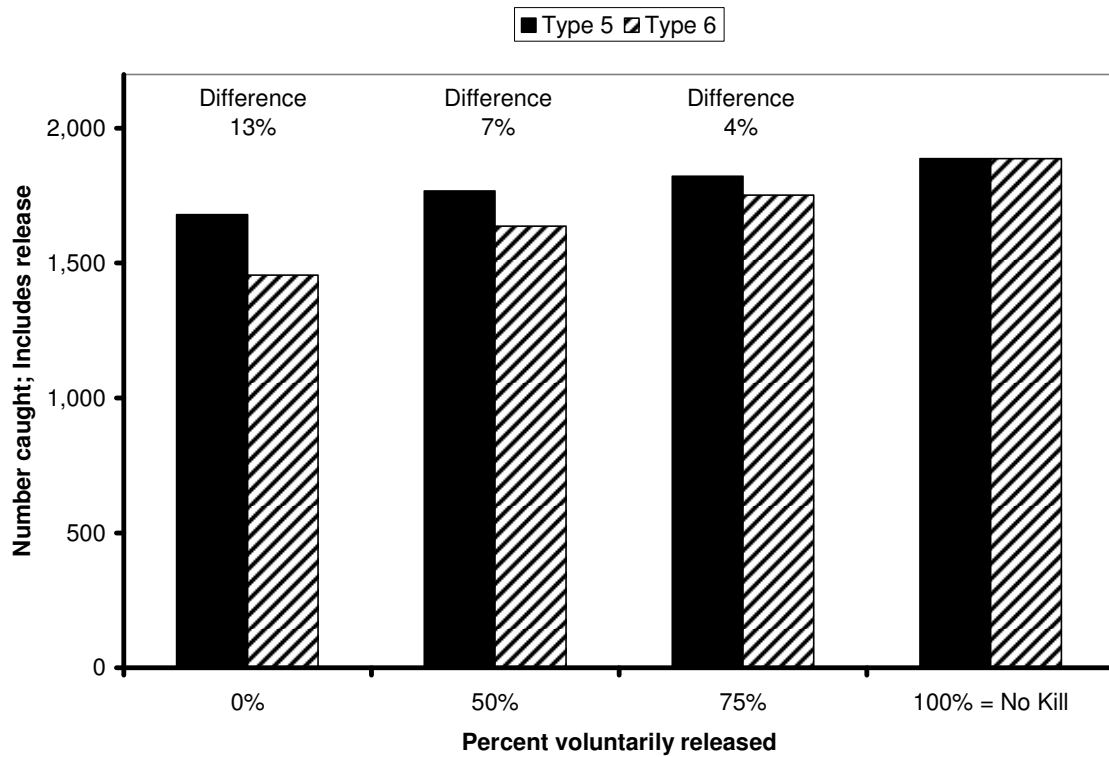


Figure 10.—Predicted angler catches of brown trout 12 inches or longer under Type 5, 6, or 7 regulations at different rates of voluntary release of legal-sized fish. Catches include both harvested and released fish. Release of all fish is equivalent to a Type 7 regulation.

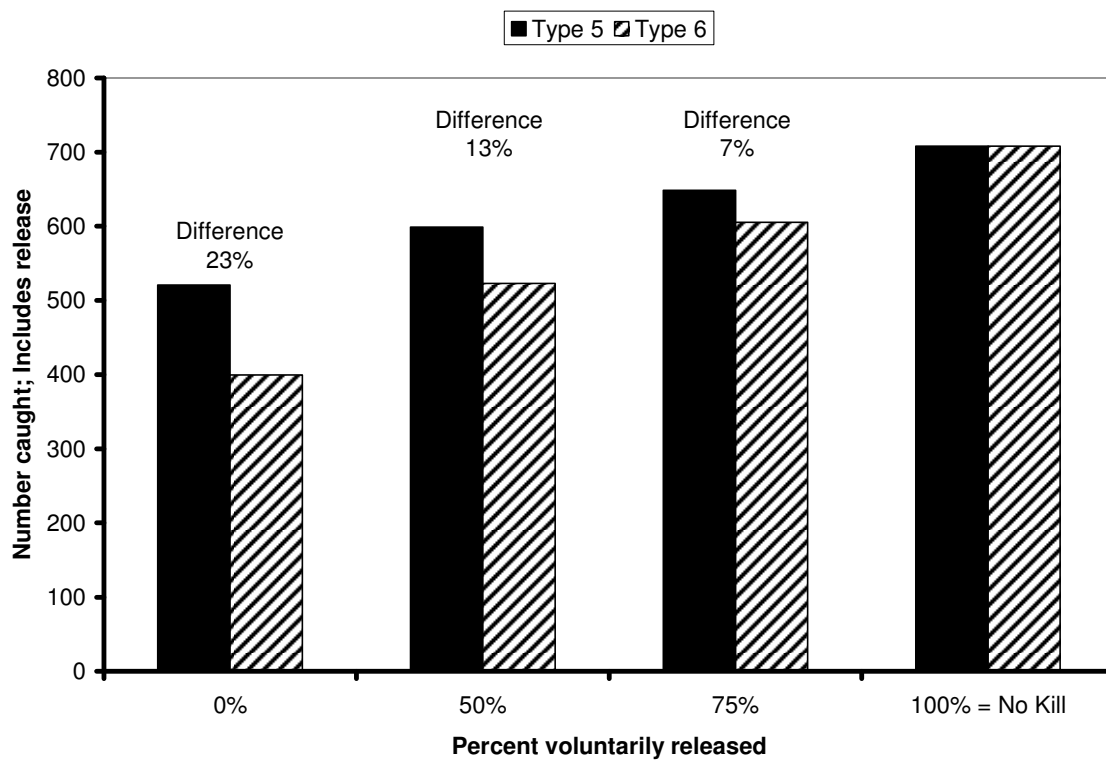


Figure 11.—Predicted angler catches of brown trout 15 inches or longer under Type 5, 6, or 7 regulations at different rates of voluntary release of legal-sized fish. Catches include both harvested and released fish. Release of all fish is equivalent to a Type 7 regulation.

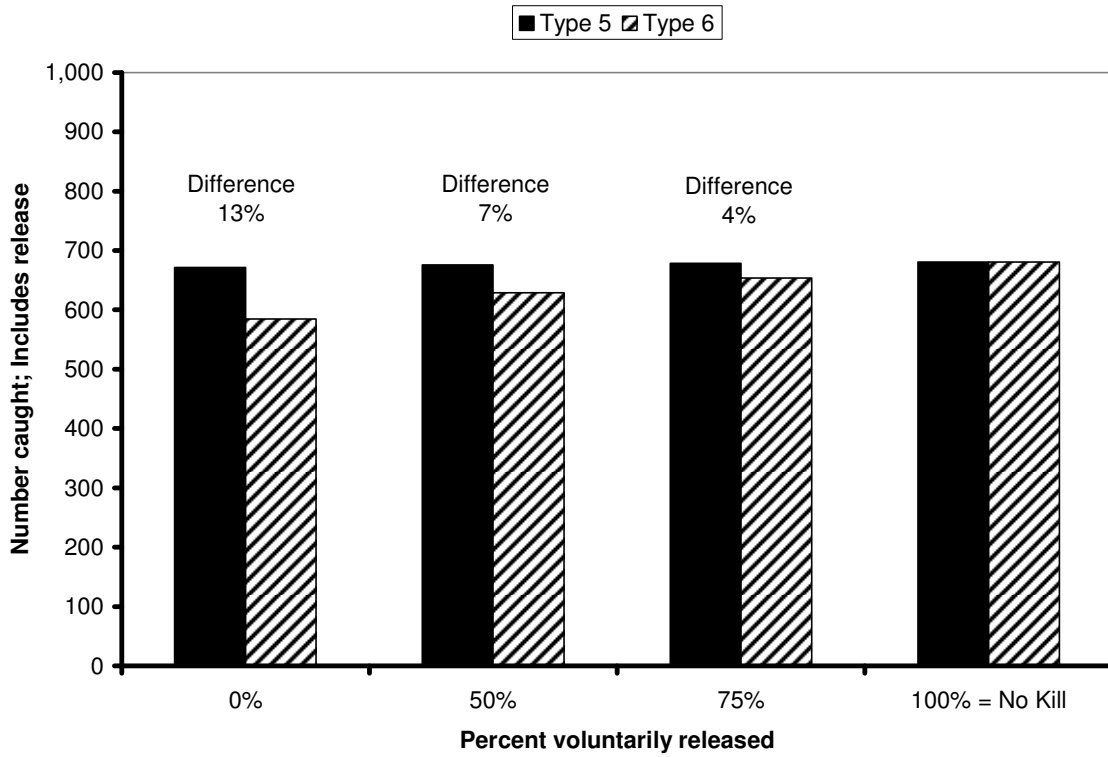
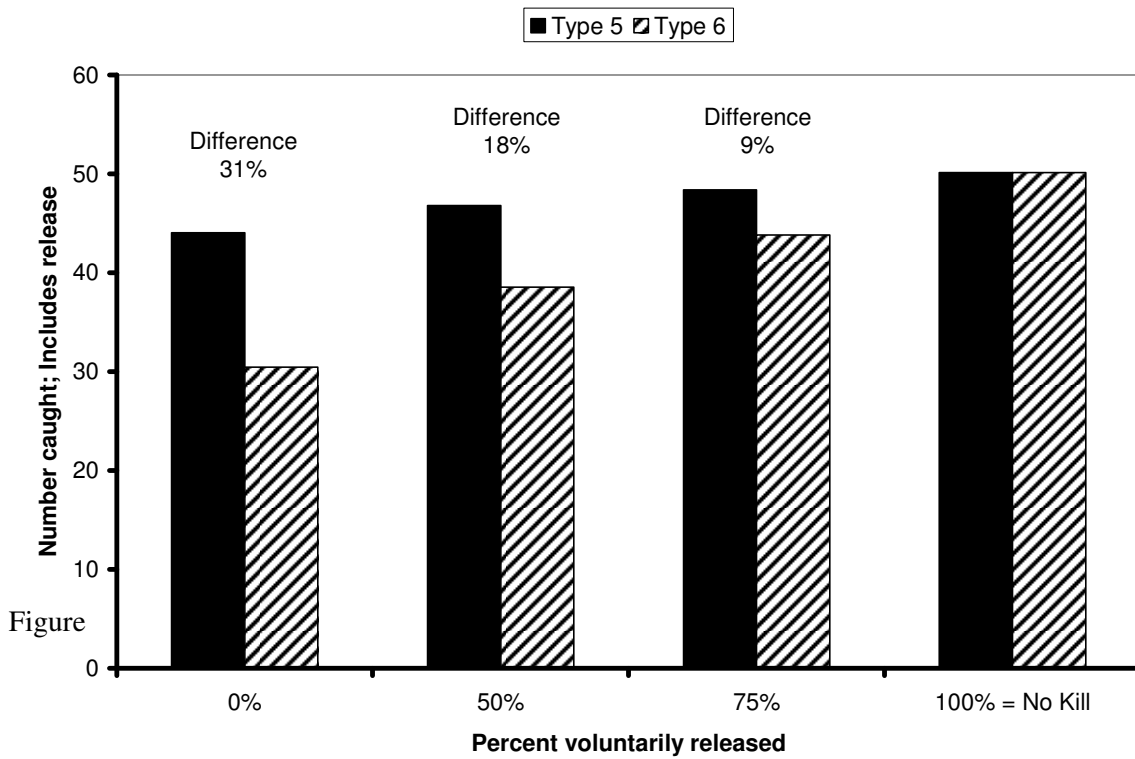


