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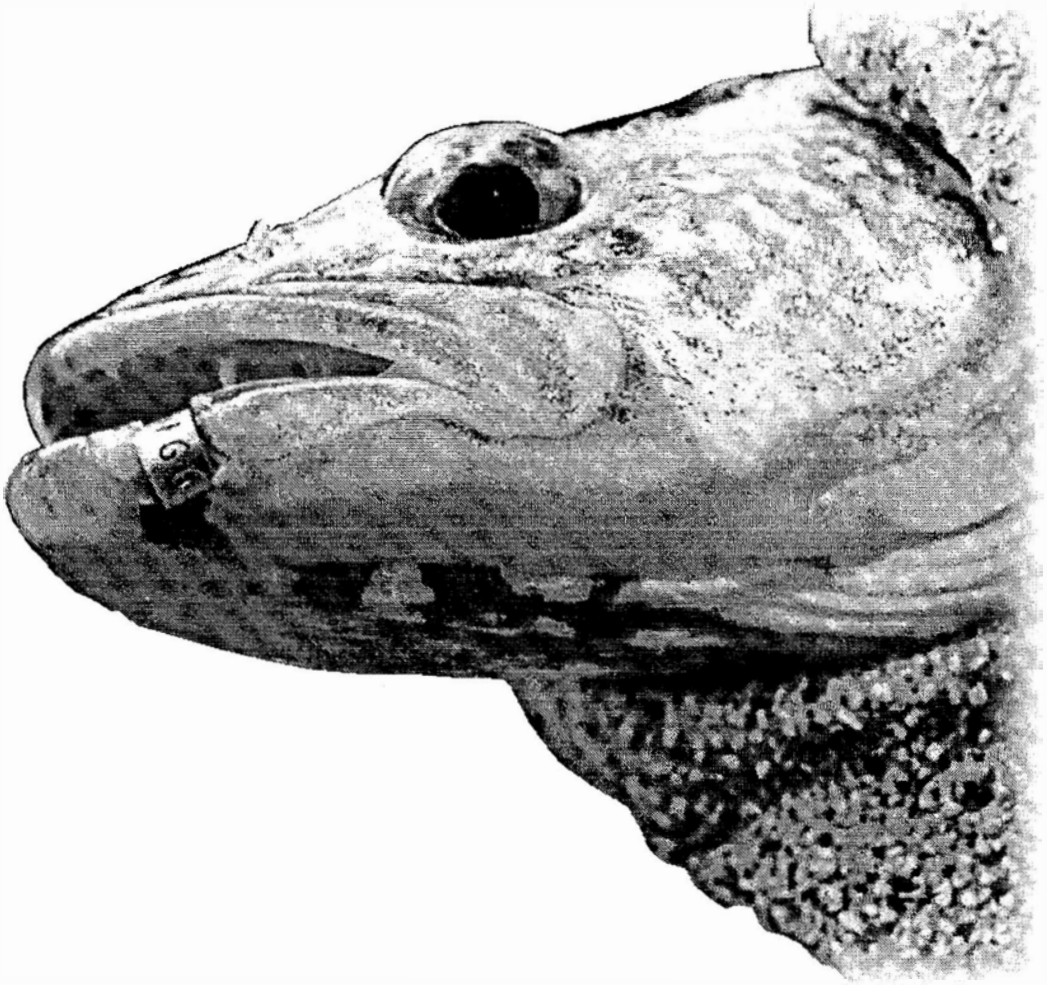

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Cover: Walleye with jaw tag.

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An Assessment of the Clinton River Walleye Population

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Abstract.—The 1990 and 1991 walleye *Stizostedion vitreum* spawning runs in the lower Clinton River and spillway channel were surveyed using DC boomshocker and trap nets. A total of 2,078 walleye were collected during 22 hours of shocking, for a catch per unit effort (CPUE) of 94.4 walleye per hour. A total of 181 walleye were collected in 35 trap net lifts representing a CPUE of 5.2 walleye. Annual population estimates for 1990 and 1991 were 8,418 and 7,406, respectively. These were generated using the Schnabel method based on recaptures of tagged walleye. Estimates for the contribution of stocked fingerlings to the run ranged from 52% to 67%. Visible lymphocystis was present on 20% of the fish examined. The walleye population in the Clinton River has not increased substantially since the early 1980s, and may be largely maintained by stocking. Fisheries managers must closely evaluate the benefits of continued maintenance walleye stocking in the Clinton River.

