2007 Croton Impoundment Angler Survey Report

Michigan Department of Natural Resources, Fisheries Division

by
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Introduction

Croton Impoundment is located 49 miles upstream of Muskegon Lake on the Muskegon River in Newaygo County. The Muskegon River is part of the Lake Michigan watershed and is located in the west, central portion of Michigan's Lower Peninsula (Figure 1). Croton Dam, that creates Croton Impoundment, is one of three hydroelectric dams located on the Muskegon River. Hardy Impoundment and Rogers Impoundment are located immediately upstream of Croton Impoundment. Croton Impoundment is 1,380 surface acres in size and has a maximum depth of about 40 to 50 feet (Figure 2). Croton Dam also impounds the lower portion of the Little Muskegon River where it joins the Muskegon River, and this portion of the impoundment is called Little Croton Impoundment. Little Croton Impoundment has a maximum depth of about 30 to 40 feet. During summer, water temperature and dissolved oxygen stratification occurs, limiting the availability of oxygen for fish at depths below 25 feet. More detailed information on the fisheries and management of Croton Impoundment can be found in the Muskegon River Watershed Assessment (O'Neal 1997).

In 2007, the Michigan Department of Natural Resources (MDNR), Fisheries Division conducted a survey to assess the level of angler-use, fish harvest, fish catch and non-fishing boating effort on Croton Impoundment. This report summarizes the results of that survey.

Methods

The angler survey, also referred to as a creel survey, was conducted from April 1 through October 31, 2007 Anglers were counted from a boat using a single one-way path beginning at the Croton Dam boat ramp, proceeding upstream through Little Croton Impoundment and then to Hardy Dam (Figure 2). Anglers were interviewed at the end of their fishing trip at three sites including the 1) Croton Dam boat ramp (N 43.449, W 85.666), the 2) Croton Township boat ramp (N 43.449, W 85.660), and the 3) Hardy Dam walk-in fishing access (N 43.485, W 85.631).

One Michigan Department of Natural Resources creel clerk worked 40-hours per week to complete the survey using a progressive roving-access points design with a roving-progressive count method (Lockwood et al. 1999). One weekend day and two or three randomly selected weekdays were sampled each week. No holidays were sampled. Both shore anglers (including those who were wading) and anglers fishing from boats were counted and interviewed. The non-fishing recreational boats were also counted.

Two types of data were collected: angler interviews for fish catch and effort information, and counts of shore and boat anglers for effort. The clerks interviewed each individual angler or boat that returned to the access sites during the scheduled shift. Date, time and interview site were recorded for all interviews. When the boater did not fish, that was recorded on the form as a non-fishing party and the interview was ended. When fishing occurred, anglers were queried as to their mode of fishing (i.e., boat or shore), where they fished, how long they fished, what they fished for, the numbers (by species) of fish they caught and numbers kept, and the number of fishing trips they made or intended to make that day.

Fishing effort was determined through angler and boat counts made by the creel clerk. One count of boat and shore anglers was made each survey day using a boat to visually verify anglers.

The starting point for counts and interviews were alternated daily following a randomized count and interview schedule. One eight-hour shift (between 6:00 am and 4:30 pm or between 11:30 am and 11:00 pm) was worked each sampling day, with starting and ending times varying each month with daylight period.

Estimates of three measures of fishing effort: angler-hours, angler-trips and angler-days were generated from this angler survey. An angler-trip was one completed fishing excursion, with no restriction on time spent fishing. An angler-day was composed of one or more angler-trips during a 24-hour period. Other estimates generated from data collected during this angler survey included: the number of fish harvested (caught and kept by anglers), the number of fish caught and released, and species specific catch rates. Estimates were made for boat and shore modes of fishing, for each month. Estimates of fish released included fish that were legal (meeting minimum size regulations) and sub-legal fish. Standard mathematical formulas for creel surveys were used to calculate all estimates (Lockwood et al. 1999). Uncertainty estimates for all catch and effort estimates in this report are defined as two standard deviations of their mean estimates (2 times the square root of the variance for an estimate).

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

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

Results

Eleven species of fish were captured by anglers during the seven month angler survey (Tables 1 – 3). The top four species, by number, of fish harvested were bluegill, yellow perch, pumpkinseed and black crappie, and they accounted for 95.2% of total harvest (Table 3). The top four species of fish caught and released were smallmouth bass, bluegill, northern pike, and yellow perch, and they represented 90.3% of total released fish (Table 3). Other species found in the catch included walleye, largemouth bass, common white sucker, brown bullhead, and rock bass.

Fish harvest represented 56.2% (31,990) of total fish catch (56,892; Table 3). Boat fishing accounted for 95.5% of total fish harvest and 94.1% of total fish released (Tables 1 & 2).

The greatest amount of fish harvest occurred during October and May, coinciding with high harvest numbers of bluegill, yellow perch and pumpkinseed (Table 3). The greatest number of fish caught and released occurred during May through August, although monthly variations were not as high as harvested fish (Table 3). Part of the monthly discrepancies in harvested and released fish was the result of fishing regulation closures during April and May for walleye, northern pike, smallmouth bass and largemouth bass.