Figure 12.—Predicted angler catches of rainbow trout 12 inches or longer under Type 5, 6, or 7 regulations at different rates of voluntary release of legal-sized fish. Catches include both harvested and released fish. Release of all fish is equivalent to a Type 7 regulation.



13.—Predicted angler catches of rainbow trout 15 inches or longer under Type 5, 6, or 7 regulations at different rates of voluntary release of legal-sized fish. Catches include both harvested and released fish. Release of all fish is equivalent to a Type 7 regulation.

**Appendix 1. – Methods used to conduct the census.**

Survey Site—M-33 to 4001 Bridge, AuSable River. Survey sites are as follows:

<u>Description</u>	<u>Site number</u>
M-33 to Power Line	250A
Power Line to Comins Flats	250B
Comins Flats to McKinley Bridge	251
McKinley Bridge to 4001 Bridge	252

What is an angler survey—An angler survey consists of samples of angling effort and individual angling activity. Effort is sampled by making counts of units representing angling parties actively fishing in the chosen survey area. For this survey we will be counting fishing boats (canoes, etc.), non-fishing boats, and wading/tubing/shore anglers in the river. Individual angling activity is sampled by interviewing angling parties and recording information for individual trips. These interview data provide several important pieces of information: rate of catch by species, number of anglers in the fishing party and length of fishing trip. Only anglers are to be interviewed (boat, tubing, shore and wading). From the counts and interviews: angling hours, angling trips and catch by species are estimated over a chosen time period (a month for example). In general, angler survey estimates are based on samples of 2% to 10% of all anglers fishing at a selected survey area.

Many people are involved in running an angler survey. Duties of team members vary, but each member has essential responsibilities. The Au Sable River angler survey team includes a statistician (design, sampling schedule and calculation of final estimates), several fisheries biologists (design and supervision), three survey clerks (counting and interviewing), and a data processor.

Purpose of survey—Collect recreational use, angling effort, catch and harvest data from the riverine reaches of the AuSable River between Mio Dam and 4001 Bridge. Plans are being formed to implement recreational and fisheries improvement projects in this section of the AuSable River. These projects include improving tailrace and riverine access for anglers and other recreationists. They also include increased trout stocking for a period of three years and improving stream habitat with the addition of various wood and rock structures. This survey will also provide insight into the recreational use patterns for evaluation of potential impacts on sensitive species and habitats.

Personnel and equipment— Three employees, vehicle transportation, one canoe and any necessary equipment to collect data described below.

Appendix 1 (continued). – Methods used to conduct the census.

**Survey time period— April 29, 2000 through September 30, 2000. Sampling hours within a day for each month are:**

<u>Month</u>	<u>Sampling hours</u>
April	6:00 a.m. to 9:30 p.m.
May	6:00 a.m. to 9:30 p.m.
June 1-7	6:00 a.m. to 9:30 p.m.
June 8-30	2:30 p.m. to 12:00 midnight
July 1-15	2:30 p.m. to 12:00 midnight
July 16-31	6:00 a.m. to 10:00 p.m.
August 1-24	6:00 a.m. to 10:00 p.m.
August 25-31	2:30 p.m. to 12:00 midnight
September 1-7	2:30 p.m. to 12:00 midnight
September 8-30	6:00 a.m. to 9:30 p.m.

Survey clerks' duties—Working as a team, they will count and interview anglers at prescribed times in the previously listed sections. Two employees will canoe the river beginning at a scheduled time and location. While canoeing the employees will count and interview all anglers encountered. Canoeing clerks will enumerate shore/wading/tubing anglers (summed and reported as wading anglers); canoes and boats containing anglers (summed and reported as fishing boats); canoes containing non-fishing anglers; and float tubes with non-fishing persons. Canoeing clerks will also interview anglers while they are fishing; thus they will be incompleting trip interviews. Only anglers fishing a minimum of 0.5 hours will be interviewed. The third employee will serve as a spotter and will drop off and pick up the canoeing employees at scheduled sites and times. While waiting for the canoeing employee, the spotter will visit access sites along the river and interview any anglers present. These interviews may be completed trip interviews. However, regardless of interview type, the same information will be collected. Clerks will interview only anglers.

Clerks will collect all data following sampling schedule prepared by the Institute for Fisheries Research, Ann Arbor MI. Schedule will assign one of two eight-hour work shifts (early morning to early afternoon; or early afternoon to evening) for five days each week during sampling period. Each weekend day (Saturday and Sunday), each holiday and three randomly selected weekdays (two weekdays for weeks with holidays) will be sampled. The Institute will provide specific counting and interviewing techniques.

Appendix 1 (continued). – Methods used to conduct the census.

**Angler survey records—Each interview record will contain the following:**

- Interview source (drifter or spotter)
- Code (site) number of the site
- Date of interview
- Interview type: completed trip or incompleting trip
- Type of activity (shore, wading, or tubing anglers; boating or canoeing anglers)
- Number of people in the party
- Time to the nearest 5 minutes the party arrived at the site
- Time to the nearest 5 minutes the party departed the site (interview time)
- County of residence party lives in
- Specie(s) angler party was fishing for
- Bait type used by angler party (live, artificial, combination etc.)
- For each angler, species name and number caught and released
- For each angler, species name and number harvested

Species codes found on the interview form are as follows:

<u>Code</u>	<u>Name</u>	<u>Code</u>	<u>Name</u>
WAE	walleye	BNT	brown trout
NOP	northern pike	RBT	rainbow trout
RKB	rock bass	BKT	brook trout
YEP	yellow perch		
LMB	largemouth bass		
SMB	smallmouth bass		

Note on the interview form there are three additional “other” codes for additional species.

Counts of river sections will be done following the schedule prepared by the Institute for Fisheries Research. For each section counted the following information will be recorded:

- Code (site) number of the site
- Date of count
- Time the section of river was entered (nearest hour)
- Number of wading, shore, or float tube anglers counted (passed)
- Number of angling boats and canoes counted (passed)
- Number of non-fishing boats and canoes counted (specific section only)
- Number of non-fishing float tubes counted (specific section only)

Appendix 1 (continued). – Methods used to conduct the census.

**Non-fishing count sections**—Non-fishing boats and canoes, and non-fishing float tubes are counted within specific sections of the river. In the middle of a specified section, all visible non-fishing boats and canoes, and all visible non-fishing float tubes are counted. Thus, the clerks will look both downstream and back upstream to make this count. Specific locations by section are as follows (GPS – not corrected):

Section 250B

44°39.34 N

84°04.96 W

Located approximately 52 minutes below powerline.

Section 251

44°38.83 N

83°57.44 W

Located approximately 1 hour 26 minutes below Comins.

Section 252

44°37.80 N

83°51.60 W

Located approximately 55 minutes below McKinley Bridge.



**Appendix 2.—Angler census data for Au Sable River site 250a, M33 to Power Line, 1999-2000.**

Appendix 2a.—Total harvest, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Appendix 2b.—Boat angler harvest, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Appendix 2c.—Shore, wading, and tubing angler harvest, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Appendix 2d.—Total angler catch and release, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis

Appendix 2e.—Boat angler catch and release, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Appendix 2f.—Shore, wading, and tubing angler catch and release, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Appendix 2g.- Total estimated harvest, harvest rate and angling effort, Au Sable River site 250a (M33 to power line), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 2h.- Boat angler estimated harvest, harvest rate and angling effort, Au Sable River site 250a (M33 to power line), summer 2000. All estimates are given with 2 SE in parentheses.

Appendix 2i.- Shore and wading angler estimated harvest, harvest rate and angling effort, Au Sable River site 250a (M33 to power line), summer 2000. All estimates are given with 2 SE in parentheses.