Since 1977, walleye *Stizostedion vitreum* fingerlings have been reared in ponds at Selfridge Air National Guard Base (SANGB) near Mt. Clemens, Michigan, in a cooperative program between the Michigan Department of Natural Resources (MDNR), Lake St. Clair Advisory Committee (LSCAC), United States Air National Guard, and the Lake St. Clair Walleye Association (LSCWA). The majority of fingerlings produced in these ponds have been stocked into the Clinton River with the goal of establishing a self-sustaining spawning run. Since the early 1980s, there have been occasional reports of spawning concentrations of walleye below a weir in the spillway channel, a flood diversion channel from the Clinton River into Lake St. Clair (Figure 1). In the late 1980s, these accounts became more frequent and were often accompanied by complaints of snagging, netting, spearing, and other illegal harvest of walleye in the spillway channel during spawning season. In response to these reports and related concerns about the status of the walleye spawning run in Clinton River, an assessment of the walleye run was conducted during spring 1990 and 1991. The objective of this assessment was to document the size of the walleye spawning run in the Clinton River.

Methods

Walleye were collected from the Clinton River spillway using a pulsed DC electrofishing boat with boom-mounted electrodes. All electrofishing was conducted in site 1 (Figure 1) between Harper Road and the spillway weir, a distance of approximately 0.5 mile. Electrofishing took place during daylight, between 0900 and 1430. Walleye were also collected with a six foot deep trap net set in the

lower river channel (site 2, Figure 1) and lifted by volunteers from the LSCAC and LSCWA.

Walleye were collected with the electrofishing boat on 14 days in 1990 and 10 days in 1991. Length, weight, sex, spawning condition, presence of previous tags, presence of visible lymphocystis, and presence of snag marks were recorded for each fish sampled. Scale samples were also removed for later age analysis. Walleye were tagged with numbered jaw tags and released into the sampling area. Fish recaptured the same day they were tagged were not recorded as recaptured. Relative abundances were noted for other species stunned by electricity. Weather conditions, water temperature, relative water depth and clarity, angler activity, and electrofishing effort were also recorded each day.

Fish were collected with trap nets in the lower river from 30 March to 3 May 1991. Length and presence of any previous tags were recorded for each walleye. Scale samples were removed, then walleye were tagged with numbered jaw tags and released at the trap net site. Relative abundance was also recorded for other species present.

The Schnabel method (Ricker 1975) was used to estimate the total number of walleye in the Clinton River spawning run. This method is designed for closed populations. I assumed migration was negligible during the course of the spawning run, resulting in a "closed" population of spawners. The Schnabel method uses multiple censuses with replacement, and input data include total number marked in the population, number marked each day, and number recaptured each day. These are input into the equation

$$N = \frac{\sum(C_t \cdot M_t)}{\sum R_t};$$

M_t is the total marked fish at large at the start of day t; C_t is the total sample taken on day t; and R_t is the number of recaptures in sample C_t. This method was applied to the population marked and recaptured at the spillway in 1990 and at both the spillway and lower river in 1991.

The contribution of stocked walleye fingerlings to the spawning run in the Clinton River in 1990 and 1991 was estimated from the recovery of fish which had been tagged prior to stocking. Each year from 1979 to 1987, small, untagged fingerlings were stocked in the Clinton River during summer, while larger, tagged fingerlings were stocked in the fall. The ratio of tagged to untagged fish stocked varied each year. An estimate of the combined contribution of tagged and untagged stocked fish was derived from the percentage of Selfridge-stocked fingerlings surviving to spawn in 1990 and 1991 that were tagged.