Boat fishing accounted for 89.5% (45,194 hours) of total fishing effort (Tables 1-4). The greatest amount of fishing effort occurred in July and the lowest occurred in April (Table 4). The total amount of fishing effort was estimated at 50,494 angler-hours or 13,133 angler-trips.

Non-fishing (recreational) boat effort was estimated at 15,816 hours for the seven month period (Table 4). This estimate is a minimum value because it does not include more than one-person per boat, but only the number of non-fishing boats present on the impoundment. The highest amount of non-fishing boat effort occurred from June through September. The combined

Fishing (boat and shore) and non-fishing recreational hours was estimated at 66,310 for the seven month period (Table 4).

Discussion

Typical of most inland warmwater lakes in Michigan, the predominant fisheries in Croton Impoundment were for panfish (bluegill, pumpkinseed, yellow perch, black crappie, and rock bass). The number of walleye harvested was similar to the number released. Most anglers keep walleye for food so it is likely that many of the released walleye were sublegal. The walleye population in Croton Impoundment is predominantly sublegal fish, partly because many of the large walleye migrate downstream through the dam when they reach maturity (Eschmeyer 1950). The number of northern pike released was much greater than the number harvested. This may also be a function of greater numbers of small fish in the population. Both largemouth and smallmouth bass were also released in greater numbers than harvested fish. Although this may also be a function of higher numbers of small fish, catch and release bass fishing is often practiced by Michigan anglers.

The value of harvested fish fillets from Croton Impoundment during 2007 was estimated at $16,924 (Table 5). This estimate is considered a minimum value because minimum lengths were used to estimated weight, and a conservative value was used to estimated fillet weight from whole fish weight. Most harvested fish are larger than the legal minimum size limit.

A total of 13,340 angler-days were expended during the seven month period on Croton Impoundment in 2007. The annual value of this fishery to the local economy, for the seven month period, is estimated at $520,260 based on the value of $39 per angler-day estimated from the 2011 national survey of fishing (U.S. Department of the Interior 2013). Angling that occurred at night and during the remaining five months of the year (November – March) were not estimated in this survey, so this should be considered a minimum value.

The number of angler hours expended on Croton Impoundment was average for lakes of the same size in Michigan (Figure 3). Angler-hours per acre on Croton Impoundment (36.6) during 2007 was nearer to the average for Upper Peninsula lakes (23.4; Table 6) than to Lower Peninsula lakes (73.1; Table 7)

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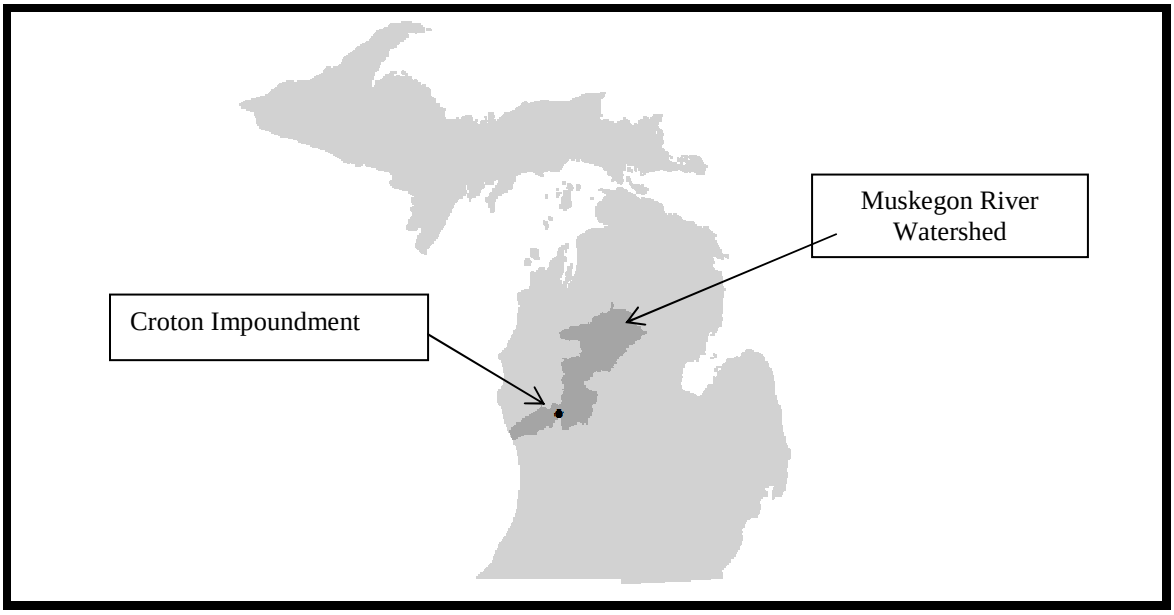

Figure 1. The location of the Muskegon River Watershed and Croton Impoundment in Michigan.