Appendix 2j.- Total estimated catch and release, release rate and angling effort, Au Sable River site 250a (M33 to power line), summer 2000. All estimates are given with 2 SE in parentheses. “Other” species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 2k.- Boat angler estimated catch and release, release rate and angling effort, Au Sable River site 250a (M33 to power line), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 2L.- Shore angler estimated catch and release, release rate and angling effort, Au Sable River site 250a (M33 to power line), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 2a.—Total harvest, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0010 (0.0014)	0 (0)	0 (0)	0 (0)	4 (8)	4 (8)	8 (11)
Rock bass	0.0019 (0.0033)	0 (0)	5 (12)	0 (0)	0 (0)	10 (23)	15 (26)
Largemouth Bass	0.0010 (0.0024)	0 (0)	0 (0)	0 (0)	8 (19)	0 (0)	8 (19)
Brown trout	0.0182 (0.0155)	106 (107)	21 (30)	0 (0)	0 (0)	19 (43)	146 (119)
Rainbow trout	0.1128 (0.0744)	540 (518)	127 (84)	46 (97)	63 (79)	130 (128)	906 (554)
White sucker	0.0042 (0.0090)	34 (72)	0 (0)	0 (0)	0 (0)	0 (0)	34 (72)
Sunfish sp.	0.0026 (0.0041)	0 (0)	14 (29)	0 (0)	7 (15)	0 (0)	21 (33)
Redhorse sp.	0.0015 (0.0033)	0 (0)	0 (0)	0 (0)	12 (26)	0 (0)	12 (26)
Total harvest	0.1432 (0.0798)	680 (534)	167 (95)	46 (97)	94 (87)	163 (137)	1,150 (574)
Angler hours		4,380 (1,788)	1,367 (421)	1,022 (448)	733 (512)	531 (348)	8,033 (1,990)

Appendix 2b.—Boat angler harvest, fishing pressure and catch per hour, AuSable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Rainbow trout	0.1642 (0.2911)	289 (477)	0 (0)	0 (0)	0 (0)	0 (0)	289 (477)
Angler hours		1,356 (1,087)	220 (247)	150 (223)	34 (68)	0 (0)	1,760 (1,139)

Appendix 2c.—Shore, wading, and tubing angler harvest, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0013 (0.0018)	0 (0)	0 (0)	0 (0)	4 (8)	4 (8)	8 (11)
Rock bass	0.0024 (0.0042)	0 (0)	5 (12)	0 (0)	0 (0)	10 (23)	15 (26)
Largemouth Bass	0.0013 (0.0031)	0 (0)	0 (0)	0 (0)	8 (19)	0 (0)	8 (19)
Brown trout	0.0233 (0.0199)	106 (107)	21 (30)	0 (0)	0 (0)	19 (43)	146 (119)
Rainbow trout	0.0984 (0.0519)	251 (203)	127 (84)	46 (97)	63 (79)	130 (128)	617 (283)
White sucker	0.0054 (0.0115)	34 (72)	0 (0)	0 (0)	0 (0)	0 (0)	34 (72)
Sunfish sp.	0.0033 (0.0053)	0 (0)	14 (29)	0 (0)	7 (15)	0 (0)	21 (33)
Redhorse sp.	0.0019 (0.0041)	0 (0)	0 (0)	0 (0)	12 (26)	0 (0)	12 (26)
Total harvest	0.1373 (0.0622)	391 (240)	167 (94)	46 (97)	94 (86)	163 (137)	861 (319)
Angler hours		3,024 (1,420)	1,147 (341)	872 (389)	699 (507)	531 (348)	6,273 (1,632)
Angler trips		1,930 (1,032)	615 (246)	438 (219)	351 (268)	194 (149)	3,528 (1,126)

Appendix 2d.—Total angler catch and release, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0009 (0.0018)	0 (0)	6 (14)	0 (0)	0 (0)	1 (2)	7 (14)
Rock bass	0.0346 (0.0259)	61 (91)	62 (65)	0 (0)	22 (42)	133 (155)	278 (196)
Yellow perch	0.0010 (0.0021)	8 (17)	0 (0)	0 (0)	0 (0)	0 (0)	8 (17)
Largemouth Bass	0.0055 (0.0090)	31 (67)	0 (0)	0 (0)	13 (24)	0 (0)	44 (71)
Smallmouth Bass	0.0769 (0.0610)	41 (72)	128 (262)	0 (0)	297 (280)	152 (254)	618 (466)
Brown trout	0.5739 (0.6854)	4,455 (5,385)	78 (93)	0 (0)	0 (0)	77 (85)	4,610 (5,386)
Rainbow trout	0.4430 (0.2598)	2,661 (1,805)	597 (434)	186 (347)	13 (20)	102 (117)	3,559 (1,892)
Brook trout	0.0019 (0.0041)	0 (0)	15 (32)	0 (0)	0 (0)	0 (0)	15 (32)
Sunfish sp.	0.0034 (0.0056)	0 (0)	0 (0)	0 (0)	9 (20)	18 (39)	27 (44)
White sucker	0.0024 (0.0055)	0 (0)	0 (0)	0 (0)	0 (0)	19 (43)	19 (43)
Total catch	1.1434 (0.7677)	7,257 (5,681)	886 (521)	186 (347)	354 (286)	502 (336)	9,185 (5,732)
Angler hours		4,380 (1,788)	1,367 (421)	1,022 (448)	733 (512)	531 (348)	8,033 (1,990)

Appendix 2e.—Boat angler catch and release, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Brown trout	0.4318 (0.7458)	760 (1,217)	0 (0)	0 (0)	0 (0)	0 (0)	760 (1,217)
Rainbow trout	1.0040 (1.1698)	1,743 (1,711)	0 (0)	24 (60)	0 (0)	0 (0)	1,767 (1,712)
Total catch	1.4358 (1.5128)	2,503 (2,100)	0 (0)	24 (60)	0 (0)	0 (0)	2,527 (2,101)
Angler hours		1,356 (1,087)	220 (247)	150 (223)	34 (68)	0 (0)	1,760 (1,139)

Appendix 2f.—Shore, wading, and tubing angler catch and release, fishing pressure and catch per hour, Au Sable River site 250a, M33 to Power Line, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0011 (0.0022)	0 (0)	6 (14)	0 (0)	0 (0)	1 (2)	7 (14)
Rock bass	0.0443 (0.0333)	61 (91)	62 (65)	0 (0)	22 (42)	133 (155)	278 (196)
Yellow perch	0.0013 (0.0028)	8 (17)	0 (0)	0 (0)	0 (0)	0 (0)	8 (17)
Largemouth Bass	0.0070 (0.0114)	31 (67)	0 (0)	0 (0)	13 (24)	0 (0)	44 (71)
Smallmouth Bass	0.0985 (0.0786)	41 (72)	128 (262)	0 (0)	297 (280)	152 (254)	618 (466)
Brown trout	0.6137 (0.8516)	3,695 (5,246)	78 (93)	0 (0)	0 (0)	77 (85)	3,850 (5,248)
Rainbow trout	0.2857 (0.1486)	918 (576)	597 (434)	162 (342)	13 (20)	102 (117)	1,792 (807)
Brook trout	0.0024 (0.0052)	0 (0)	15 (32)	0 (0)	0 (0)	0 (0)	15 (32)
Sunfish sp.	0.0043 (0.0071)	0 (0)	0 (0)	0 (0)	9 (20)	18 (39)	27 (44)
White sucker	0.0030 (0.0068)	0 (0)	0 (0)	0 (0)	0 (0)	19 (43)	19 (43)
Total catch	1.0614 (0.8940)	4,754 (5,279)	886 (520)	162 (342)	354 (285)	502 (335)	6,658 (5,334)
Angler hours		3,024 (1,420)	1,147 (341)	872 (389)	699 (507)	531 (348)	6,273 (1,632)
Angler trips		1,930 (1,032)	615 (246)	438 (219)	351 (268)	194 (149)	3,528 (1,126)

Appendix 2g.- Total estimated harvest, harvest rate and angling effort, Au Sable River site 250a (M33 to power line), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Apr- Jun 7	Jun 8-Jul 15	Jul 16-Aug 24	Aug 25-Sep 7	Sep 8-30	Season
Walleye	0.0042 (0.0097)	0 (0)	0 (0)	20 (46)	0 (0)	0 (0)	20 (46)
Rock bass	0.0091 (0.0140)	0 (0)	17 (35)	0 (0)	26 (55)	0 (0)	43 (65)
Brown trout	0.0078 (0.0139)	37 (65)	0 (0)	0 (0)	0 (0)	0 (0)	37 (65)
Rainbow trout	0.0245 (0.0287)	36 (40)	4 (9)	0 (0)	76 (124)	0 (0)	116 (131)
Other	0.0082 (0.0189)	0 (0)	0 (0)	39 (89)	0 (0)	0 (0)	39 (89)
Total harvest	0.0538 (0.0432)	73 (76)	21 (36)	59 (100)	102 (136)	0 (0)	255 (189)
Angler hours		1,342 (909)	693 (333)	1,576 (970)	688 (348)	439 (404)	4,738 (1,471)

### **Appendix 3.—Angler census data: Au Sable River site 250b, Power Line to Comins Flats, 1999-2000**

Appendix 3a.—Total harvest, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Appendix 3b.—Total boat angler harvest, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Appendix 3c.—Total shore and wading angler harvest, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Appendix 3d.—Total angler catch and release, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Appendix 3e.—Total boat angler catch and release, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Appendix 3f.—Total shore and wading angler catch and release, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Appendix 3g.- Total estimated harvest, harvest rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses.

Appendix 3h.- Boat angler estimated harvest, harvest rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses.

Appendix 3i.- Shore and wading angler estimated harvest, harvest rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses.

Appendix 3j.- Total estimated catch and release, release rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 3k.- Boat angler estimated catch and release, release rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 3L.- Shore and wading angler estimated catch and release, release rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.