An annual mortality rate of 50% is characteristic of walleye in Lake St. Clair (R.C. Hass, MDNR, Mt. Clemens; personal communication). This annual mortality rate was then applied to the tagged and untagged cohorts of walleye fingerlings stocked each year from 1979 to 1986, to estimate the percentage of Selfridge-stocked fingerlings surviving to 1990 that were tagged. The number of Selfridge-tagged spawners caught during the assessment then represents that same percentage of the total number of Selfridge spawners collected during the 1990 assessment. The same method was used to estimate the contribution to the 1991 spawning run. The 1987 cohort of stocked fingerlings was included in the 1991 estimate of contribution.

Results

Spillway Electrofishing Assessment

Water temperatures varied from 40 to 64° F during electrofishing collections. Weather conditions varied widely, from cold windy days with occasional snow flurries to calm warm days. Water level and clarity in the spillway also varied considerably during the sampling period. At times, water flow over the weir appeared low enough to restrict upstream fish movement. Peak flows and corresponding min-imum water clarity occurred 2, 6, and 11 April 1990 and 28 March and 10 April 1991.

At least fifteen species were observed while electrofishing in the spillway (Table 1). Species observed on a daily basis included white sucker, walleye, redhorse, and common carp. The most

abundant species observed throughout the sampling period were white sucker and walleye.

A total of 2,078 walleye were collected during 22.0 hours of shocking (Table 2). Catch per hour of shocking (CPUE) varied greatly between sampling dates with a minimum of 21.7 on 8 April 1991 and a maximum of 325.6 on 2 April 1990. Mean CPUE in 1990 (159.6 fish/hr) was higher than in 1991 (82.7 fish/hr). Sex ratio of walleye collected varied between 1990 and 1991; females accounted for 15% of the total in 1990 and 43% in 1991. Possible snag marks were observed on few walleye. Lymphocystis was observed on 20.1% of the walleye collected in 1990 and 19.7% in 1991. A total of 1,256 walleye were tagged on the jaw and released in the spillway area in 1990. A total of 554 walleye were tagged and released in the spillway in 1991.

In both years, walleye were collected that had been previously tagged. In 1990, 109 tagged walleye were collected in the spillway. One hundred of these were fish tagged earlier during the 1990 spillway collections, eight of the tagged fish were from Selfridge rearing ponds, and one walleye was recovered that had been originally tagged in the St. Clair River in 1984. A total of 110 walleye that were collected in 1991 had been tagged previously. Seventy-seven of these recoveries were fish tagged during the 1990 spawning run assessment. Twenty-nine fish tagged during the 1991 spawning run were recaptured on subsequent collecting trips. Three recoveries were fish tagged as fingerlings from Selfridge rearing ponds and stocked in the Clinton River. One fish was recovered whose jaw tag number was not traceable.

Lower River Trap Net Collections

At least twenty-two species were collected by trapnet in the lower Clinton River during the sampling period in 1991. The most abundant species were black crappie, bullheads, white sucker, common carp, and white perch (Table 3). Walleye were the eighth most abundant species collected.

A total of 181 walleye were collected in 35 trapnet lifts with a mean CPUE of 5.1. Thirty-one of the collected walleye bore tags. Seven recoveries were fish tagged during the 1990 spawning run assessment; six recoveries were fish tagged as fingerlings from the Selfridge rearing ponds and stocked in the Clinton River, two were fish tagged at other locations, and two were fish whose jaw tag numbers were not traceable. Fourteen fish tagged during the 1991 spawning run assessment were later recaptured in the trap net.

Population estimates

A total of 1,393 walleye were collected in 1990, of which 1,266 were tagged and 100 were tagged fish recaptured at least 1 day after tagging. Using the Schnabel method, the 1990 walleye spawning run in the lower Clinton River was estimated at 8,418, with 95% confidence limits of 6,923 to 10,737 fish (Table 4).

In 1991, a total of 866 walleye were collected, of which 788 were tagged and 43 were tagged fish recaptured at least 1 day after tagging. Using the Schnabel method, the 1991 walleye spawning run in the lower Clinton River and spillway was estimated at 7,406 with 95% confidence limits of 5,655 to 10,726 fish (Table 4).