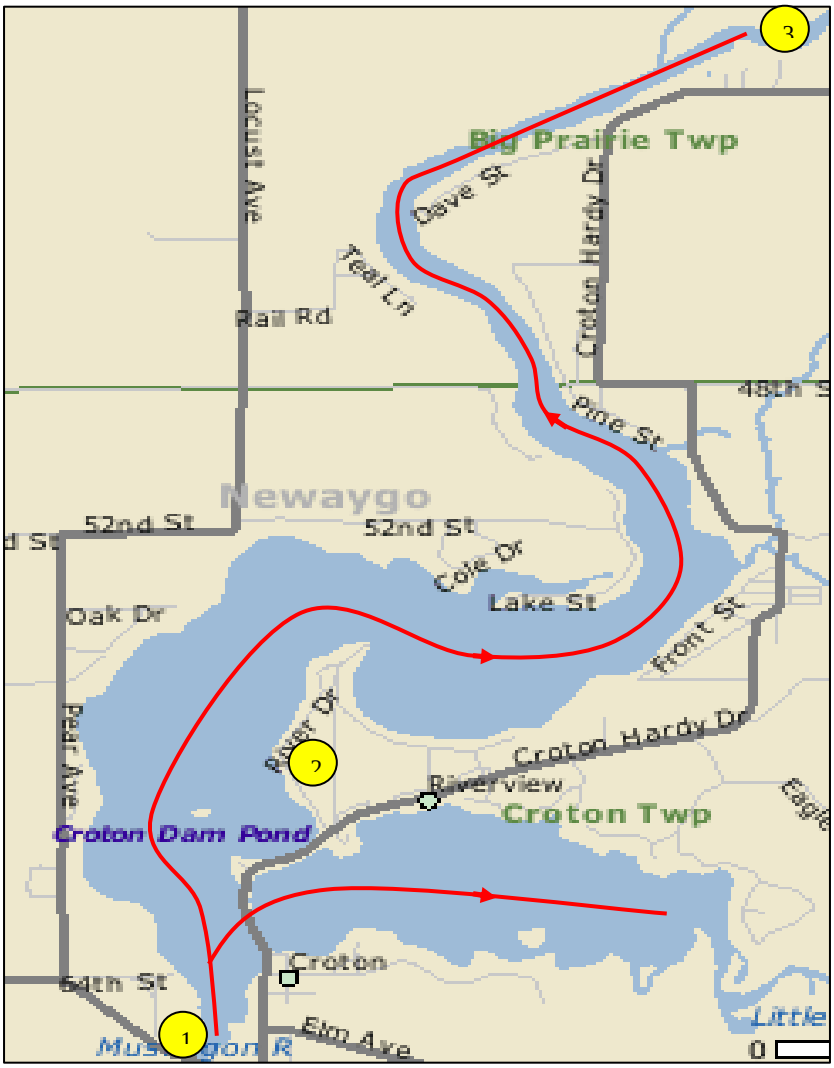

Figure 2. Croton Impoundment (including Little Croton Impoundment) on the Muskegon River. The arrowed line indicates the boat path used to count anglers. Angler interview sites are indicated by the numbers 1-3.