Appendix 3a.—Total harvest, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Brown trout	0.0074 (0.0146)	77 (151)	0 (0)	0 (0)	0 (0)	0 (0)	77 (151)
Rainbow trout	0.0171 (0.0124)	53 (51)	41 (40)	21 (29)	57 (103)	6 (10)	178 (126)
Total harvest	0.0245 (0.0193)	130 (159)	41 (40)	21 (29)	57 (103)	6 (10)	255 (196)
Angler hours		3,674 (1,073)	3,026 (863)	2,061 (829)	490 (255)	1,159 (510)	10,410 (1,705)
Angler trips		1,130 (425)	1,057 (370)	767 (355)	150 (101)	323 (187)	3,427 (699)

Appendix 3b.—Total boat angler harvest, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Rainbow trout	0.0118 (0.0103)	4 (9)	21 (29)	21 (29)	0 (0)	6 (10)	52 (43)
Angler hours		1,514 (877)	1,349 (541)	873 (633)	211 (141)	473 (290)	4,420 (1,252)
Angler trips		316 (191)	282 (124)	182 (136)	44 (30)	99 (63)	923 (274)

Appendix 3c.—Total shore and wading angler harvest, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Brown trout	0.0129 (0.0254)	77 (151)	0 (0)	0 (0)	0 (0)	0 (0)	77 (151)
Rainbow trout	0.0210 (0.0201)	49 (50)	20 (27)	0 (0)	57 (103)	0 (0)	126 (118)
Total harvest	0.0339 (0.0326)	126 (159)	20 (27)	0 (0)	57 (103)	0 (0)	203 (191)
Angler hours		2,160 (618)	1,677 (672)	1,188 (536)	279 (212)	686 (419)	5,990 (1,158)
Angler trips		814 (380)	775 (349)	585 (328)	106 (96)	224 (176)	2,504 (643)

Appendix 3d.—Total angler catch and release, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0011 (0.0017)	0 (0)	8 (16)	3 (7)	0 (0)	0 (0)	11 (17)
Northern pike	0.0011 (0.0026)	0 (0)	0 (0)	0 (0)	11 (26)	0 (0)	11 (26)
Rock bass	0.0026 (0.0051)	0 (0)	0 (0)	25 (53)	2 (5)	0 (0)	27 (53)
Yellow perch	0.0005 (0.0011)	0 (0)	5 (11)	0 (0)	0 (0)	0 (0)	5 (11)
Largemouth Bass	0.0011 (0.0026)	0 (0)	0 (0)	0 (0)	11 (26)	0 (0)	11 (26)
Smallmouth Bass	0.0092 (0.0092)	0 (0)	7 (11)	33 (33)	8 (15)	48 (87)	96 (95)
Brown trout	0.1740 (0.1128)	393 (228)	954 (1,086)	182 (140)	41 (33)	241 (197)	1,811 (1,136)
Rainbow trout	0.6439 (0.2278)	2,958 (1,302)	2,504 (1,548)	820 (524)	140 (116)	281 (202)	6,703 (2,102)
Brook trout	0.0328 (0.0316)	34 (33)	188 (267)	109 (179)	10 (23)	0 (0)	341 (324)
White sucker	0.0016 (0.0019)	0 (0)	5 (10)	7 (12)	5 (13)	0 (0)	17 (20)
Sunfish sp.	0.0007 (0.0014)	0 (0)	7 (14)	0 (0)	0 (0)	0 (0)	7 (14)
Total catch	0.8684 (0.2721)	3,385 (1,322)	3,678 (1,910)	1,179 (575)	228 (130)	570 (295)	9,040 (2,415)
Angler hours		3,674 (1,073)	3,026 (863)	2,061 (829)	490 (255)	1,159 (510)	10,410 (1,705)
Angler trips		1,130 (425)	1,057 (370)	767 (355)	150 (101)	323 (187)	3,427 (699)

Appendix 3e.—Total boat angler catch and release, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0018 (0.0036)	0 (0)	8 (16)	0 (0)	0 (0)	0 (0)	8 (16)
Rock bass	0.0005 (0.0013)	0 (0)	0 (0)	0 (0)	2 (5)	0 (0)	2 (5)
Smallmouth Bass	0.0088 (0.0085)	0 (0)	7 (11)	14 (23)	8 (15)	10 (21)	39 (36)
Brown trout	0.1206 (0.0647)	171 (163)	180 (125)	108 (115)	24 (21)	50 (55)	533 (243)
Rainbow trout	0.4837 (0.2811)	1,228 (996)	445 (233)	328 (350)	52 (42)	85 (78)	2,138 (1,085)
Brook trout	0.0249 (0.0396)	15 (19)	10 (13)	75 (169)	10 (23)	0 (0)	110 (172)
White sucker	0.0038 (0.0046)	0 (0)	5 (10)	7 (12)	5 (13)	0 (0)	17 (20)
Total catch	0.6441 (0.3132)	1,414 (1,009)	655 (266)	532 (406)	101 (56)	145 (98)	2,847 (1,125)
Angler hours		1,514 (877)	1,349 (541)	873 (633)	211 (141)	473 (290)	4,420 (1,252)
Angler trips		316 (191)	282 (124)	182 (136)	44 (30)	99 (63)	923 (274)

Appendix 3f.—Total shore and wading angler catch and release, fishing pressure and catch per hour, Au Sable River site 250b, Power Line to Comins Flats, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0005 (0.0012)	0 (0)	0 (0)	3 (7)	0 (0)	0 (0)	3 (7)
Northern pike	0.0018 (0.0043)	0 (0)	0 (0)	0 (0)	11 (26)	0 (0)	11 (26)
Rock bass	0.0042 (0.0089)	0 (0)	0 (0)	25 (53)	0 (0)	0 (0)	25 (53)
Yellow perch	0.0008 (0.0018)	0 (0)	5 (11)	0 (0)	0 (0)	0 (0)	5 (11)
Largemouth Bass	0.0018 (0.0043)	0 (0)	0 (0)	0 (0)	11 (26)	0 (0)	11 (26)
Smallmouth Bass	0.0095 (0.0146)	0 (0)	0 (0)	19 (23)	0 (0)	38 (84)	57 (87)
Brown trout	0.2134 (0.1899)	222 (160)	774 (1,079)	74 (80)	17 (26)	191 (189)	1,278 (1,110)
Rainbow trout	0.7621 (0.3348)	1,730 (839)	2,059 (1,530)	492 (390)	88 (108)	196 (186)	4,565 (1,801)
Brook trout	0.0386 (0.0466)	19 (27)	178 (267)	34 (59)	0 (0)	0 (0)	231 (275)
Sunfish sp.	0.0012 (0.0024)	0 (0)	7 (14)	0 (0)	0 (0)	0 (0)	7 (14)
Total catch	1.0339 (0.4088)	1,971 (855)	3,023 (1,891)	647 (407)	127 (117)	425 (278)	6,193 (2,136)
Angler hours		2,160 (618)	1,677 (672)	1,188 (536)	279 (212)	686 (419)	5,990 (1,158)
Angler trips		814 (380)	775 (349)	585 (328)	106 (96)	224 (176)	2,504 (643)

Appendix 3g.- Total estimated harvest, harvest rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses.

Species	Catch/hour	Jun 8-		Aug 25-Sep 7	Sep 8-		Season
		Apr-Jun7	Jul 15		Jul 16- Aug 24	Sep 30	
Walleye	0.0010 (0.0016)	0 (0)	24 (38)	0 (0)	0 (0)	0 (0)	24 (38)
Smallmouth bass	0.0056 (0.0065)	49 (60)	49 (94)	0 (0)	0 (0)	0 (0)	98 (112)
Brown trout	0.0460 (0.0573)	193 (170)	39 (56)	475 (970)	61 (126)	43 (92)	811 (999)
Rainbow trout	0.0072 (0.0070)	87 (114)	23 (32)	17 (28)	0 (0)	0 (0)	127 (122)
Brook trout	0.0040 (0.0058)	0 (0)	10 (17)	0 (0)	61 (101)	0 (0)	71 (102)
Total harvest	0.0642 (0.0589)	329 (213)	145 (121)	492 (970)	122 (161)	43 (92)	1,131 (1,017)
Angler hours		6,185 (1,653)	3,703 (1,246)	4,647 (2,164)	2,397 (1,163)	683 (363)	17,615 (3,233)
Angler trips		1,378 (805)	794 (324)	998 (877)	594 (395)	258 (159)	4,022 (1,305)

Appendix 3h.- Boat angler estimated harvest, harvest rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses.

Species	Catch/hour	Jun 8-		Jul 16- Aug 24	Aug 25-Sep 7	Sep 8-		Season
		Apr-Jun7	Jul 15			Sep 30		
Walleye	0.0031 (0.0050)	0 (0)	24 (38)	0 (0)	0 (0)	0 (0)	24 (38)	
Smallmouth bass	0.0094 (0.0133)	24 (39)	49 (94)	0 (0)	0 (0)	0 (0)	73 (102)	
Brown trout	0.0167 (0.0114)	104 (79)	14 (22)	8 (17)	4 (8)	0 (0)	130 (84)	
Rainbow trout	0.0070 (0.0067)	29 (38)	20 (31)	6 (14)	0 (0)	0 (0)	55 (51)	
Brook trout	0.0003 (0.0006)	0 (0)	2 (4)	0 (0)	0 (0)	0 (0)	2 (4)	
Total harvest	0.0364 (0.0205)	157 (96)	109 (108)	14 (22)	4 (8)	0 (0)	284 (146)	
Angler hours		3,137 (1,022)	1,621 (933)	2,024 (1,033)	778 (383)	245 (242)	7,805 (1,785)	
Angler trips		506 (182)	343 (216)	312 (165)	153 (100)	46 (51)	1,360 (346)	

Appendix 3i.- Shore and wading angler estimated harvest, harvest rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses.