Analysis of Stocked Walleye Fingerlings

Since 1977, walleye have been reared in ponds at SANGB. During the period from 1979 to 1989, this program resulted in stocking of 547,649 fingerlings in the North Branch of Clinton River. Although most of these fish were not tagged, 4,268 of the largest fingerlings produced were jaw tagged.

Tagged walleye from the Selfridge ponds were recaptured during both years of Clinton River spawning assessment. During 1990, eight tagged walleye from Selfridge were found in a total collection of 1,293 (recaptured fish tagged in 1990 were not included). Their distribution by year class was: 1983, 1; 1984, 2; 1985, 2; 1986, 3. In 1991, nine tagged walleye from Selfridge were found in a total collection of 822 walleye (recaptured fish tagged in 1991 again were not included). Their distribution by year

class was: 1979, 1; 1984, 1; 1985, 3; 1986, 1; 1987, 3.

The contribution of walleye raised in Selfridge ponds to the Clinton River spawning run was estimated from these tag returns. Using an assumed annual mortality of 50% for all walleyes stocked, the surviving number of fish which could spawn in 1990 was 7,396 (Table 5). Based on these calculations, 1.2% (88/7,396) of the Selfridge-origin walleye fingerlings surviving to 1990 should be tagged, and the 8 walleye tagged from Selfridge ponds that were collected during this survey should also represent 1.2% of the total Selfridge-origin walleye recovered. This suggests that 667 of the walleye collected in 1990 were of Selfridge origin, representing 52% of the total walleye collected. Thus, an estimated 52% of the 1990 walleye spawning run in Clinton River consisted of fish from Selfridge stocking.

For 1991, the number of surviving spawners from the 1979 to 1987 stocked cohorts was estimated at 4,521 (Table 5). Since estimated tagged survivors to 1991 from those cohorts numbered 74, then 1.6% (74/4,521) of the Selfridge-origin walleye fingerlings surviving to 1991 should be tagged. The 9 walleye tagged from Selfridge ponds that were collected in 1991 then represent 1.6% of the total Selfridge-origin walleye collected. This suggests that 552 of the walleye collected in 1991, or 67%, were Selfridge-origin fish.

Lymphocystis Infection Rate

Overall, the rate of visible external lymphocystis infection for walleye in the Clinton River spawning run remained essentially unchanged from 1990 to 1991 (Table 2).

Sixty-eight walleye which were recaptured during the 1991 assessment had been tagged in 1990 and were examined for lymphocystis in 1990 and 1991. These fish provided an opportunity to explore the temporal nature of observable symptoms of lymphocystis in individual fish. Seventy-one percent of the fish exhibited no change in lymphocystis condition (Table 6). Twelve fish which exhibited no visible signs of lymphocystis in 1990 had visible signs of the infection in 1991. Eight fish experienced a reversal of symptoms, exhibiting visible signs of lymphocystis in 1990, but none in 1991. Apparent infection rate in these 68 fish increased from 22% in 1990 to 28% in 1991.

Discussion

Population Estimates

Estimates of the number of fish in the 1990 and 1991 walleye spawning runs in the lower Clinton River and spillway channel were based on the assumption that walleye movement into and out of this area was minimal during the assessment periods. The frequency of recapturing tagged walleye a few days later in the same location during both years of the assessment lends some support to this assumption. Non-randomness of the collection locations during the assessment could also reduce the reliability of the estimates. However, the general magnitude of the run should be reliably reflected in the estimates produced with the Schnabel method for both years.

Numerical estimates of the 1990 and 1991 spawning runs were very similar. These estimates are also similar to the estimated size of the Clinton River walleye run in the early 1980's. The United States Fish and Wildlife Service estimated the 1980 run at 20,307 (with 95% C.L. from 25,907 to 15,908) (R. Julian 1981, U.S. Fish and Wildlife Service; unpublished report) and the 1981 run at 18,700 walleye (±2,205) (from R.C. Haas and K. Pearce, MDNR; unpublished report).