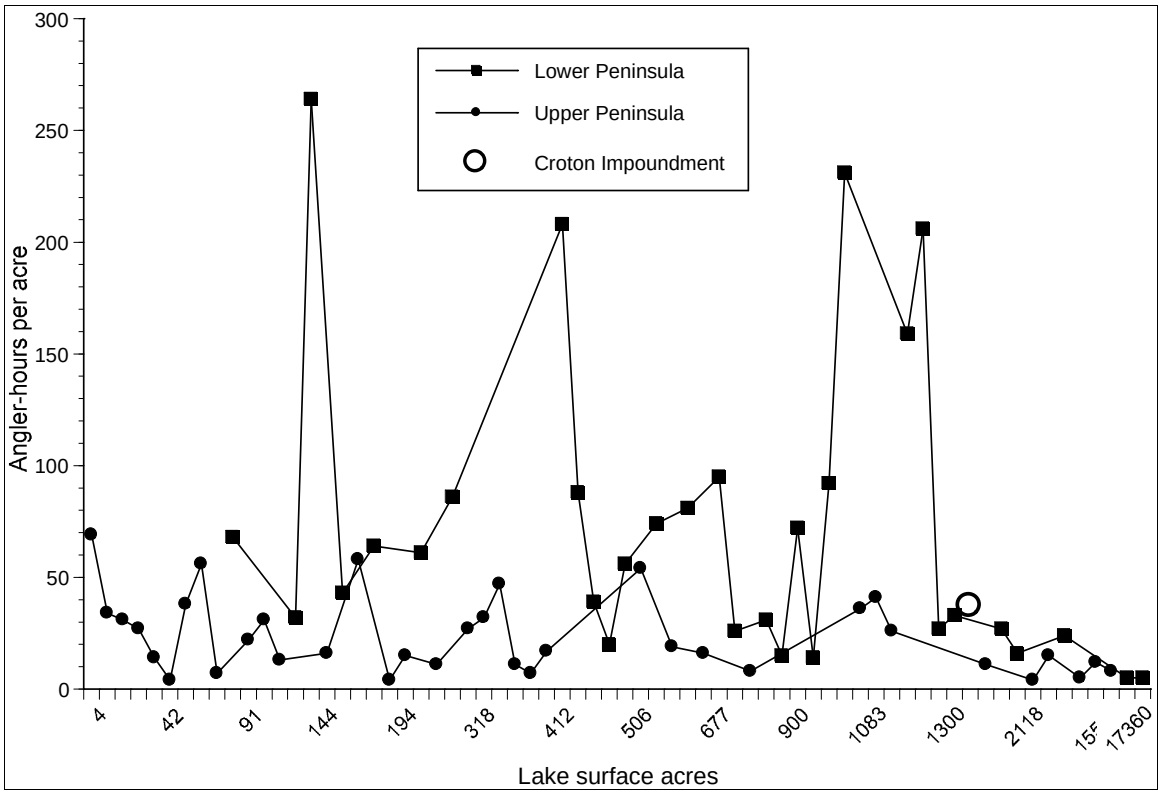

Figure 3. The number of angler-hours per acre expended on Croton Impoundment during 2007, compared to other lakes in Michigan.

Table 1. Estimated fish harvested and released by boat fishing on Croton Impoundment during 2007. C/H indicates catch per hour. Two standard errors are given in parentheses.

Species	C/H	April	May	June	July	August	September	October	Season
Walleye	0.0116	0	0	99	300	92	33	0	525
	(0.0102)	(0)	(0)	(92)	(407)	(177)	(62)	(0)	(457)
Northern pike	0.0086	0	0	152	44	23	132	40	391
	(0.0062)	(0)	(0)	(174)	(53)	(47)	(178)	(86)	(273)
Largemouth bass	0.0014	0	0	61	0	0	0	0	61
	(0.0028)	(0)	(0)	(126)	(0)	(0)	(0)	(0)	(126)
Smallmouth bass	0.0069	0	0	128	116	40	17	10	311
	(0.0056)	(0)	(0)	(136)	(198)	(53)	(33)	(20)	(250)
Yellow Perch	0.1337	342	60	70	1,551	750	1,228	2,044	6,044
	(0.0691)	(320)	(73)	(91)	(1,475)	(562)	(1,273)	(2,193)	(3,006)
Bluegill	0.4512	510	5,243	210	1,421	3,637	1,261	8,110	20,391
	(0.2115)	(708)	(3,365)	(290)	(1,138)	(3,186)	(1,022)	(7,667)	(9,120)
Pumpkinseed	0.0395	0	1,061	20	0	17	166	521	1,786
	(0.0264)	(0)	(866)	(41)	(0)	(31)	(313)	(715)	(1,166)
Rock bass	0.0012	0	21	35	0	0	0	0	56
	(0.0015)	(0)	(43)	(51)	(0)	(0)	(0)	(0)	(66)
Black crappie	0.0196	0	127	50	264	0	0	443	884
	(0.0179)	(0)	(263)	(71)	(515)	(0)	(0)	(548)	(799)
Brown bullhead	0.0028	0	0	0	128	0	0	0	128
	(0.0051)	(0)	(0)	(0)	(232)	(0)	(0)	(0)	(232)
Total harvest	0.6766	852	6,512	825	3,824	4,558	2,838	11,167	30,577
	(0.2353)	(776)	(3,485)	(418)	(1,999)	(3,241)	(1,673)	(8,026)	(9,728)
Walleye	0.0162	18	40	0	276	224	165	10	733
	(0.0123)	(37)	(59)	(0)	(339)	(283)	(314)	(19)	(547)
Northern pike	0.1002	79	1,506	1,341	854	211	431	106	4,529
	(0.0370)	(98)	(953)	(802)	(777)	(202)	(422)	(110)	(1,548)
Largemouth bass	0.0218	0	60	350	290	40	83	163	986
	(0.0107)	(0)	(86)	(297)	(281)	(58)	(99)	(170)	(465)
Smallmouth bass	0.1622	898	1,434	1,709	1,094	1,408	663	127	7,333
	(0.0749)	(1,741)	(1,057)	(999)	(958)	(1,981)	(631)	(133)	(3,226)
Yellow Perch	0.0734	1,392	40	175	1,385	200	66	58	3,317
	(0.0512)	(1,458)	(59)	(354)	(1,671)	(274)	(90)	(119)	(2,268)
Bluegill	0.1300	85	175	954	1,191	1,461	1,394	614	5,873
	(0.0598)	(103)	(242)	(834)	(957)	(1,188)	(1,610)	(975)	(2,575)
Pumpkinseed	0.0003	0	0	0	12	0	0	0	12
	(0.0005)	(0)	(0)	(0)	(24)	(0)	(0)	(0)	(24)
Rock bass	0.0022	0	38	44	0	17	0	0	99
	(0.0027)	(0)	(82)	(85)	(0)	(32)	(0)	(0)	(123)
Black crappie	0.0040	0	0	0	181	0	0	0	181
	(0.0080)	(0)	(0)	(0)	(358)	(0)	(0)	(0)	(358)
White sucker	0.0081	18	276	15	0	23	33	0	364
	(0.0117)	(37)	(519)	(29)	(0)	(42)	(69)	(0)	(527)
Brown bullhead	0.0003	0	0	0	12	0	0	0	12
	(0.0005)	(0)	(0)	(0)	(24)	(0)	(0)	(0)	(24)
Total released	0.5186	2,489	3,571	4,587	5,296	3,584	2,835	1,077	23,439
	(0.1334)	(2,276)	(1,541)	(1,600)	(2,357)	(2,353)	(1,814)	(1,011)	(5,052)
Total catch	1.1952	3,341	10,083	5,412	9,120	8,142	5,673	12,244	54,016
	(0.2949)	(2,405)	(3,811)	(1,653)	(3,090)	(4,005)	(2,468)	(8,089)	(10,962)