Species	Catch/hour	Jun 8-				Sep 8-	Season
		Apr-Jun7	Jul 15	Jul 16- Aug 24	Aug 25-Sep 7	Sep 30	
Smallmouth bass	0.0025 (0.0047)	25 (46)	0 (0)	0 (0)	0 (0)	0 (0)	25 (46)
Brown trout	0.0694 (0.1032)	89 (151)	25 (51)	467 (970)	57 (126)	43 (92)	681 (995)
Rainbow trout	0.0073 (0.0113)	58 (107)	3 (6)	11 (24)	0 (0)	0 (0)	72 (110)
Brook trout	0.0070 (0.0105)	0 (0)	8 (17)	0 (0)	61 (101)	0 (0)	69 (102)
Total harvest	0.0863 (0.1053)	172 (191)	36 (54)	478 (970)	118 (161)	43 (92)	847 (1,007)
Angler hours		3,048 (1,299)	2,082 (826)	2,623 (1,902)	1,619 (1,098)	438 (270)	9,810 (2,696)
Angler trips		872 (784)	451 (242)	686 (861)	441 (382)	212 (151)	2,662 (1,258)



Appendix 3j.- Total estimated catch and release, release rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Jun 8-				Sep 8-	Season
		Apr-Jun7	Jul 15	Jul 16- Aug 24	Aug 25-Sep 7	Sep 30	
Walleye	0.0108 (0.0176)	0 (0)	11 (15)	176 (307)	3 (6)	0 (0)	190 (307)
Rock bass	0.0028 (0.0044)	3 (7)	7 (14)	36 (75)	3 (7)	0.0028 (0.0046)	49 (77)
Smallmouth bass	0.0071 (0.0090)	6 (13)	33 (31)	86 (152)	0 (0)	0 (0)	125 (156)
Brown trout	0.1879 (0.0741)	1,210 (633)	727 (321)	945 (879)	273 (201)	155 (140)	3,310 (1156)
Rainbow trout	0.3696 (0.1115)	2,891 (1,047)	1,995 (791)	985 (752)	473 (331)	166 (170)	6,510 (1,558)
Brook trout	0.0307 (0.0156)	70 (78)	153 (119)	188 (183)	70 (75)	60 (79)	541 (256)
Other	0.0307 (0.0266)	76 (119)	36 (36)	132 (227)	295 (378)	1 (3)	540 (458)
Total catch	0.6395 (0.1649)	4,256 (1,232)	2,962 (863)	2,548 (1,243)	1,117 (546)	382 (234)	11,265 (2,040)
Angler hours		6,185 (1,653)	3,703 (1,246)	4,647 (2,164)	2,397 (1,163)	683 (363)	17,615 (3,233)
Angler trips		1,378 (805)	794 (324)	998 (877)	594 (395)	258 (159)	4,022 (1,305)

Appendix 3k.- Boat angler estimated catch and release, release rate and angling effort, AuSable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Jun 8-				Sep 8-	Season
		Apr-Jun7	Jul 15	Jul 16- Aug 24	Aug 25-Sep 7	Sep 30	
Walleye	0.0050 (0.0088)	0 (0)	4 (6)	32 (67)	3 (6)	0 (0)	39 (68)
Rock bass	0.0008 (0.0013)	3 (7)	0 (0)	0 (0)	3 (7)	0 (0)	6 (10)
Smallmouth bass	0.0068 (0.0055)	6 (13)	33 (31)	14 (24)	0 (0)	0 (0)	53 (41)
Brown trout	0.1249 (0.0527)	393 (195)	212 (164)	261 (221)	70 (57)	39 (53)	975 (346)
Rainbow trout	0.2997 (0.1145)	1,341 (541)	572 (400)	262 (223)	120 (80)	44 (67)	2,339 (716)
Brook trout	0.0106 (0.0074)	11 (17)	24 (28)	36 (42)	7 (11)	5 (10)	83 (55)
Other	0.0138 (0.0089)	11 (17)	20 (23)	34 (42)	42 (41)	1 (3)	108 (65)
Total catch	0.4616 (0.1475)	1,765 (576)	865 (435)	639 (327)	245 (107)	89 (86)	3,603 (804)
Angler hours		3,137 (1,022)	1,621 (933)	2,024 (1,033)	778 (383)	245 (242)	7,805 (1,785)
Angler trips		506 (182)	343 (216)	312 (165)	153 (100)	46 (51)	1,360 (346)

Appendix 3L.- Shore and wading angler estimated catch and release, release rate and angling effort, Au Sable River site 250b (power line to Comins Flats), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Jun 8-		Jul 16- Aug 24	Aug 25-Sep 7	Sep 8-		Season
		Apr-Jun7	Jul 15			Sep 30		
Walleye	0.0154 (0.0309)	0 (0)	7 (14)	144 (300)	0 (0)	0 (0)	151 (300)	
Rock bass	0.0044 (0.0079)	0 (0)	7 (14)	36 (75)	0 (0)	0 (0)	43 (76)	
Smallmouth bass	0.0073 (0.0153)	0 (0)	0 (0)	72 (150)	0 (0)	0 (0)	72 (150)	
Brown trout	0.2380 (0.1301)	817 (602)	515 (276)	684 (851)	203 (193)	116 (130)	2,335 (1,103)	
Rainbow trout	0.4252 (0.1830)	1,550 (896)	1,423 (682)	723 (718)	353 (321)	122 (156)	4,171 (1,382)	
Brook trout	0.0467 (0.0285)	59 (76)	129 (116)	152 (178)	63 (74)	55 (78)	458 (250)	
Other	0.0440 (0.0478)	65 (118)	16 (28)	98 (223)	253 (376)	0 (0)	432 (454)	
Total catch	0.7810 (0.2874)	2,491 (1,089)	2,097 (746)	1,909 (1,200)	872 (536)	293 (218)	7,662 (1,875)	
Angler hours		3,048 (1,299)	2,082 (826)	2,623 (1,902)	1,619 (1,098)	438 (270)	9,810 (2,696)	
Angler trips		872 (784)	451 (242)	686 (861)	441 (382)	212 (151)	2,662 (1,258)	

**Appendix 4 .—Angler census data: Au Sable River site 251, Comins Flats to McKinley, 1999-2000**

Appendix 4a.—Total angler harvest, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Appendix 4b.—Total boat angler harvest, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Appendix 4c.—Total shore and wading angler harvest, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Appendix 4d.—Total angler catch and release, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Appendix 4e.—Total boat angler catch and release, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Appendix 4f.—Total shore and wading angler catch and release, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Appendix 4g.- Total estimated harvest, harvest rate and angling effort, Au Sable River site 251 (Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses.

Appendix 4h.- Boat angler estimated harvest, harvest rate and angling effort, Au Sable River site 251(Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses.

Appendix 4i.- Shore and wading angler estimated harvest, harvest rate and angling effort, Au Sable River site 251(Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses.

Appendix 4j.- Total estimated catch and release, release rate and angling effort, Au Sable River site 251(Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 4k.- Boat angler estimated catch and release, release rate and angling effort, Au Sable River site 251(Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 4L.- Shore and wading angler estimated catch and release, release rate and angling effort, Au Sable River site 251(Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 4a.—Total angler harvest, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0017 (0.0031)	0 (0)	0 (0)	12 (22)	0 (0)	0 (0)	12 (22)
Smallmouth Bass	0.0006 (0.0015)	0 (0)	0 (0)	4 (10)	0 (0)	0 (0)	4 (10)
Brown trout	0.0035 (0.0050)	20 (34)	3 (5)	0 (0)	1 (3)	0 (0)	24 (34)
Rainbow trout	0.0409 (0.0514)	185 (331)	5 (12)	89 (104)	2 (6)	0 (0)	281 (347)
Brook trout	0.0047 (0.0099)	32 (67)	0 (0)	0 (0)	0 (0)	0 (0)	32 (67)
Total harvest	0.0514 (0.0532)	237 (339)	8 (13)	105 (107)	3 (7)	0 (0)	353 (356)
Angler hours		3,005 (987)	1,529 (560)	1,553 (1,027)	383 (237)	395 (364)	6,865 (1,591)
Angler trips		894 (560)	417 (177)	387 (238)	103 (103)	86 (77)	1,887 (647)

Appendix 4b.—Total boat angler harvest, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0036 (0.0067)	0 (0)	0 (0)	12 (22)	0 (0)	0 (0)	12 (22)
Smallmouth Bass	0.0012 (0.0030)	0 (0)	0 (0)	4 (10)	0 (0)	0 (0)	4 (10)
Brown trout	0.0012 (0.0019)	0 (0)	3 (5)	0 (0)	1 (3)	0 (0)	4 (6)
Rainbow tr.	0.0249 (0.0314)	3 (6)	0 (0)	79 (101)	2 (6)	0 (0)	84 (101)
Total catch	0.0308 (0.0332)	3 (6)	3 (5)	95 (104)	3 (7)	0 (0)	104 (105)
Angler hours		1,288 (655)	676 (301)	1,085 (1,002)	113 (122)	210 (328)	3,372 (1,283)
Angler trips		316 (169)	108 (51)	218 (205)	19 (20)	39 (63)	700 (278)

Appendix 4c.—Total shore and wading angler harvest, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Brown trout	0.0057 (0.0098)	20 (34)	0 (0)	0 (0)	0 (0)	0 (0)	20 (34)
Rainbow trout	0.0564 (0.0963)	182 (331)	5 (12)	10 (23)	0 (0)	0 (0)	197 (332)
Brook trout	0.0092 (0.0194)	32 (67)	0 (0)	0 (0)	0 (0)	0 (0)	32 (67)
Total catch	0.0713 (0.0992)	234 (339)	5 (12)	10 (23)	0 (0)	0 (0)	249 (340)
Angler hours		1,717 (738)	853 (472)	468 (223)	270 (203)	185 (157)	3,493 (940)
Angler trips		578 (534)	309 (169)	169 (120)	84 (101)	47 (45)	1,187 (583)