Stocking of Walleye

The method used to estimate contribution of stocked fish suggests that 50% or more of the walleye spawning run in the Clinton River consisted of walleye stocked from SANGB. This level of contribution has several management implications. First, if Selfridge-origin walleye, which are Muskegon River genetic stock, make up a large portion of the annual spawning run in the Clinton River, genetic composition of this run should differ from that of the Thames River spawning run. In

the early 1980's, no genetic difference was found between walleye collected in the Clinton River and Thames River spawning runs (Haas et al. 1988). Genetic analysis of the Clinton River walleye spawning run is needed to more conclusively identify the present stock composition of the run.

After 15 years of fingerling stocking, the number of walleye in the Clinton River spawning run has not increased substantially. Since stocked fish from SANGB made up a large portion of the Clinton River spawning run, contributions to the run by walleyes naturally reproduced in the Clinton and surviving to return as adults are low. Efforts to document fry production by walleye in the Clinton River during the 1980's were unsuccessful. Zooplankton abundance in Lake St. Clair off the Clinton River is low and likely unsuitable for walleye fry survival. In light of these results, continued walleye stocking in the Clinton River must be considered a maintenance stocking program and the benefits of continuing such a program should be carefully considered. Practically no walleye fishing exists in the Clinton River at any time of the year. However, Clinton River walleye undoubtedly contribute to the fisheries of Lake St. Clair and the St. Clair River, or places even further removed. Analysis of angler tag returns from walleye tagged in the Clinton River during the spring of 1990 and 1991 will aid in identifying the contribution of this stocking program to the walleye fishery in southeast Michigan.

Lymphocystis Infection Rate

The rate of lymphocystis infection appears to be high in walleye from the Clinton River run. The documented rate of about 20% is consistent with that observed in spring walleye collections from the Great Lakes waters of southeast Michigan over the last two decades (R.C. Haas, MDNR; personal communication). This infection rate is higher than rates of 9.5% to 14.4% observed in walleye from Saginaw Bay during their annual spawning run in the Tittabawassee River from 1984 to 1991 (J.P. Baker, MDNR; personal communication). Lymphocystis is a viral disease transmitted by the bursting and/or sloughing of host cells and release of virus particles (Allison et al. 1977). The higher infection rate observed in the Clinton River spawning run could be a reflection of the higher walleye population density in Lake St. Clair and the St. Clair River.

The collection of tagged and infected fish from 1990 in the 1991 survey indicated that most fish maintained lymphocystis infection for at least a year, although some developed an infection or lost it in that time. It is unclear if the increase in infection rate from 22% in 1990 to 28% in 1991 was a function of small sample size or was due to collection and associated handling in 1990. Captured fish experience considerable contact with each other while in the shocker boat. Scale sampling may also increase the chance of infection by removing the protective mucus coating and scales. Finally, the virus could be transferred from infected fish to uninfected fish via the scale sampling knife. In 1991, visible signs of lymphocystis were observed on several recaptured fish at the location where scales had been removed in 1990.

Discreteness of the Clinton River Walleye Spawning Run

Over 10% of the walleye collected in 1991 were tagged in the Clinton River during the1990 spawning run. This is a rather high recapture rate for a walleye spawning run on a Lake St. Clair or Lake Erie tributary (R.C. Haas, MDNR; personal communication). Some inferences can be drawn from these recaptures. First, the 1,256 walleye tagged in the Clinton River in 1990 could also represent a sizable fraction of the spawning run. Since the 1990 spawning run was estimated to be between 6,923 and 10,737 fish, this is not inconsistent with the data collected. Walleye spawning runs in the Thames River, Ontario, and the Maumee River, Ohio, are believed to include millions of walleye. The Clinton River spawning run is small compared to these. The high recapture rate also indicates that a substantial number of walleye in the spawning run return each year, which may reflect a homing instinct of walleye stocked or naturally produced in Clinton River. Based on

these recapture data, the Clinton River walleye spawning run appears to be dominated by a small, rather discrete walleye stock.