Table 2. Estimated fish harvested and released by shore fishing on Croton Impoundment during 2007. C/H indicates catch per hour. Two standard errors are given in parentheses.

Species	C/H	April	May	June	July	August	September	October	Season
Walleye	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Northern pike	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Largemouth bass	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Smallmouth bass	0.0134	0	0	0	71	0	0	0	71
	(0.0238)	(0)	(0)	(0)	(125)	(0)	(0)	(0)	(125)
Yellow Perch	0.2244	1,118	0	0	71	0	0	0	1,189
	(0.1426)	(677)	(0)	(0)	(125)	(0)	(0)	(0)	(689)
Bluegill	0.0287	0	0	0	0	152	0	0	152
	(0.0075)	(0)	(0)	(0)	(0)	NAN	(0)	(0)	(0)
Pumpkinseed	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Rock bass	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Black crappie	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Brown bullhead	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Total	0.2666	1,118	0	0	142	152	0	0	1,413
harvest	(0.1494)	(677)	(0)	(0)	(176)	NAN	(0)	(0)	(700)
Walleye	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Northern pike	0.0813	0	206	0	225	0	0	0	431
	(0.0213)	(0)	NAN	(0)	NAN	(0)	(0)	(0)	(0)
Largemouth bass	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Smallmouth bass	0.0823	0	54	73	214	95	0	0	436
	(0.0808)	(0)	(140)	(103)	(374)	NAN	(0)	(0)	(413)
Yellow Perch	0.0495	0	162	0	0	0	0	100	262
	(0.0575)	(0)	(297)	(0)	(0)	(0)	(0)	NAN	(297)
Bluegill	0.0561	0	0	183	0	114	0	0	297
	(0.0692)	(0)	(0)	(358)	(0)	NAN	(0)	(0)	(358)
Pumpkinseed	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Rock bass	0.0069	0	0	37	0	0	0	0	37
	(0.0110)	(0)	(0)	(58)	(0)	(0)	(0)	(0)	(58)
Black crappie	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
White sucker	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Brown bullhead	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Total	0.2760	0	422	293	439	209	0	100	1,463
released	(0.1016)	(0)	NAN	(377)	NAN	NAN	(0)	NAN	(377)
Total	0.5426	1,118	422	293	581	362	0	100	2,876
catch	(0.2068)	(677)	NAN	(377)	NAN	NAN	(0)	NAN	(795)

Table 3. Estimated fish harvested and released from Croton Impoundment during 2007. C/H indicates catch per hour. Two standard errors are given in parentheses.