Appendix 4d.—Total angler catch and release, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0102 (0.0113)	6 (12)	11 (14)	28 (49)	25 (55)	0 (0)	70 (76)
Northern pike	0.0004 (0.0007)	3 (5)	0 (0)	0 (0)	0 (0)	0 (0)	3 (5)
Yellow perch	0.0001 (0.0003)	0 (0)	0 (0)	1 (3)	0 (0)	0 (0)	1 (3)
Smallmouth Bass	0.0109 (0.0116)	0 (0)	39 (71)	12 (15)	18 (25)	6 (16)	75 (78)
Brown trout	0.0540 (0.0304)	179 (133)	57 (40)	55 (51)	0 (0)	80 (120)	371 (190)
Rainbow trout	0.6696 (0.2845)	2,574 (1,337)	1,147 (689)	575 (524)	60 (68)	241 (373)	4,597 (1,637)
Brook trout	0.0071 (0.0097)	0 (0)	7 (8)	34 (63)	8 (18)	0 (0)	49 (66)
Chub sp.	0.0185 (0.0173)	0 (0)	0 (0)	78 (91)	47 (70)	2 (6)	127 (115)
White sucker	0.0034 (0.0045)	0 (0)	0 (0)	15 (24)	8 (18)	0 (0)	23 (30)
Tiger musky	0.0010 (0.0024)	0 (0)	0 (0)	0 (0)	7 (17)	0 (0)	7 (17)
Total catch	0.7754 (0.3010)	2,762 (1,344)	1,261 (694)	798 (541)	173 (119)	329 (392)	5,323 (1,658)
Angler hours		3,005 (987)	1,529 (560)	1,553 (1,027)	383 (237)	395 (364)	6,865 (1,591)
Angler trips		894 (560)	417 (177)	387 (238)	103 (103)	86 (77)	1,887 (647)

Appendix 4e.—Total boat angler catch and release, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0133 (0.0162)	6 (12)	11 (14)	28 (49)	0 (0)	0 (0)	45 (52)
Northern pike	0.0009 (0.0015)	3 (5)	0 (0)	0 (0)	0 (0)	0 (0)	3 (5)
Yellow perch	0.0003 (0.0009)	0 (0)	0 (0)	1 (3)	0 (0)	0 (0)	1 (3)
Smallmouth Bass	0.0199 (0.0238)	0 (0)	39 (71)	12 (15)	10 (17)	6 (16)	67 (76)
Brown trout	0.0460 (0.0426)	42 (44)	37 (31)	29 (40)	0 (0)	47 (112)	155 (131)
Rainbow trout	0.4887 (0.2924)	616 (371)	374 (229)	473 (516)	17 (28)	168 (349)	1,648 (761)
Brook trout	0.0047 (0.0064)	0 (0)	4 (6)	4 (9)	8 (18)	0 (0)	16 (21)
Chub sp.	0.0202 (0.0255)	0 (0)	0 (0)	48 (73)	20 (37)	0 (0)	68 (82)
White sucker	0.0044 (0.0072)	0 (0)	0 (0)	15 (24)	0 (0)	0 (0)	15 (24)
Tiger musky	0.0021 (0.0052)	0 (0)	0 (0)	0 (0)	7 (17)	0 (0)	7 (17)
Total catch	0.6005 (0.3258)	667 (374)	465 (242)	610 (526)	62 (55)	221 (367)	2,025 (783)
Angler hours		1,288 (655)	676 (301)	1,085 (1,002)	113 (122)	210 (328)	3,372 (1,283)
Angler trips		316 (169)	108 (51)	218 (205)	19 (20)	39 (63)	700 (278)



Appendix 4f.—Total shore and wading angler catch and release, fishing pressure and catch per hour, Au Sable River site 251, Comins Flats to McKinley, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0072 (0.0160)	0 (0)	0 (0)	0 (0)	25 (55)	0 (0)	25 (55)
Smallmouth Bass	0.0023 (0.0052)	0 (0)	0 (0)	0 (0)	8 (18)	0 (0)	8 (18)
Brown trout	0.0618 (0.0428)	137 (125)	20 (25)	26 (31)	0 (0)	33 (43)	216 (138)
Rainbow trout	0.8443 (0.4730)	1,958 (1,284)	773 (650)	102 (92)	43 (62)	73 (132)	2,949 (1,449)
Brook trout	0.0094 (0.0178)	0 (0)	3 (6)	30 (62)	0 (0)	0 (0)	33 (62)
Chub sp.	0.0169 (0.0236)	0 (0)	0 (0)	30 (54)	27 (60)	2 (6)	59 (81)
White sucker	0.0023 (0.0052)	0 (0)	0 (0)	0 (0)	8 (18)	0 (0)	8 (18)
Total catch	0.9442 (0.4894)	2,095 (1,290)	796 (651)	188 (127)	111 (105)	108 (139)	3,298 (1,461)
Angler hours		1,717 (738)	853 (472)	468 (223)	270 (203)	185 (157)	3,493 (940)
Angler trips		578 (534)	309 (169)	169 (120)	84 (101)	47 (45)	1,187 (583)

Appendix 4g.- Total estimated harvest, harvest rate and angling effort, Au Sable River site 251 (Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses.

Species	Catch/hour	Apr-Jun7	Jun 8-Jul 15	Jul 16- Aug 24	Aug 25-Sep 7	Sep 8-Sep 30	Season
Walleye	0.0051 (0.0069)	3 (6)	9 (17)	22 (41)	0 (0)	0 (0)	34 (45)
Brown trout	0.0056 (0.0094)	6 (10)	24 (49)	0 (0)	0 (0)	0 (0)	30 (50)
Rainbow trout	0.0035 (0.0043)	9 (15)	9 (17)	0 (0)	1 (4)	0 (0)	19 (23)
Total catch	0.0154 (0.0137)	18 (19)	42 (55)	22 (41)	1 (4)	0 (0)	83 (71)
Angler hours		2,007 (1,029)	1,363 (429)	1,271 (540)	235 (207)	527 (330)	5,403 (1,299)
Angler trips		448 (262)	299 (135)	278 (133)	52 (54)	109 (82)	1,186 (338)

Appendix 4h.- Boat angler estimated harvest, harvest rate and angling effort, Au Sable River site 251(Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses.

Species	Catch/hour	Apr- Jun7	Jun 8-Jul 15	Jul 16- Aug 24	Aug 25- Sep 7	Sep 8- Sep 30	Season
Walleye	0.0133 (0.0183)	3 (6)	9 (17)	22 (41)	0 (0)	0 (0)	34 (45)
Brown trout	0.0024 (0.0041)	6 (10)	0 (0)	0 (0)	0 (0)	0 (0)	6 (10)
Rainbow trout	0.0071 (0.0094)	9 (15)	9 (17)	0 (0)	0 (0)	0 (0)	18 (23)
Total catch	0.0228 (0.0217)	18 (19)	18 (24)	22 (41)	0 (0)	0 (0)	58 (51)
Angler hours		935 (690)	480 (258)	776 (501)	89 (97)	268 (241)	1,415 (737)
Angler trips		180 (136)	79 (44)	155 (107)	16 (19)	45 (44)	475 (185)

Appendix 4i.- Shore and wading angler estimated harvest, harvest rate and angling effort, Au Sable River site 251(Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses.

Species	Catch/hour	Apr- Jun7	Jun 8-Jul 15	Jul 16- Aug 24	Aug 25- Sep 7	Sep 8- Sep 30	Season
Brown trout	0.0084 (0.0174)	0 (0)	24 (49)	0 (0)	0 (0)	0 (0)	24 (49)
Rainbow trout	0.0004 (0.0016)	0 (0)	0 (0)	0 (0)	1 (4)	0 (0)	1 (4)
Total catch	0.0088 (0.0175)	0 (0)	24 (49)	0 (0)	1 (4)	0 (0)	25 (49)
Angler hours		1,072 (764)	883 (343)	495 (201)	146 (183)	259 (225)	2,855 (909)
Angler trips		268 (224)	220 (128)	123 (79)	36 (51)	64 (69)	711 (283)

Appendix 4j.- Total estimated catch and release, release rate and angling effort, Au Sable River site 251(Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Apr-Jun7	Jun 8-Jul 15	Jul 16- Aug 24	Aug 25-Sep 7	Sep 8-Sep 30	Season
Walleye	0.0053 (0.0098)	0 (0)	8 (17)	0 (0)	0 (0)	27 (62)	35 (64)
Smallmouth bass	0.0021 (0.0033)	0 (0)	14 (22)	0 (0)	0 (0)	0 (0)	14 (22)
Brown trout	0.0925 (0.0589)	41 (42)	160 (183)	86 (82)	110 (173)	103 (124)	500 (295)
Rainbow trout	0.3522 (0.1743)	782 (561)	493 (314)	330 (428)	132 (185)	166 (214)	1,903 (823)
Brook trout	0.0167 (0.0147)	18 (28)	1 (3)	42 (58)	3 (6)	26 (39)	90 (76)
Other	0.0411 (0.0635)	6 (10)	193 (337)	21 (30)	2 (5)	0 (0)	222 (339)
Total catch	0.5116 (0.2134)	847 (563)	869 (496)	479 (441)	247 (253)	322 (258)	2,764 (942)
Angler hours		2,007 (1,029)	1,363 (429)	1,271 (540)	235 (207)	527 (330)	5,403 (1,299)
Angler trips		448 (262)	299 (135)	278 (133)	52 (54)	109 (82)	1,186 (338)

Appendix 4k.- Boat angler estimated catch and release, release rate and angling effort, Au Sable River site 251(Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Apr- Jun7	Jun 8-Jul 15	Jul 16- Aug 24	Aug 25- Sep 7	Sep 8- Sep 30	Season
Walleye	0.0137 (0.0255)	0 (0)	8 (17)	0 (0)	0 (0)	27 (62)	35 (64)
Smallmouth bass	0.0055 (0.0089)	0 (0)	14 (22)	0 (0)	0 (0)	0 (0)	14 (22)
Brown trout	0.0530 (0.0382)	12 (14)	41 (36)	37 (49)	1 (3)	44 (56)	135 (84)
Rainbow trout	0.2602 (0.2144)	205 (195)	79 (53)	275 (423)	12 (29)	92 (141)	663 (490)
Brook trout	0.0063 (0.0074)	0 (0)	1 (3)	2 (6)	3 (6)	10 (16)	16 (18)
Other	0.0098 (0.0101)	3 (6)	12 (18)	8 (14)	2 (5)	0 (0)	25 (24)
Total catch	0.3485 (0.2347)	220 (196)	155 (72)	322 (426)	18 (30)	173 (165)	888 (503)
Angler hours		935 (690)	480 (258)	776 (501)	89 (97)	268 (241)	2,548 (928)
Angler trips		180 (136)	79 (44)	155 (107)	16 (19)	45 (44)	475 (185)