Conclusion

Estimated size of the 1990 and 1991 Clinton River walleye spawning runs ranged from 7,406 to 8,418 fish. These estimates are similar in magnitude to the estimated size of the run in the early 1980's. Tag recoveries suggest between 52% and 67% of the spawning run could be Selfridge-origin fish. Contributions to the run by natural reproduction in the Clinton River are limited (33 to 48%). Continued walleye stocking in the Clinton River for the purpose of artificially maintaining the spawning run must be closely evaluated. Documentation of the current genetic composition of the Clinton River walleye spawning run would verify the contribution of Selfridge-origin fish. In addition, analysis of future angler tag returns from walleye tagged in the Clinton River during the spring of 1990 and 1991 will aid in identifying the contribution of fish from the Clinton River spawning run to the walleye fishery in southeast Michigan.

Acknowledgments

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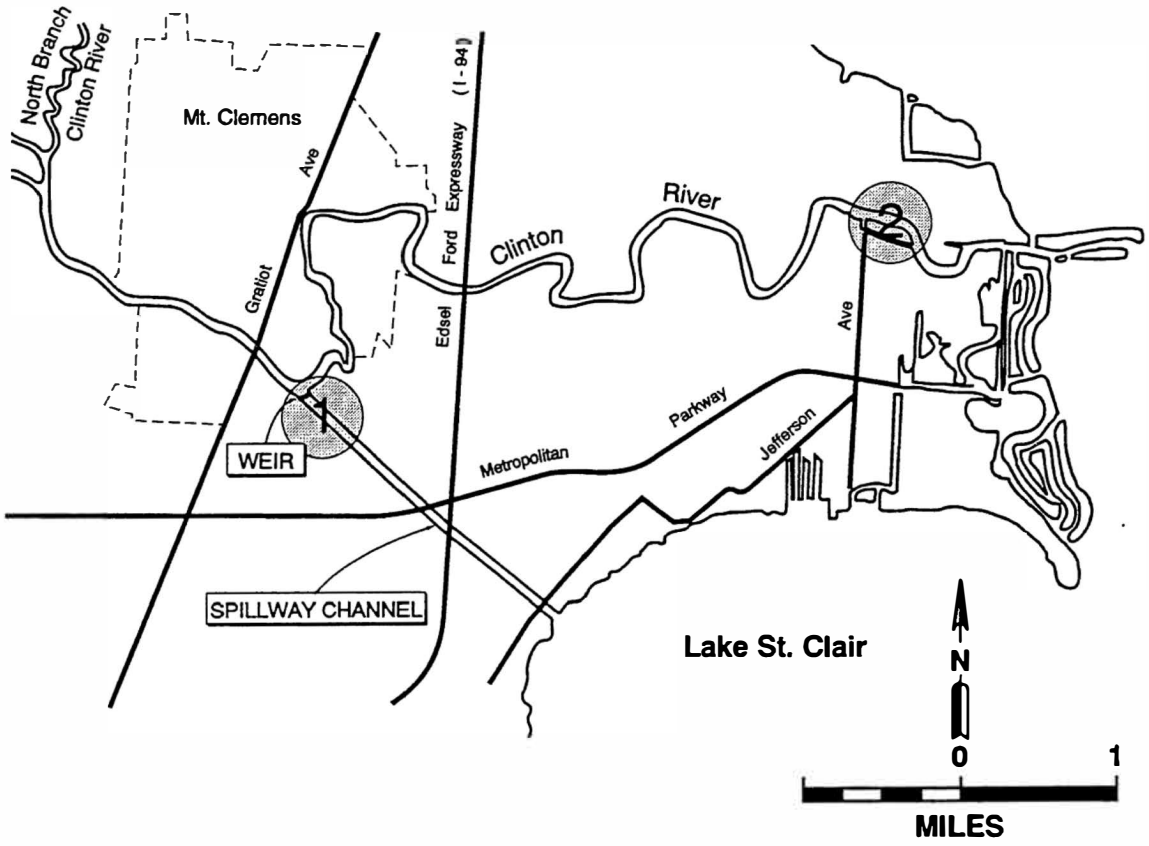

Figure 1.—Lower Clinton River and Spillway Channel with 1990 and 1991 walleye spawning run assessment sampling sites noted, 1 = DC boomshocker collection area and 2 = trap net site.

Table 1.—Fish species observed in the Clinton River spillway during 1991 electroshocking assessment, in descending order of estimated overall abundance.