Species	C/H	April	May	June	July	August	September	October	Season
Walleye	0.0104	0	0	99	300	92	33	0	525
	(0.0092)	(0)	(0)	(92)	(407)	(177)	(62)	(0)	(457)
Northern pike	0.0077	0	0	152	44	23	132	40	391
	(0.0055)	(0)	(0)	(174)	(53)	(47)	(178)	(86)	(273)
Largemouth bass	0.0012	0	0	61	0	0	0	0	61
	(0.0025)	(0)	(0)	(126)	(0)	(0)	(0)	(0)	(126)
Smallmouth bass	0.0076	0	0	128	187	40	17	10	382
	(0.0056)	(0)	(0)	(136)	(234)	(53)	(33)	(20)	(279)
Yellow Perch	0.1433	1,460	60	70	1,622	750	1,228	2,044	7,234
	(0.0638)	(749)	(73)	(91)	(1,481)	(562)	(1,273)	(2,193)	(3,084)
Bluegill	0.4069	510	5,243	210	1,421	3,789	1,261	8,110	20,544
	(0.1771)	(708)	(3,365)	(290)	(1,138)	NAN	(1,022)	(7,667)	(8,546)
Pumpkinseed	0.0354	0	1,061	20	0	17	166	521	1,786
	(0.0235)	(0)	(866)	(41)	(0)	(31)	(313)	(715)	(1,166)
Rock bass	0.0011	0	21	35	0	0	0	0	56
	(0.0013)	(0)	(43)	(51)	(0)	(0)	(0)	(0)	(66)
Black crappie	0.0175	0	127	50	264	0	0	443	884
	(0.0160)	(0)	(263)	(71)	(515)	(0)	(0)	(548)	(799)
Brown bullhead	0.0025	0	0	0	128	0	0	0	128
	(0.0046)	(0)	(0)	(0)	(232)	(0)	(0)	(0)	(232)
Total	0.6335	1,970	6,512	825	3,967	4,710	2,838	11,167	31,990
harvest	(0.1996)	(1,030)	(3,485)	(418)	(2,007)	NAN	(1,673)	(8,026)	(9,199)
Walleye	0.0145	18	40	0	276	224	165	10	733
	(0.0110)	(37)	(59)	(0)	(339)	(283)	(314)	(19)	(547)
Northern pike	0.0982	79	1,712	1,341	1,079	211	431	106	4,959
	(0.0225)	(98)	NAN	(802)	NAN	(202)	(422)	(110)	(940)
Largemouth bass	0.0195	0	60	350	290	40	83	163	986
	(0.0096)	(0)	(86)	(297)	(281)	(58)	(99)	(170)	(465)
Smallmouth bass	0.1539	898	1,488	1,782	1,307	1,504	663	127	7,769
	(0.0548)	(1,741)	(1,066)	(1,005)	(1,029)	NAN	(631)	(133)	(2,579)
Yellow Perch	0.0709	1,392	203	175	1,385	200	66	158	3,579
	(0.0462)	(1,458)	(303)	(354)	(1,671)	(274)	(90)	NAN	(2,285)
Bluegill	0.1222	85	175	1,137	1,191	1,575	1,394	614	6,171
	(0.0484)	(103)	(242)	(907)	(957)	NAN	(1,610)	(975)	(2,313)
Pumpkinseed	0.0002	0	0	0	12	0	0	0	12
	(0.0005)	(0)	(0)	(0)	(24)	(0)	(0)	(0)	(24)
Rock bass	0.0027	0	38	80	0	17	0	0	135
	(0.0027)	(0)	(82)	(103)	(0)	(32)	(0)	(0)	(135)
Black crappie	0.0036	0	0	0	181	0	0	0	181
	(0.0071)	(0)	(0)	(0)	(358)	(0)	(0)	(0)	(358)
White sucker	0.0072	18	276	15	0	23	33	0	364
	(0.0105)	(37)	(519)	(29)	(0)	(42)	(69)	(0)	(527)
Brown bullhead	0.0002	0	0	0	12	0	0	0	12
	(0.0005)	(0)	(0)	(0)	(24)	(0)	(0)	(0)	(24)
Total	0.4932	2,489	3,993	4,880	5,735	3,794	2,835	1,177	24,902
released	(0.0917)	(2,276)	NAN	(1,643)	NAN	NAN	(1,814)	NAN	(3,342)
Total	1.1267	4,460	10,505	5,705	9,701	8,504	5,673	12,344	56,892
catch	(0.2420)	(2,498)	NAN	(1,696)	NAN	NAN	(2,468)	NAN	(9,788)

Table 4. Estimated fishing (boat and shore) and non-fishing (recreational) boat effort expended on Croton Impoundment during April – October 2007. C/H indicates catch/hour. Two standard errors are given in parentheses.

Species	April	May	June	July	August	September	October	Season
Boat								
Angler hours	2,700	5,216	8,376	11,559	6,397	6,925	4,021	45,194
	(1,575)	(1,558)	(2,105)	(4,381)	(1,651)	(2,234)	(1,989)	(6,341)
Angler trips	732	1,217	1,835	2,705	1,465	1,602	1,106	10,661
	(455)	(408)	(531)	(1,057)	(452)	(556)	(606)	(1,629)
Shore								
Angler hours	300	742	567	2,331	1,154	132	75	5,300
	(148)	(379)	(514)	(1,127)	(464)	(110)	(90)	(1,391)
Angler trips	100	428	324	851	701	44	25	2,472
	(142)	(305)	(308)	(552)	(461)	(69)	(45)	(856)
Boat and Shore								
Angler hours	3,000	5,958	8,943	13,890	7,550	7,057	4,096	50,494
	(1,581)	(1,604)	(2,167)	(4,524)	(1,715)	(2,236)	(1,991)	(6,491)
Angler trips	832	1,644	2,159	3,555	2,166	1,646	1,131	13,133
	(476)	(509)	(614)	(1,192)	(646)	(560)	(608)	(1,840)
Non-fishing Boat								
Hours	301	570	3,265	3,508	4,746	2,758	667	15,816
	(342)	(469)	(1,805)	(1,362)	(2,773)	(3,082)	(730)	(4,814)
Fishing and Non-fishing								
Hours	3,301	6,528	12,208	17,398	12,296	9,815	4,763	66,310
	(1,923)	(2,073)	(3,973)	(5,886)	(4,488)	(5,318)	(2,720)	(11,305)

Table 5. Estimated minimum dollar value of fish harvested from Croton Impoundment, from April through October 2007. Estimated weight based on minimum harvest size and standard length weight equations from Schneider et al. (2000). Fillet weight was estimated at 30% of total weight.