Appendix 4L.- Shore and wading angler estimated catch and release, release rate and angling effort, Au Sable River site 251(Comins Flats to McKinley), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Apr- Jun7	Jun 8-Jul 15	Jul 16- Aug 24	Aug 25- Sep 7	Sep 8- Sep 30	Season
Brown trout	0.1278 (0.1071)	29 (40)	119 (179)	49 (66)	109 (173)	59 (111)	365 (283)
Rainbow trout	0.4343 (0.2694)	577 (526)	414 (309)	55 (63)	120 (183)	74 (161)	1,240 (660)
Brook trout	0.0259 (0.0272)	18 (28)	0 (0)	40 (58)	0 (0)	16 (36)	74 (74)
Other	0.0690 (0.1204)	3 (8)	181 (337)	13 (27)	0 (0)	0 (0)	197 (338)
Total catch	0.6624 (0.3809)	1,024 (890)	990 (717)	200 (143)	295 (328)	209 (282)	2,718 (1,230)
Angler hours		1,744 (1,264)	1,175 (527)	633 (274)	188 (239)	363 (335)	4,103 (1,456)
Angler trips		268 (224)	220 (128)	123 (79)	36 (51)	64 (69)	711 (283)

**Appendix 5 .—Angler census data: Au Sable River site 252, McKinley to 4001 Bridge, 1999-2000**

Appendix 5a.—Total angler harvest, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Appendix 5b.—Total boat angler harvest, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Appendix 5c.—Total shore and wading angler harvest, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Appendix 5d.—Total angler catch and release, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Appendix 5e.—Total boat angler catch and release, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Appendix 5f.—Total shore and wading angler catch and release, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Appendix 5g.- Total estimated harvest, harvest rate and angling effort, Au Sable River site 252 (McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 5h.- Boat angler estimated harvest, harvest rate and angling effort, Au Sable River site 252(McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 5i.- Shore and wading angler estimated harvest, harvest rate and angling effort, Au Sable River site 252(McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses.

Appendix 5j.- Total estimated catch and release, release rate and angling effort, Au Sable River site 252(McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 5k.- Boat angler estimated catch and release, release rate and angling effort, Au Sable River site 252(McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Appendix 5L.- Shore and wading angler estimated catch and release, release rate and angling effort, Au Sable River site 252(McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.



Appendix 5a.—Total angler harvest, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0030 (0.0040)	0 (0)	14 (21)	2 (3)	0 (0)	0 (0)	16 (21)
Rock bass	0.0076 (0.0155)	40 (81)	0 (0)	0 (0)	0 (0)	0 (0)	40 (81)
Largemouth Bass	0.0013 (0.0030)	0 (0)	7 (16)	0 (0)	0 (0)	0 (0)	7 (16)
Smallmouth Bass	0.0002 (0.0004)	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)	1 (2)
Brown trout	0.0409 (0.0353)	170 (169)	3 (7)	10 (21)	1 (2)	32 (62)	216 (181)
Rainbow trout	0.1958 (0.0885)	857 (396)	78 (55)	78 (102)	0 (0)	22 (46)	1,035 (415)
Brook trout	0.0019 (0.0029)	3 (1)	7 (15)	0 (0)	0 (0)	0 (0)	10 (15)
White sucker	0.0144 (0.0207)	46 (94)	7 (16)	23 (50)	0 (0)	0 (0)	76 (108)
Bowfin	0.0002 (0.0004)	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)	1 (2)
Total harvest	0.2652 (0.1054)	1,116 (448)	116 (65)	113 (116)	3 (3)	54 (77)	1,402 (474)
Angler hours		2,922 (709)	799 (341)	1,109 (713)	207 (224)	250 (205)	5,287 (1,104)
Angler trips		1,094 (624)	343 (173)	423 (283)	48 (71)	139 (146)	2,047 (725)

Appendix 5b.—Total boat angler harvest, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul 16- Aug24	Aug25-Sep7	Sep8-30	Season
Brown trout	0.0366 (0.0380)	40 (47)	3 (7)	10 (21)	0 (0)	31 (62)	84 (81)
Rainbow trout	0.1645 (0.1108)	239 (172)	41 (42)	76 (102)	0 (0)	21 (46)	377 (209)
Brook trout	0.0031 (0.0067)	0 (0)	7 (15)	0 (0)	0 (0)	0 (0)	7 (15)
Total harvest	0.2042 (0.1255)	279 (178)	51 (45)	86 (104)	0 (0)	52 (77)	468 (225)
Angler hours		853 (417)	418 (257)	755 (681)	137 (210)	129 (150)	2,292 (878)
Angler trips		146 (84)	65 (41)	143 (149)	23 (36)	22 (26)	399 (181)

Appendix 5c.—Total shore and wading angler harvest, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0053 (0.0071)	0 (0)	14 (21)	2 (3)	0 (0)	0 (0)	16 (21)
Rock bass	0.0134 (0.0273)	40 (81)	0 (0)	0 (0)	0 (0)	0 (0)	40 (81)
Largemouth Bass	0.0023 (0.0053)	0 (0)	7 (16)	0 (0)	0 (0)	0 (0)	7 (16)
Smallmouth Bass	0.0003 (0.0006)	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)	1 (2)
Brown trout	0.0441 (0.0550)	130 (162)	0 (0)	0 (0)	1 (2)	1 (2)	132 (162)
Rainbow trout	0.2197 (0.1296)	618 (357)	37 (35)	2 (3)	0 (0)	1 (2)	658 (359)
Brook trout	0.0010 (0.0004)	3 (1)	0 (0)	0 (0)	0 (0)	0 (0)	3 (1)
White sucker	0.0254 (0.0365)	46 (94)	7 (16)	23 (50)	0 (0)	0 (0)	76 (108)
Bowfin	0.0003 (0.0006)	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)	1 (2)
Total harvest	0.3119 (0.1558)	837 (411)	65 (47)	27 (50)	3 (3)	2 (3)	934 (417)
Angler hours		2,069 (573)	381 (224)	354 (211)	70 (78)	121 (140)	2,995 (670)
Angler trips		948 (618)	278 (168)	280 (241)	25 (61)	117 (144)	1,648 (702)

Appendix 5d.—Total angler catch and release, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0059 (0.0073)	5 (12)	7 (14)	8 (10)	0 (0)	11 (32)	31 (38)
Northern pike	0.0036 (0.0074)	19 (39)	0 (0)	0 (0)	0 (0)	0 (0)	19 (39)
Rock bass	0.0011 (0.0024)	0 (0)	0 (0)	6 (13)	0 (0)	0 (0)	6 (13)
Smallmouth Bass	0.0061 (0.0064)	0 (0)	5 (8)	21 (29)	6 (14)	0 (0)	32 (33)
Brown trout	0.0968 (0.1322)	16 (23)	43 (41)	451 (689)	2 (5)	0 (0)	512 (691)
Rainbow trout	0.3959 (0.1852)	1,345 (573)	333 (530)	413 (397)	2 (5)	0 (0)	2,093 (876)
Brook trout	0.0183 (0.0211)	8 (16)	7 (9)	7 (16)	75 (107)	0 (0)	97 (110)
White sucker	0.0078 (0.0087)	0 (0)	18 (30)	23 (34)	0 (0)	0 (0)	41 (45)
Chub sp.	0.0070 (0.0143)	0 (0)	0 (0)	35 (75)	2 (5)	0 (0)	37 (75)
Total catch	0.5425 (0.2412)	1,393 (575)	413 (533)	964 (800)	87 (108)	11 (32)	2,868 (1,126)
Angler hours		2,922 (709)	799 (341)	1,109 (713)	207 (224)	250 (205)	5,287 (1,104)
Angler trips		1,094 (624)	343 (173)	423 (283)	48 (71)	139 (146)	2,047 (725)

Appendix 5e.—Total boat angler catch and release, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0057 (0.0073)	5 (12)	0 (0)	8 (10)	0 (0)	0 (0)	13 (16)
Rock bass	0.0026 (0.0057)	0 (0)	0 (0)	6 (13)	0 (0)	0 (0)	6 (13)
Smallmouth Bass	0.0140 (0.0154)	0 (0)	5 (8)	21 (29)	6 (14)	0 (0)	32 (33)
Brown trout	0.2120 (0.3118)	0 (0)	43 (41)	441 (689)	2 (5)	0 (0)	486 (690)
Rainbow trout	0.2853 (0.2308)	230 (248)	83 (83)	339 (386)	2 (5)	0 (0)	654 (466)
Brook trout	0.0100 (0.0132)	0 (0)	6 (9)	7 (16)	10 (23)	0 (0)	23 (29)
White sucker	0.0017 (0.0043)	0 (0)	0 (0)	4 (10)	0 (0)	0 (0)	4 (10)
Chub sp.	0.0161 (0.0332)	0 (0)	0 (0)	35 (75)	2 (5)	0 (0)	37 (75)
Total catch	0.5476 (0.4212)	235 (248)	137 (93)	861 (794)	22 (28)	0 (0)	1,255 (837)
Angler hours		853 (417)	418 (257)	755 (681)	137 (210)	129 (150)	2,292 (878)
Angler trips		146 (84)	65 (41)	143 (149)	23 (36)	22 (26)	399 (181)

Appendix 5f.—Total shore and wading angler catch and release, fishing pressure and catch per hour, Au Sable River site 252, McKinley to 4001, 1999. Two standard errors are given in parenthesis.