Species	Scientific name
White sucker	*Catostomus commersoni*
Walleye	*Stizostedion vitreum*
Unidentified redhorse	*Moxostoma* spp.
Gizzard shad	*Dorosoma cepedianum*
Common carp	*Cyprinus carpio*
Steelhead	*Oncoryhnchus mykiss*
Northern pike	*Esox lucius*
Rock bass	*Ambloplites rupestris*
Smallmouth bass	*Micropterus dolomieui*
Largemouth bass	*Micropterus salmoides*
Unidentified shiner	*Notropis spp.*
White perch	*Morone americana*
Freshwater drum	*Aplodinotus grunniens*
Yellow perch	*Perca flavescens*
Bluegill	*Lepomis macrochirus*
Smelt	*Osmerus mordax*

Table 2.—Results of electrofishing collections from the Clinton River spillway during 1990 and 1991.

	1990	1991
Sampling period	22 Mar to 14 Apr	25 Mar to 11 Apr
Days sampled	14	10
Walleye collected	1,393	685
Shocking time (hours)	12.1	9.9
Catch per hour (CPUE)	159.6 ± 26.5	82.7 ± 20.6
Percent Female	15.0	43.0
Mean length (mm) - Females	545.6	573.2
- Males	473.8	490.6
Percent with lymphocystis	20.1	19.7
Percent with snag marks	0.8	0.4
Walleye tagged & released	1,256	554
Tagged walleye recovered	109	110[1]

[1]Includes seventy-seven recovered with 1990 Clinton River tags

Table 3.—Number of fish caught in trap nets (35 lifts) in the lower Clinton River between 30 March and 3 May 1991.

Species	Number collected
Black crappie (*Pomoxis nigromaculatus*)	1,020
Bullhead (*Ameiurus* sp.)	639
White sucker	371
Common carp	292
White perch	231
Bluegill	214
Spotted sucker (*Minytrema melanops*)	207
Walleye	181
Northern pike	171
Pumpkinseed sunfish (*Lepomis gibbosus*)	124
Quillback carpsucker (*Carpoides cyprinus*)	112
Rock bass	112
Gizzard shad	107
Freshwater drum	101
Channel catfish (*Ictalurus punctatus*)	49
Bowfin (*Lota lota*)	38
Largemouth bass	30
Yellow perch	27
White bass (*Morone chrysops*)	22
Smallmouth bass	14
Golden shiner (*Notemigonus crysoleucas*)	7
Steelhead	1

Table 4.—Population estimates using the Schnabel method for data from 1990 electrofishing in the spillway and 1991 electrofishing in the spillway, as well as trap netting in the lower river.

Year	Population estimate	Lower 95% C. L.	Upper 95% C. L.
1990	8,418	6,923	10,737
1991	7,406	5,655	10,726

Table 5.—Survivorship estimates of Selfridge-origin walleye of 1979 to 1987 year-classes to the 1990 and 1991 spawning runs, based on 50% annual mortality rate.

Selfridge year class	Number tagged[1]	Number stocked[1]	Tagged spawners 1990	Total spawners 1990	Tagged spawners 1991	Total spawners 1991
1979	100	8,500	0.0	4	0.0	2
1980	366	25,059	0.4	24	0.2	12
1981	513	55,496	1.0	108	0.5	54
1982	200	56,474	0.8	221	0.4	110
1983	649	33,263	5.1	260	2.5	130
1984	410	51,000	6.4	797	3.2	398
1985	484	54,629	15.1	1,707	7.6	854
1986	955	68,388	59.7	4,274	29.8	2,137
1987	473	13,172	—	—	29.6	823
Total	4,150	365,981	88.5	7,396	73.8	4,521

[1]Stocking and tagging records from District 10 files.

Table 6.—Incidence of lymphocystis in 68 tagged walleye from the Clinton River spawning run, individually examined in 1990 and 1991.

	Lymphocystis condition in 1991		
Lymphocystis condition in 1990	Absent	Present	Total
Absent	41	12	53 (78%)
Present	8	7	15 (22%)
Total	49 (72%)	19 (28%)	

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