Species	Number harvested	Size (in.)	Weight (lb.)	Fillet weight (lb.)	Fillet value at $8.00/lb.
Bass, Largemouth	61	14	88	26	$210
Bass, Smallmouth	382	14	544	163	$1,307
Bass, Rock	56	6	9	3	$22
Bluegill	20,544	6	3,091	927	$8,418
Bullheads	128	7	22	7	$53
Crappie, Black	884	7	163	49	$390
Perch, Yellow	7,234	7	1,040	312	$2,496
Pike, Northern	391	24	1,197	359	$2,872
Pumpkinseed	1,786	6	320	96	$767
Walleye	525	15	579	174	$1,389
Total	31,991		7,051	2,115	$16,924

Table 6. Angler survey summaries for 37 Upper Peninsula Michigan lakes. Angler-trips were estimated (italicized) for some lakes based on a ratio of angler trips to angler-hours (0.32) from 96 Michigan inland lake surveys. Angler-days were estimated (italicized) for most lakes based on a ratio of angler-days to angler trips (0.87) from five Michigan inland lake surveys on three lakes. Note that "ww" indicates warmwater fish and "tr" indicates trout. Data obtained from Beyerle (1980, 1984), Dexter (1991), Duffy (1995), Herman (1989), Laarman (1980), Laarman and Schneider (1986), Lockwood (2000), Ryckman and Lockwood (1985), Schneider et al. (1989), Thomas (1990), Wagner (1988), and Waybrant and Thomas (1988).

Waterbody	County	Year	Number of months	Type of fishing	Surface acres	Angler hours/acre	Angler trips/acre	Angler days/acre
Brockies Pond	Luce	1978	5	tr	4	69.5	26.0	*22.6*
Buckies Pond	Luce	1978	6	tr	6	34.5	16.8	*14.6*
Brush Lake	Luce	1978	5	ww	9	31.6	9.4	*8.2*
Wedge	Schoolcraft	1993	5	ww	27	27.6	8.3	*7.2*
Deep Lake	Schoolcraft	1978	4	ww	35	14.3	9.0	*7.8*
Beaver House Lake	Luce	1978	5	tr	42	4.3	0.5	*0.4*
Pretty Lake	Luce	1978	6	ww	46	38.5	23.0	*20.0*
Anderson Lake	Marquette	1985	5	ww	49	56.2	*18.0*	*15.6*
Camp Lake	Luce	1978	6	tr	67	6.7	1.9	*1.6*
Skeels Lake	Delta	1978	4	ww	91	21.6	8.0	*7.0*
Stager	Iron	1983	5	ww	110	30.9	*9.9*	*8.6*
Tepee	Iron	1983	5	ww	121	13.0	*4.2*	*3.6*
Corner Lake	Delta	1978	4	ww	144	15.9	9.9	*8.6*
Big Shag	Marquette	1985	5	ww	185	58.0	*18.6*	*16.1*
Straits Lake	Schoolcraft	1978	4	ww	189	4.2	2.9	*2.6*
Petes Lake	Schoolcraft	1993	5	ww	194	15.5	5.7	*5.0*
Bass Lake	Schoolcraft	1995	5	ww	287	11.5	3.8	*3.3*
Pomeroy	Gogebic	1993, 94	5, 5	ww	317	27.3	7.3	*6.4*
Stanley	Iron	1993	7	ww	318	32.0	8.7	*7.5*
Stanley	Iron	1994	10	ww	318	46.8	14.0	*12.2*

Continued

Table 6. Continued

Waterbody	County	Year	Number of months	Type of fishing	Surface acres	Angler hours/acre	Angler trips/acre	Angler days/acre
Marion Lake	Gogebic	1993	5	ww	318	10.6	3.3	*2.9*
Tamarack	Gogebic	1993	5	ww	326	7.4	1.9	*1.7*
Thunder	Schoolcraft	1995	5	ww	349	17.2	7.5	*6.5*
Cisco Lake	Gogebic	1977, 78	6, 4	ww	506	54.5	18.6	*16.2*
Hagerman	Iron	1993, 94	8, 9	ww	566	19.5	4.5	*3.9*
Duck	Gogebic	1993, 94	5, 5	ww	622	16.4	4.0	*3.5*
Beaver	Alger	1998	5	ww	765	8.5	2.4	*2.1*
Thousand Island Lake	Gogebic	1977, 78	6, 4	ww	1,020	35.7	11.3	*9.9*
Chicagon	Iron	1994	10	ww + tr	1,083	41.1	9.8	*8.5*
Chicagon	Iron	1993	7	ww + tr	1,083	25.7	6.1	*5.3*
McDonald Lake	Schoolcraft	1976, 77	6, 6	ww	1,612	11.1	3.8	*3.3*
Bond Falls Flowage	Ontonogan	1994	5	ww	2,118	3.7	0.8	*0.7*
S. Manistique Lake	Mackinac	1978	4	ww	4,001	15.4	6.5	*5.7*
Big Manistique Lake	Luce	1979, 80	10, 10	ww	10,130	5.5	1.7	*1.5*
Gogebic Lake	Gogebic	1976, 77	5, 6	ww	15,530	1.5	0.5	*0.4*
Gogebic Lake	Gogebic	1999	9	ww	15,530	7.8	1.8	*1.5*
Average						23.4	8.1	7.0