Species	Catch/Hour	Apr24-Jun7	Jun8-Ju15	Jul16-Aug24	Aug25-Sep7	Sep8-30	Season
Walleye	0.0060 (0.0117)	0 (0)	7 (14)	0 (0)	0 (0)	11 (32)	18 (35)
Northern pike	0.0063 (0.0130)	19 (39)	0 (0)	0 (0)	0 (0)	0 (0)	19 (39)
Brown trout	0.0087 (0.0099)	16 (23)	0 (0)	10 (17)	0 (0)	0 (0)	26 (29)
Rainbow trout	0.4805 (0.2695)	1,115 (516)	250 (523)	74 (91)	0 (0)	0 (0)	1,439 (740)
Brook trout	0.0247 (0.0358)	8 (16)	1 (3)	0 (0)	65 (105)	0 (0)	74 (106)
White sucker	0.0124 (0.0150)	0 (0)	18 (30)	19 (32)	0 (0)	0 (0)	37 (44)
Total catch	0.5386 (0.2782)	1,158 (518)	276 (524)	103 (98)	65 (105)	11 (32)	1,613 (751)
Angler hours		2,069 (573)	381 (224)	354 (211)	70 (78)	121 (140)	2,995 (670)
Angler trips		948 (618)	278 (168)	280 (241)	25 (61)	117 (144)	1,648 (702)

Appendix 5g.- Total estimated harvest, harvest rate and angling effort, Au Sable River site 252 (McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Apr- Jun 7	Jun 8- Jul 15	Jul 16-Aug 24	Aug 25-Sep 7	Sep 8-30	Season
Walleye	0.0024 (0.0048)	16 (34)	1 (3)	0 (0)	0 (0)	0 (0)	17 (34)
Brown trout	0.0110 (0.0107)	53 (56)	24 (47)	0 (0)	0 (0)	0 (0)	77 (73)
Rainbow trout	0.0105 (0.0090)	20 (34)	21 (22)	27 (42)	5 (12)	0 (0)	73 (60)
Brook trout	0.0001 (0.0003)	0 (0)	1 (3)	0 (0)	0 (0)	0 (0)	1 (3)
Other	0.0004 (0.0009)	0 (0)	0 (0)	3 (7)	0 (0)	0 (0)	3 (7)
Total harvest	0.0245 (0.0156)	89 (74)	47 (52)	30 (43)	5 (12)	0 (0)	171 (101)
Angler hours		2,651 (1,042)	2,017 (698)	1,518 (951)	415 (248)	377 (356)	6,978 (1,633)
Angler trips		969 (582)	872 (403)	436 (262)	161 (114)	127 (139)	2,565 (776)

Appendix 5h.- Boat angler estimated harvest, harvest rate and angling effort, Au Sable River site 252(McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Apr- Jun 7	Jun 8- Jul 15	Jul 16-Aug 24	Aug 25-Sep 7	Sep 8-30	Season
Walleye	0.0003 (0.0009)	0 (0)	1 (3)	0 (0)	0 (0)	0 (0)	1 (3)
Brown trout	0.0038 (0.0049)	11 (15)	2 (4)	0 (0)	0 (0)	0 (0)	13 (16)
Rainbow trout	0.0136 (0.0147)	5 (10)	14 (19)	27 (42)	0 (0)	0 (0)	46 (47)
Brook trout	0.0003 (0.0009)	0 (0)	1 (3)	0 (0)	0 (0)	0 (0)	1 (3)
Other	0.0009 (0.0021)	0 (0)	0 (0)	3 (7)	0 (0)	0 (0)	3 (7)
Total harvest	0.0189 (0.0165)	16 (18)	18 (20)	30 (43)	0 (0)	0 (0)	64 (51)
Angler hours		1,247 (591)	722 (427)	1,038 (900)	179 (186)	204 (273)	3,390 (1,204)
Angler trips		214 (112)	176 (113)	178 (182)	34 (35)	34 (45)	636 (248)



Appendix 5i.- Shore and wading angler estimated harvest, harvest rate and angling effort, Au Sable River site 252(McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses.

Species	Catch/hour	Apr- Jun 7	Jun 8- Jul 15	Jul 16-Aug 24	Aug 25-Sep 7	Sep 8-30	Season
Walleye	0.0045 (0.0097)	16 (34)	0 (0)	0 (0)	0 (0)	0 (0)	16 (34)
Brown trout	0.0178 (0.0208)	42 (54)	22 (47)	0 (0)	0 (0)	0 (0)	64 (72)
Rainbow trout	0.0075 (0.0103)	15 (32)	7 (11)	0 (0)	5 (12)	0 (0)	27 (36)
Total harvest	0.0298 (0.0259)	73 (71)	29 (48)	0 (0)	5 (12)	0 (0)	107 (87)
Angler hours		1,404 (858)	1,295 (552)	480 (306)	236 (164)	173 (228)	3,588 (1,102)
Angler trips		755 (571)	696 (387)	258 (189)	127 (109)	93 (131)	1,929 (735)

Appendix 5j.- Total estimated catch and release, release rate and angling effort, Au Sable River site 252(McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Apr- Jun 7	Jun 8- Jul 15	Jul 16-Aug 24	Aug 25-Sep 7	Sep 8-30	Season
Walleye	0.0042 (0.0060)	6 (13)	8 (16)	15 (36)	0 (0)	0 (0)	29 (41)
Northern pike	0.0014 (0.0038)	10 (27)	0 (0)	0 (0)	0 (0)	0 (0)	10 (27)
Rock bass	0.0011 (0.0026)	0 (0)	8 (19)	0 (0)	0 (0)	0 (0)	8 (19)
Smallmouth bass	0.0044 (0.0040)	0 (0)	22 (23)	9 (15)	0 (0)	0 (0)	31 (27)
Brown trout	0.0883 (0.0529)	100 (104)	289 (240)	86 (142)	88 (103)	53 (128)	616 (340)
Rainbow trout	0.1466 (0.0709)	467 (313)	414 (277)	124 (108)	18 (31)	0 (0)	1,023 (433)
Brook trout	0.0380 (0.0302)	40 (58)	108 (109)	45 (89)	19 (31)	53 (128)	265 (201)
Other	0.0191 (0.0159)	31 (37)	16 (26)	48 (72)	38 (63)	0 (0)	133 (106)
Total catch	0.3031 (0.1114)	654 (338)	865 (385)	327 (216)	163 (128)	106 (181)	2,115 (599)
Angler hours		2,651 (1,042)	2,017 (698)	1,518 (951)	415 (248)	377 (356)	6,978 (1,633)
Angler trips		969 (582)	872 (403)	436 (262)	161 (114)	127 (139)	2,565 (776)

Appendix 5k.- Boat angler estimated catch and release, release rate and angling effort, Au Sable River site 252(McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Apr- Jun 7	Jun 8- Jul 15	Jul 16-Aug 24	Aug 25-Sep 7	Sep 8-30	Season
Walleye	0.0065 (0.0115)	6 (13)	1 (3)	15 (36)	0 (0)	0 (0)	22 (38)
Northern pike	0.0029 (0.0079)	10 (27)	0 (0)	0 (0)	0 (0)	0 (0)	10 (27)
Rock bass	0.0024 (0.0058)	0 (0)	8 (19)	0 (0)	0 (0)	0 (0)	8 (19)
Smallmouth bass	0.0053 (0.0056)	0 (0)	15 (17)	3 (5)	0 (0)	0 (0)	18 (18)
Brown trout	0.0177 (0.0191)	5 (10)	43 (56)	4 (9)	8 (19)	0 (0)	60 (61)
Rainbow trout	0.1327 (0.0790)	172 (116)	178 (150)	96 (101)	4 (9)	0 (0)	450 (215)
Brook trout	0.0100 (0.0148)	0 (0)	31 (48)	3 (7)	0 (0)	0 (0)	34 (49)
Other	0.0215 (0.0248)	8 (17)	5 (9)	48 (72)	12 (28)	0 (0)	73 (80)
Total catch	0.1991 (0.1017)	201 (121)	281 (169)	169 (130)	24 (35)	0 (0)	675 (248)
Angler hours		1,247 (591)	722 (427)	1,038 (900)	179 (186)	204 (273)	3,390 (1,204)
Angler trips		214 (112)	176 (113)	178 (182)	34 (35)	34 (45)	636 (248)

Appendix 5L.- Shore and wading angler estimated catch and release, release rate and angling effort, Au Sable River site 252(McKinley to 4001 Bridge), summer 2000. All estimates are given with 2 SE in parentheses. Other species category may include sunfish, bluegill, suckers, bowfin, redhorse, and catfish.

Species	Catch/hour	Apr- Jun 7	Jun 8- Jul 15	Jul 16-Aug 24	Aug 25-Sep 7	Sep 8-30	Season
Walleye	0.0020 (0.0046)	0 (0)	7 (16)	0 (0)	0 (0)	0 (0)	7 (16)
Smallmouth bass	0.0036 (0.0059)	0 (0)	7 (16)	6 (14)	0 (0)	0 (0)	13 (21)
Brown trout	0.1550 (0.1046)	95 (104)	246 (233)	82 (142)	80 (101)	53 (128)	556 (334)
Rainbow trout	0.1597 (0.1157)	295 (291)	236 (233)	28 (37)	14 (30)	0 (0)	573 (376)
Brook trout	0.0644 (0.0581)	40 (58)	77 (98)	42 (89)	19 (31)	53 (128)	231 (196)
Other	0.0167 (0.0199)	23 (33)	11 (24)	0 (0)	26 (56)	0 (0)	60 (69)
Total harvest	0.4013 (0.1954)	453 (316)	584 (345)	158 (172)	139 (123)	106 (181)	1,440 (544)
Angler hours		1,404 (858)	1,295 (552)	480 (306)	236 (164)	173 (228)	3,588 (1,102)
Angler trips		755 (571)	696 (387)	258 (189)	127 (109)	93 (131)	1,929 (735)