Table 7. Angler survey summaries for 31 Lower Peninsula Michigan lakes. Angler-trips were estimated (italicized) for some lakes based on a ratio of angler trips to angler-hours (0.32) from 96 Michigan inland lake surveys. Angler-days were estimated (italicized) for most lakes based on a ratio of angler-days to angler trips (0.87) from five Michigan inland lake surveys on three lakes. Note that "ww" indicates warmwater fish and "tr" indicates trout. Data obtained from Beyerle (1980, 1984), Dexter (1991), Duffy (1995), Herman (1989), Laarman (1980), Laarman and Schneider (1986), Lockwood (2000), Ryckman and Lockwood (1985), Schneider et al. (1989), Thomas (1990), Wagner (1988), and Waybrant and Thomas (1988).

Waterbody	County	Year	Number of months	Type of fishing	Surface acres	Angler hours/acre	Angler trips/acre	Angler days/acre
Little Wolf Lake	Oscoda	1982	5	ww	86	67.8	50.0	*43.5*
Little Bear Lake	Otsego	1982	5	ww	127	32.4	29.8	*26.0*
Sessions Imp.	Ionia	1996, 97	6, 6	ww	135	264.3	77.1	*67.1*
Osterhout Lake	Allegan	1979	4	ww	168	42.9	16.9	*14.7*
Round Lake	Van Buren	1977, 78, 79, 80	7, 4, 5, 5	ww	187	64.5	21.0	*18.3*
Bankson	Van Buren	1986	3	ww	217	61.4	13.1	*11.4*
Long Lake	Barry	1975, 76, 77, 78	12	ww	297	86.5	31.7	*27.5*
Ovid Lake	Clinton	1977, 1978	5	ww	412	207.7	83.1	*72.3*
Maceday-Lotus Lake	Oakland	1986	11	ww	419	88.3	28.5	*24.8*
Big Bear Lake	Otsego	1982	5	ww	435	39.1	18.9	*16.5*
Lake Lansing	Ingham	1987	6	ww	453	19.8	5.8	*5.0*
Vinyard Lake	Jackson	1987	6	ww	505	55.6	14.5	*12.6*
White Lake	Oakland	1987	10	ww	540	74.6	2.4	*2.1*
Pontiac Lake	Oakland	1980	6	ww	585	81.0	21.8	*19.0*
Whitmore Lake	Livingson	1980	6	ww	677	95.3	24.0	*20.9*
Silver Lake	Oceana	1996, 97	6, 5	ww	690	26.3	6.9	*6.0*
Orchard Lake	Okland	1986	11	ww	788	31.0	8.2	*7.2*
Manistee Lake	Kalkaska	1976, 77, 78	12	ww	860	15.0	6.4	*5.6*
Manistee Lake	Manistee	1999, 2000, 01	9, 10, 11	ww + tr	900	72.6	19.7	16.2

Continued

Table 7. Continued

Waterbody	County	Year	Number of months	Type of fishing	Surface acres	Angler hours/acre	Angler trips/acre	Angler days/acre
East Twin Lake	Montmorency	1982	5	ww	974	13.6	7.5	*6.5*
Kent Lake	Oakland	1987	5	ww	1,000	92.1	25.5	*24.4*
Kent Lake	Oakland	1987	10	ww	1,000	231.0	74.7	65.0
Kent Lake	Oakland	1980	6	ww	1,200	159.3	42.6	*37.1*
Belleville Imp.	Wayne	1976-79	6	ww	1,270	206.1	66.9	*58.2*
Cass Lake	Oakland	1986, 87	11, 9	ww	1,280	27.3	7.2	6.4
Devils Lake	Lenawee	1987	6	ww	1,300	32.6	8.4	*7.3*
Missaukee Lake	Missaukee	1978	7	ww	1,707	27.4	9.0	*7.8*
Gull Lake	Barry	1987	5	ww + tr	2,022	15.9	3.7	*3.2*
Fletcher Floodwater	Alpena	1995-97	8	ww	8,970	24.2	5.7	*5.0*
Burt lake	Chebygan	1977, 93	4, 6	ww + tr	17,120	5.3	1.3	*1.2*
Mullet Lake	Cheboygan	1998	4	ww + tr	17,360	5.0	1.2	*1.1*
Average						73.1	23.7	20.6